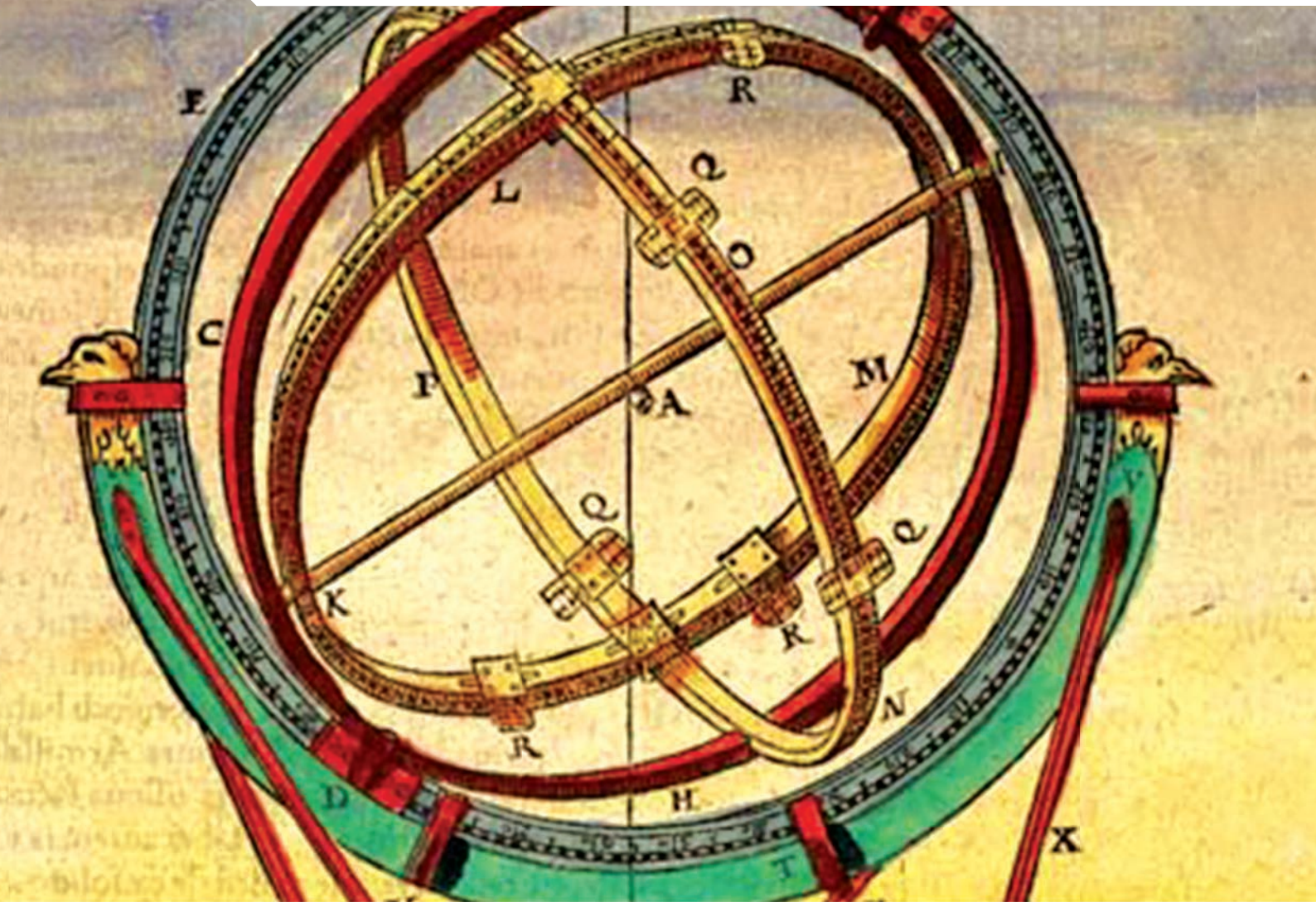
Educational Research and Innovation

# Measuring Innovation in Education 2019

## WHAT HAS CHANGED IN THE CLASSROOM?




OECD

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Stéphan Vincent-Lancrin, Joaquin Urgel,
Soumyajit Kar and Gwénaël Jacotin

OECD
BETTER POLICIES FOR BETTER LIVES

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# Foreword

How will education reinvent itself to respond to the megatrends that are shaping the future of our societies and educate learners for their future, rather than our past?

Governments cannot innovate in the classroom, but they can help build and communicate the case for change. They can also play a key role as platform and broker, as stimulator and enabler; they can focus resources, set a facilitative policy climate, and use accountability to allow innovation rather than compliance. To that effect, education policy makers need to develop proper innovation policies, better identify key agents of change, champion them, and find more effective approaches to scaling and disseminating innovation. This includes finding better ways to recognise, reward and give visibility to success, doing whatever is possible to make it easier for innovators to take risks, to encourage the emergence of new ideas – but also to monitor change in education systems and be able to link innovations with educational performance.

While it is easy to talk about innovation in education, it is time to engage in the more difficult task to talk about how we actually know where and how innovation is happening, and whether it is effective. While most countries and most companies have innovation policies or departments, innovation remains a marginal policy agenda in most education systems. Even where there is some policy, few systems know whether their efforts have any effectiveness. Policy reform is usually preferred, as a top-down change decision, but many policy reforms change institutions and administrative rules without having impact on what really makes a difference: teaching and learning within the classroom.

*Measuring Innovation in Education* is one of the few available tools to make innovation in education visible. This year's edition builds on the first issue that was published in 2014 with a wealth of information about what has changed in education systems over the last decade. It aims to initiate debate on how to develop the capacity of our education systems to prepare learners for their future, to sharpen innovation policies in education and better target policy instruments.

In most areas, the prevalence of educational practices varies greatly across countries. There is perhaps more innovation than we might believe, but probably a lot less than what the challenges faced by many systems would require.

Among the educational practices covered by this report, major changes in informal teacher professional development should be highlighted as an encouraging trend. Innovation and improvement requires collaboration, peer learning, including international peer learning. It requires to turn schools into learning organisations. Apparently, this is gradually happening, and that's a great news, even if it happens slowly.

Some of the results should lead us to think more carefully about policy implementation. For example, some countries have invested in major curriculum reforms, but saw little innovation in the classroom.

There is also little evidence that the curriculum emphasis on teaching the skills that will allow students to thrive in a world were innovation is critical have translated into different teaching and learning practices. This is worrisome in a world where artificial intelligence and robotics might transform the role of humans in the productive and social processes.

This report exploits in innovative ways the international studies that countries have engaged in over the past few years, showing the value of countries' investments in these surveys. The OECD is committed to do more on this agenda. Our work on developing new measures of innovation in education will continue, taking new innovative approaches, so that countries better understand how to deal effectively with innovation to improve their education systems.

While waiting for the next edition, I strongly encourage readers to browse this book, a few indicators or one chapter at a time, to check how educational practices have evolved within countries, and to reflect on whether they believe this is the right strategic move. The information provided here is indeed a key resource to step back on how students learn and are taught, and to think strategically on the education we want in the future.

Andreas Schleicher

Director for Education and Skills

Special Adviser on Education Policy to the OECD Secretary General

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# Executive summary

## How we measure innovation in education

The understanding of innovation and ability to measure it is essential to the improvement of education. Monitoring systematically whether, and how, practices are changing within classrooms and educational organisations, how teachers develop professionally and use learning resources, how schools communicate with their communities, and to what extent change and innovation are linked to better educational outcomes would provide a substantial increase in the international education knowledge base. Policy makers would be able to better target interventions and resources, get quick feedback on whether reforms changed educational practices as expected, and we would better understand the conditions for and impact of innovation in education.

In accordance with international practice, we start with the definition of innovation as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)".

Educational organisations (e.g. schools, universities, training centres, education publishers) have *product innovation* when they introduce new or improved products and services, such as new syllabi, textbooks or educational resources, but they more commonly have *business process* innovation when they introduce (1) new or significantly changed processes for delivering their services, such as new pedagogies or new mixes of pedagogies, including e-learning services, (2) new ways of organising their activities, for example by changing how teacher work together, how they group students and manage other aspects of their learning, and (3) new marketing and external relations techniques, such as differential pricing of postgraduate courses, new forms of communication with students and parents.

In this book, innovation is defined and measured at the system level as a significant change in selected key educational practices. The publication examines change in 139 educational practices in primary and secondary education covered in international databases as they were found critical to understand educational improvement. Our indicators tell us whether some practices have gained or lost ground within a system – in the literal sense that more or less students have been exposed to them in the past decade. Should they be significant in magnitude, the spread or contraction of a practice corresponds to a systemic innovation for a given education system and its students.

## What has changed in the past decade

On average there has been a moderate level of innovation in educational practices in primary and secondary education in the OECD area. Students within an average OECD education system have experienced a different mix of teaching and learning practices compared to their 10-year older peers, even though the change has not been dramatic.

Pedagogical innovation – the main focus of the book – has been moderate at the system level. The largest innovation lay in independent knowledge acquisition and homework practices, followed by both rote learning and active learning practices. More students have used computers during their lessons to look up for ideas and information and also experienced more systematic discussion of their homework during class.

While innovation in educational practices is not necessarily related to technology, innovation in the availability of computers and in the use of information and communication technology (ICT) in student's school work have actually been important drivers of change over the past decade. More students have used technology in class or for their school work. In almost all countries though, students have experienced decreases in the availability of desktop computers and tablets for use in their lessons – event though this availability remained high.

One of the most remarkable innovations for students lay in how their teachers developed their professional knowledge. The share of students taught by teachers who took part in peer learning increased considerably in the past decade, while those taught by teachers who attended a formal teacher training in the past two years remained stable. Given the importance of peer learning for professional development, this is good news. In some countries, a strong increase in peer learning seems to have been accompanied by a strong decrease in formal teacher training – an innovation which is more difficult to assess as such.

Innovation is not an end in itself: it should improve some educational outcome. The specific or mix of innovations that lead to improvement remains an open question. Innovation can have a differentiated impact on different educational goals: students' learning outcomes (measured through tests), students' engagement, equity, cost-efficiency, teachers' work wellbeing, etc. At this stage of our measurement effort, linking innovation intensity to educational outcomes at the international level allows one to start a discussion and make more elaborate assumptions about the role of innovation in education's improvement process. On average, countries that have changed their pedagogical practices the most have also had improved students' academic outcomes (the only exception being in maths in secondary education). Countries that have innovated the most over the past decade tend to also have experienced increases in their student satisfaction and enjoyment in school. There was no consistent association with the reduction of educational inequity across disciplines and levels. Innovation was also on average positively associated with teachers' collective self-efficacy within their school and with their collective ambition of their students. Given the types of pedagogical activities reviewed, which can largely be implemented at no or little cost, it is perhaps not surprising to find little association between innovation and systems' expenditures per student.

## Next steps

Measures of innovation in education still need to diversify, improve and become more targeted. New approaches to measuring innovation in education should be explored. Two promising ways ahead lie in the exploration of other data sources than those that have been used so far and in the development of dedicated survey instruments to measure innovation efforts at all levels of education.

# Chapter 1. Overview

*Abstract: This chapter gives an overview of why and how we measure innovation in education, relates the methodology used to other existing measures or approaches, and provides a summary of the main findings of the book. It ends by pointing to some possible next steps for strengthening the measurement of innovation in the education sector.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Why measure innovation in education?

The understanding of innovation is essential to the improvement of education. Developing the ability to measure it as well as its drivers and effects is a first step to refining this understanding.

Monitoring systematically whether, and how, practices are changing within classrooms and educational organisations, how teachers develop professionally and use learning resources, how schools communicate with their communities, and to what extent change and innovation are linked to better educational outcomes would provide a substantial increase in the international education knowledge base. Policy makers would be able to better target interventions and resources, get quick feedback on whether reforms changed educational practices as expected, and we would better understand the conditions for and impact of innovation in education.

The OECD project *Measuring Innovation in Education* uses three perspectives for addressing these issues: 1) comparing innovation in education to innovation in other sectors (see OECD, 2014); 2) identifying meaningful innovations across educational systems; and 3) constructing metrics in order to examine the relationship between educational innovation and changes in educational outcomes. This publication mainly focuses on the two latter points.

The work also aims to set the basis for cumulative work on educational innovation and educational innovation policy by providing countries with indicators that can be regularly updated over time (and a methodology to do so). While this can partially rely on the use of existing international data sets, the work also aims to analyse and better understand the drivers of innovation in the education sector (see Vincent-Lancrin, 2017), where countries stand in this area, and to expand the methodologies and data sources to measure innovation in an accurate and comprehensive way.

## How do we define innovation in education?

In accordance with international practice, we start with the definition of innovation as "a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)" (OECD/Eurostat, 2018). Simplifying the previous edition of the *Oslo Manual*, which categorised innovation into product, process, marketing and organisation innovation, the new edition distinguishes between two main types of innovation: "product" innovation and "process" innovation. These two categories can easily be mapped against the four previous types of innovation.

Product innovation refers to innovation in goods and services, two categories that are sometimes intertwined, especially in the context of digitalisation. Process innovation refers to innovation in production processes or activities, that is, "all activities under the control of an institutional unit that use inputs of labour, capital, goods and services to produce outputs of goods and services". In brief, process innovation mainly refers to innovation in organisational processes, even though processes can be broader: "processes include policies that provide an overall strategy that drives a unit's activities, activities that transform inputs into outputs, and procedures that govern the detailed steps for activities to transform inputs into outputs" (OECD/Eurostat, 2018).

Educational organisations (e.g. schools, universities, training centres, education publishers) contribute to *product innovation* when they introduce new or significantly different products and services, such as new syllabi, textbooks or educational resources, or new pedagogies or educational experiences (for example e-learning or new qualifications). They contribute to *process* innovation when they change significantly their organisational processes for producing their educational goods or services. For example, they may change how teachers work together, how they group students and manage other aspects of their learning experience; they may collaborate with other entities, use new marketing and external relations methods, new forms of communication with students and parents, etc. In the case of services such as education, products and processes may also be difficult to tell apart.

New or significantly changed practices aim at improving the provision of education in one way or another, and should therefore be regarded as intended "improvements" (rather than proven ones). While the definition of innovation of the *Oslo Manual* refers to new or "improved" products and processes, the main emphasis lies in establishing shared standards about how "significantly different" or "novel" the products or processes are (rather than demonstrating they are improvements). For some goods and services, notably manufactured products, technical or cost improvements may be easy to observe and document. This is not the case for all, though, and more difficult for processes. While innovation usually aims at improving something, for example a firm's bottom line or the performance of a good, there is no guarantee that it achieves its goal. Innovation is in fact merely a new or significantly changed (or different) product or process, and measured as such, whether it is an improvement or not. As noted in the *Oslo Manual*, innovation does not necessarily result in desirable outcomes for all parties. Specific innovations may also prove to be good or bad for society. It usually takes time to find out with some level of certainty whether specific innovations are improvements or not…

## What are the different ways to measure innovation in education?

Two broad approaches to measuring innovation in education have been used so far, aligned with existing approaches to measuring innovation in the public sector.

The first broad approach to measuring innovation in education is the adaptation to education of national innovation surveys' methodology (e.g. the EU Community Innovation Survey). Such surveys offer well-established tools for measuring innovation, and have been used for several decades in the private sector. In recent years, there were some efforts to adapt them for a use in the public sector (e.g. Bloch and Bugge, 2013).

*Measuring Innovation in Education: A New Perspective* (OECD, 2014) explored this approach and presented indicators based on the analysis of two surveys asking graduate questions about innovation in their work environment, in line with the methodology of the Community Innovation Survey. Rather than firm representatives, as is usually the case in innovation surveys, it was employees working in different sectors of the economy who were surveyed.

This "innovation survey" approach has recently been implemented to measure innovation in education in Hungary. An innovation survey was designed and administered to 5 000 educational units from all sub-systems (from pre-school to higher education) and connected to pupil performance thanks to the regular national evaluations (Halász, 2018). The survey exhibited good levels of innovation in all systems, and exhibited strong associations between innovation and performance in the case of low-performance schools. In Australia and New Zealand, a survey of management and service innovations within universities was carried out with a similar methodology (Arundel et al., 2016). A similar approach was also used in the Netherlands to analyse innovation in secondary education (Haelermans, 2010).

The second broad approach that has been used to measure innovation in the public (and business) sector is inspired by surveys of organisational change. These surveys typically measure the dissemination of specific innovations in work practices, for example computers or organisational practices (e.g. Greenan and Lorenz, 2013; MEADOW Consortium, 2010).

*Measuring Innovation in Education: A New Perspective* (OECD, 2014) also adapted this approach and measured innovation as a new or significantly changed process, practice, organisational or marketing method observed at the education system level through micro-data collected within schools. The emphasis is particularly placed on change in practices. Contrary to the "organisational change" surveys, change was measured by comparing reports on similar practices at different points in time. This publication also adopts this approach.

Other approaches to identify (rather than measure) innovation have also contributed to the better understanding of what innovations may transform education. Examples are the annual New Horizon reports by EDUCAUSE and formerly the New Consortium Media (Adams Becker et al., 2018).

## How do we measure innovation in education in this publication?

We define innovation as a significant change in selected key practices in education (and mix thereof). We use the Programme on International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS) and Progress in International Reading Literacy Study (PIRLS) databases to cover and identify these key practices at the classroom or school levels. The repeated cross-sectional nature of these surveys makes it possible to map trends over time. For this reason, we focus on questions that were asked in at least two waves of these surveys and build indicators that allow identifying how much change students in a given country were exposed to.

Our indicators measure "systemic innovation". They tell what percentages of students in a system are exposed to a given practice at more or less 10 years of interval (depending on our data source). We identify whether and to what extent some practices have gained or lost ground within a system – in the literal sense that more or less students have been exposed to them. If a given practice has increased *significantly* in a country, for example the use of computers in maths lessons, there has been innovation: observers waking up from a decade-long sleep would find that students are experiencing significantly different instruction methods than when they fell asleep. The same is true if the practice has significantly lost ground. Should they be significant in magnitude, both the spread and contraction of a practice correspond to an innovation for a given system and its students.

How much change counts as a significant change? There is no definitive answer to this question. The Oslo Manual acknowledges this as a key comparability challenge within and across countries and suggests that innovation survey respondents should be given a same reference point to identify what to report as innovation. Our methodology makes the challenge different. Given that innovation is not directly reported by one individual in a retrospective manner, but inferred from the reporting on the prevalence of the same practice at two different points in time by a representative sample of students, teachers or school principals, the challenge does not lie with the respondents but with those interpreting the observed change. For example, the degree to which the adoption of a teaching practice by 10% more teachers can be considered innovative depends on the context: it may be considered a more significant change in a country in which 10% of teachers used the practice than in a country in which 70% of teachers already used it. For that reason, while we focus on the change and its magnitude, we also provide readers with the actual prevalence of the practice.

We also translate these changes from percentage points to *effect sizes* in order to assist the readers in making their judgment about the significance of the difference. Effect sizes give a standardised measure of these changes and help interpret their relative magnitude across all indicators: the greater the effect size, the higher the magnitude (and likelier the "significance") of change over time. In line with common practice, we refer to effect sizes below 0.2 to "small", from 0.2 to 0.4 to "moderate", and over 0.4, to "large". This is a continuum though, and readers can choose their own thresholds.

## What educational practices do we cover?

This edition of *Measuring Innovation in Education* focuses on pedagogical innovation in primary and secondary education. The publication covers 158 educational practices. Most of them (107) are pedagogical practices used by teachers during their reading, mathematics and science instruction in primary and secondary education. These pedagogical innovations cover a large number of teaching and learning strategies in reading, mathematics and science, including information about the use of homework and assessment.

The book covers three other areas of interest: the availability of learning resources (books and ICT), teacher professional development practices (formal training and peer learning), external relations with stakeholders (parents, the public at large, other education agencies). All the practices covered in this edition can thus be considered to be "business process" operations. At the same time, in the case of services, "services" and "business process" can overlap, and the distinction is more clear-cut between "product" and "business process" innovations.

Because we rely on international data that were collected to contextualise international assessments of students, the coverage of practices is not as comprehensive as one might have wished to assess innovation in all its dimensions, nor targeting enough emerging practices. Given our methodology, only practices that experts and policy makers deemed important to document 10 years ago could be covered. Given the limited comparative information available on tertiary education, we cover only primary and secondary education.

Notwithstanding these limitations, the covered practices correspond to key teaching and learning practices that countries and a community of international experts deemed important enough to be repeatedly documented to understand the performance of education systems in terms of learning outcomes.

One strength of our methodology is to clearly know which practices contribute to innovation within a country, whereas most innovation surveys identify innovation in generic terms (broad types of innovation), leaving the innovations unnamed. One other strength is that our innovation indices synthesise a large number and types of practices rather than just a few, as is usually the case with composite indices. This is particularly important when one focuses on one particular sector (education). Innovation surveys usually aim to compare different sectors of the economy, which makes the identification of relevant practices more difficult.

Being aware of the change in the key educational practices covered in the publication is important regardless of whether one is interested in innovation or not. The measurement of their level and change over time gives policy- and other decision-makers a state of the educational practices their students are exposed to. Without this visibility, they cannot know whether ongoing pedagogical practices correspond to those they would like to see in their system's classrooms.

## Is innovation necessarily "innovative"?

Can there be systemic innovation in traditional practices? Of course. Many of the practices covered in the book are not necessarily those that would come to mind when thinking about educational innovation. An emerging practice such as the flipped classroom is for instance not covered. While it would certainly be worthwhile to measure the prevalence of practices that were recently introduced in the education sector, there is no international (and perhaps even national) dataset covering the uptake of these practices. Moreover, identifying relevant practices internationally may not be trivial. Such an approach was beyond the scope and budget of this project.

Measuring the diffusion or disappearance of educational practices remains an important and valid measure of systemic innovation, even though it does not cover the entire spectrum of educational innovation. Given that teaching and learning is a mix of different practices, the appearance of new or "innovative" practices are not necessarily what changes the most significantly the educational process within a country. While learning by memorisation is an old pedagogical strategy, its disappearance from formal education would be a noticeable innovation to students in most systems. Its significant increase would also be an innovation: students would then be exposed to a significantly different teaching and learning process. In short, what is innovative may not be the practice itself.

The word "innovative" can be particularly misleading in our context. What we measure in this book is how much change students have experienced in their learning environment over a decade. Where we observe significant change, there is (systemic) innovation. This does not imply that the new practices (or mix thereof) are more innovative than the previous ones. Neither does this imply that the countries where more innovation has been observed in the past decade are intrinsically more "innovative": they have in fact just experienced more innovation in the way education is delivered over the past decade. This may have been different in the past and may be different in the future given that innovation is often governed by cycles. The situation may also be different for other types of innovation.

We do not assume that innovation is necessarily an improvement, but it should be noted that almost all of the practices covered in this publication are "good" practices according to the research literature – although they are usually too narrow to be looked at in isolation. Education is a mix of all those instructional practices. Our comments on each practice are based on the existing research literature, for example evidence from meta-analyses (e.g. Hattie, 2008; OECD, 2010; Education Endowment Foundation, 2018). We signal the few practices that are inherently to be avoided.

Innovation can also be conceived as a mix of "alternative" practices that remain at the margins of education systems, or whose uptake remains limited (OECD, 2013). The indicators provided in this edition (as well as in the 2014 edition) give readers information about some of those practices – and allow readers to identify which practices are "mainstream" and which are "alternative".

## Country coverage

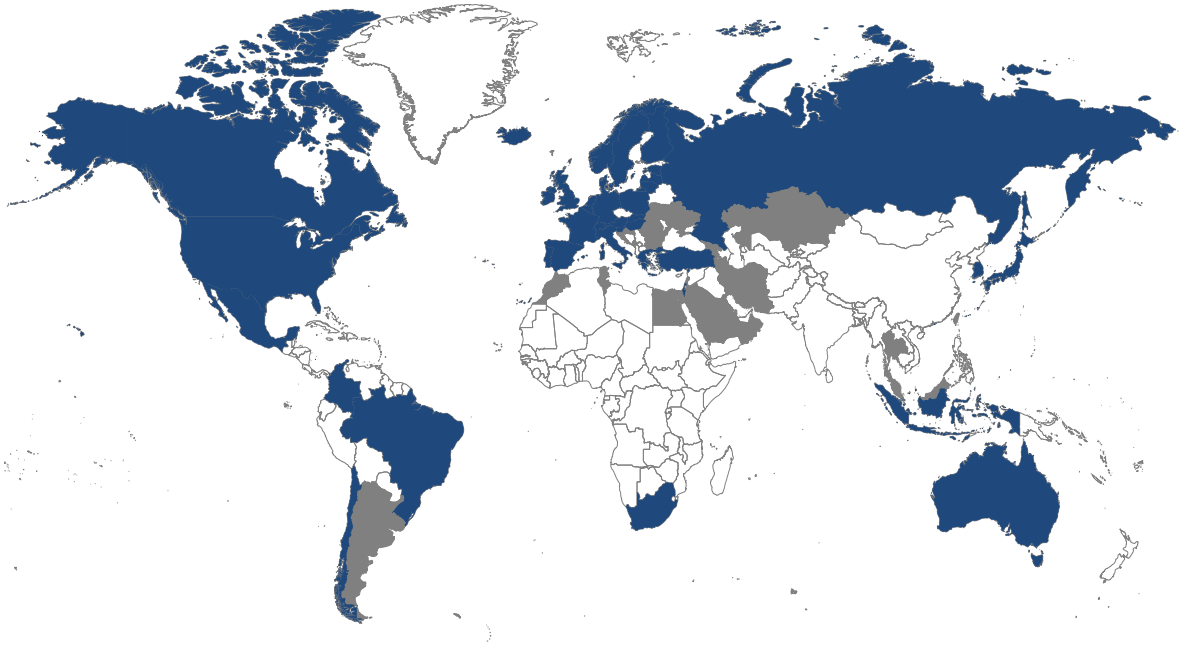
### *Education systems covered in this edition*

Australia, Austria, Belgium, Brazil, Canada (Quebec and Ontario), Colombia, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, China, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russian Federation, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom (England), United States (including Massachusetts and Minnesota).

### *Education systems covered in the online tables*

Argentina, Armenia, Bahrain, Bulgaria, Croatia, Egypt, Georgia, Jordan, Kazakhstan, Kuwait, Islamic Republic of Iran, Lebanon, Malaysia, Malta, Morocco, Oman, Qatar, Montenegro, Romania, Saudi Arabia, Chinese Taipei, Thailand, Tunisia, Ukraine, Uruguay.

**Figure 1.1. Education systems covered in this edition**



*Note*: Education systems covered in blue are part of the main report, while those in grey are included in the online tables.

## Systemic innovation in primary and secondary education

On average there has been a moderate level of innovation in educational practices in primary and secondary education in the OECD area. At the education system level, students have experienced a different mix of teaching and learning practices compared to their peers at the same level 10 years ago. As already noted in the 2014 edition of *Measuring Innovation in Education*, there is a fair level of innovation in primary and secondary education and depicting it as devoid of innovation is certainly ungrounded. However, as innovation has remained moderate rather than large in the past decade, while education is not quite the same as what it used to be, it is still easily recognisable.

The average innovation index for OECD countries has been a bit greater between 2005-2016 than it was between 2001-2011, pointing to increased changes in educational practices in recent years. Comparisons between the two editions of *Measuring Innovation in Education* should be taken with caution though, given changes in the methodology and country coverage. That being said, over time repeated measures of innovation could give us an accurate idea of whether innovation has intensified or slowed down in the OECD area or within specific education systems over a certain period of time.

The innovation intensity has not varied much across countries overall: most of them are close to the OECD average. There are some differences though: some education systems such as Japan, Ontario (Canada) or the United States have had more stable educational practices over the past decade, while others, such as Quebec (Canada) or Slovenia, have experienced more innovation. As was the case in the previous edition, innovation has not necessarily concerned the same educational practices across countries. Apart from the increase in peer learning for teachers, the increase in the use of ICT in school work, and the slight decrease in access to computers, changes in educational practices have not been consistent across countries. In spite of stronger international learning across countries, there is no convergence in the adopted changes.

Systemic innovation was also measured separately in primary and secondary education, as well as in relation to different disciplines. The average level of innovation in educational practices is about the same in primary and secondary education, so that the two levels contribute equally to the overall innovation index. The variation across countries is also similar in primary and in secondary education, ranging from countries that have experienced moderate-small levels of innovation in their system practices to others with large or moderate-large levels. Countries for which innovation indices could be computed at both levels experienced similar levels of innovation in primary and secondary education, suggesting that innovation might have come from similar forces within country (or at least gone hand in hand in primary and secondary education).

## Pedagogical innovation

Pedagogical innovation in mathematics, science and reading lessons is the main focus of the book. On average, it has been moderate in the last decade. What are the practices that have significantly spread (or receded)? The largest innovation lay in independent knowledge acquisition and homework practices, followed by both rote learning and active learning practices.

The main innovation in independent knowledge acquisition lay in the use of computers during lessons to look up for ideas and information. In science and reading, the practice has increased by around 20 percentage points on average in the OECD area, but already concerned 20 to 30% students at the beginning of the studied period. The real novelty is in mathematics for which it was hardly used 10 years ago: the share of students using computers during lessons to search ideas and information in maths went up from 3 to 31% in primary education, and from 5 to 23% in secondary education. In some countries, such as the United States, Australia or New Zealand, the increase was even more spectacular.

Practices around homework represented a second big domain of pedagogical innovation. Whereas there was virtually no change on average in the frequency of homework, the main consistent change among countries occurred in teachers discussing their homework in class in secondary education: the share of students that experienced this practice systematically increased from 22 to 58% on average in maths, and from 25 to 55% in science between 2007 and 2015. In Hungary or Lithuania, the practice was nascent in 2007, and almost universal in 2015.

Learning by memorising and drilling is often opposed to active learning. However, they can also go hand in hand. The spread of both types of practices has been moderate, but has gone in the same upward direction. Memorising rules, procedures and facts in at least half of the maths and science lessons has gained ground. The share of students concerned expanded from 22 to 43% in primary maths education, and increased by about 15 percentage points in primary and in secondary science lessons to reach about one student in two. As for active learning in science, it has mainly spread in primary science lessons. For example, the share of students asked to plan or design an experiment in at least half of their lessons increased from 19 to 37% in primary education (and 19 to 31% in secondary education).

Interestingly, in spite of the enhanced awareness of the need to develop students' higher order skills, there has been relatively little expansion in the practices trying to foster them. Only practices fostering observation skills in science have increased significantly, while opportunities given to students to explain their ideas, draw conclusions or make inferences remained stable and concerned relatively few students.

## Technology-related innovation

Most people associate innovation to (information and communication) technology, perhaps because this is the most visible form in an increasingly digital world. While innovation in educational practices is not necessarily related to technology, innovation in the availability of computers and in the use of ICT in student's school work have actually been strong drivers of change over the past decade.

In almost all countries, students have experienced small decreases in the availability of desktop computers and tablets for use in their reading, maths and science lessons, as well as less desktop computers available in school. The Russian Federation and New Zealand are the only two exceptions. This is a paradoxical trend, confirmed by several country-level studies. However, access to desktop remains very high: 80% of secondary students on average still have access to desktop computers at school, and an increasing share have had access to laptop computers. In Sweden and Denmark where the share of secondary students having access to desktop computers in school has dropped to around 65%, 85-90% of students could access laptops in school in 2015. By contrast, students having access to desktops decreased significantly in Poland and Japan (to about 65%) without any notable increase in access to laptops, so that there was arguably no strong substitution effect. The availability of computers and tablets during lessons has decreased (be it in mathematics, science or reading). This downward trend may be explained by a variety of reasons: the greater availability of computers at home may have changed the role of computers in school, mobile phones and personal computers may be used under a "bring your own device" policy, etc.

The decrease in the availability of computers has been accompanied by an intensified use of computers and information technology. This is the case in all covered countries, except Portugal, Chile, and to a lesser extent Ireland. A greater percentage of students having access to computers use them in their lessons and for their schoolwork. On average, in an OECD education system the share of students using computers to practice their maths skills and procedures at least once a week has increased by 42 percentage points in primary education (to 51%) and by 23 percentage points (to 32%) in secondary education. The average share of students using computers to practice their science skills and procedure at least once a week increased by 17 percentage points in primary education and 15 percentage points in secondary education (to 22% and 26% respectively). And in reading, the average share of students using computers to write stories and texts at least once a week increased by 10 percentage points (to 34%). Looking up for ideas and info on computers in mathematics, science and reading is a new practice that has spread quickly over the past decade, with a significant increase by 27 percentage points in primary mathematics (from 3 to 31% of students doing it on average), and by around 20% in secondary mathematics (from 5% to 23%), primary and secondary science (22 to 39% and 17 to 38%, respectively), and primary reading (30 to 52%). The use of computers to access information has thus continued to spread across systems, and emerged and diffused quickly in mathematics.

## Innovation in teacher professional development

One of the most remarkable innovations for students lay in how their teachers developed their professional knowledge. In brief, the share of students taught by teachers who took part in peer learning increased considerably, while those taught by teachers who attended a formal teacher training in the past two years remained stable. Given the importance of peer learning for professional development, this is good news. In some countries, a strong increase in peer learning seemed to have been accompanied by a strong decrease in formal teacher training – an innovation which is more difficult to assess as such.

On average, the share of students with teachers who participated in a formal teacher training programme remained relatively stable. The OECD average usually points to a small decrease that rarely exceeds 10 percentage points. There are a few exceptions, but only training about the integration of IT in mathematics has increased by more than 4 percentage points (7 percentage points). Overall, this consistent downward change represented a small innovation for students. However, average stability sometimes hides contrasting directions of change within countries. For example, during the past decade, the share of Slovenian students whose primary teachers had a training in mathematics, in science, in maths pedagogy or in science pedagogy dropped significantly (from 43 to 20%, 63 to 24%, 35 to 17%, and 57 to 15% respectively). In Hungary, Turkey, the Slovak Republic, there has also been an important decrease in some if not all of these teacher trainings. By contrast, in Poland teacher training increased significantly between 2011 and 2015: the share of students with a teacher who took a training in the past two years went up from 32 to 56% for maths content, from 34 to 74% for science content, from 31 to 69% for maths pedagogy and from 19 to 49% for science pedagogy. Some countries also had big changes in one or more of these domains (for example Australia, Sweden, and New Zealand).

The diffusion of teacher professional development through peer learning has been (on average) the largest innovation experienced by students in the OECD area, notably in secondary education. The share of secondary students having a teacher discussing how to teach a particular maths or science topic has increased in all covered countries, and by 21% on average (from 41 to 62% in maths, and 39 to 60% in maths). In Israel, the practice has become almost universal during the last decade (going up from 35 to 78% in maths and 83% in science). Collaboration in planning and preparing lessons has also become more prevalent, with the OECD average increasing from 40 to 56% in maths and from 37 to 55% in science. In Israel, Italy and New Zealand, this has represented a major change in the system. Finally, even though only 18% of secondary students had a teacher visiting a colleague's classroom in an average OECD country, there was significant spread of this practice in the last decade: in 2007, only 3-4% of secondary students had a maths or science teacher in this case. The largest increases occurred in Korea (38 percentage points in maths and 35 in science), Turkey (37 in maths and 35 in science), and the Russian Federation (40 in maths and 34 in science).

## Innovation and education systems' performance

Ultimately, innovation should be about improvement, and the main reason why countries should monitor changes (or lack thereof) is to understand and monitor whether changes in educational practices lead to progress, to identify which changes or combination of changes lead to improvement of specific outcomes. At the very least, it helps monitor whether intended changes did translate into actual change in practices – and to see whether innovation policies in education, where they exist, produce the expected levels and types of innovation.

At this early stage of our measurement effort, we can assess the strength of associations between innovation and certain educational outcomes, and, more importantly, start raising some questions and assumptions about the relationship between innovation and educational outcomes. Any deeper analysis would require more granular analysis using longitudinal data that allow for the tracking of students over time, of their outcomes and of their corresponding teaching and learning environment. Part of this work is done by specific evaluation or "scaling up" studies, but very few still have sufficient scale to tell us much about innovation at the system level. Many assumptions about the possible effect of educational innovation in general or specific innovation on various educational outcomes remain to be proven or more carefully examined.

In the past decade, innovation in education has been associated with the improvement of academic learning outcomes, both in primary and secondary education. In countries where there has been more change in educational practices, students' scores to international assessments have improved more on average. This is also generally true at the disciplinary level. More innovation in science education is associated with more improvement in science scores in primary and secondary education; countries where primary reading lessons have changed the most have also usually had more improvement in reading. A positive association also exists in maths education, but only at the primary education level. Other outcomes such as student satisfaction or the enjoyment of science have also increased more where there was more innovation. Innovation is not always accompanied by better outcomes though. In secondary education, countries that experienced more innovation have not improved their learning outcomes the most in mathematics, and no relationship with student satisfaction could be found.

Innovation in education should in principle only be encouraged when its benefits outweigh its costs – and if it is an improvement compared to the status quo. While in practice this is not feasible, because the generation of evidence and cost-benefit analysis is too slow (and relatively uncertain), this remains an important objective, and more research on the effects of specific educational practices and of their combination should be encouraged at the local, regional, national and international levels. In our report, there is a weak or inexistent association between innovation in the past 10 years and educational expenditure (per student). While it would be hasty to generalise that innovation does not require additional budget, it shows that many innovations, notably when they are pedagogical in nature, may be implemented within existing resources.

## What are the drivers of innovation?

Innovation can be the result of different processes, especially when it happens in the classroom. It can be mandated or incentivised by local authorities or central governments as part of reforms or regulatory measures. It can be willingly adopted with no hierarchical incentives or mandates as part of the circulation of knowledge (training, peer learning, independent learning), the perceived demands of students and parents, feedback loops from data, the persuasiveness of "evidence", the introduction of new products on the education market, etc.

Key drivers of innovation and improvement in education are as follows:

- **Human resources**: the skills for and openness to innovation of actors within the education sector, notably teachers and faculty, are key aspects of a good innovation ecosystem.
- **Learning organisations**: innovation and improvement are strongly related to how work is organised and whether education establishments and professionals are able to both absorb and generate improved knowledge and practice.
- **Technology**: the application of general purpose technologies to the education sector, and notably of digital technologies, is a key promise for innovation and improvement. In particular, the development and use of longitudinal information systems (and their "big data") holds key promises for innovating the education sector.
- **Regulation and system organisation**: innovation and improvement only thrives where good ideas can be implemented and are not hidden by too risk-averse regulations on curriculum, assessment, etc. It also depends on the entrepreneurialism of the actors, on incentives, and on the availability of funds for educational innovation.
- **Educational research**: the investment in and use of research and evaluation are key elements in an educational innovation ecosystem.
- **Educational Development**: as in other sectors, an education industry should develop innovative tools, organisations and processes to improve and change the practices in the education sector.

Some of these different pillars of innovation could be measured and monitored over time at the country level and thus pave the way towards an "innovation capacity index" in education. In any event, it would give countries a better understanding of their strengths and weaknesses in the further of their education systems.

## Towards an international survey instrument on innovation in education

While existing international datasets already provide us with important information about systemic innovation, improved measures of innovation in education would entail more specific studies. Our preferred approach to measuring innovation in education would be to develop a dedicated international survey – or at least survey instrument. This survey would ideally:

- Adopt and adapt the "organisational change" approach using matched employer-employee-user surveys.
- Be administered to the central educational administration (ministries or relevant local authorities) and to educational establishments in primary, secondary and tertiary education.
- Question three levels of stakeholders (principal/president, teachers/faculty and students) about the state and changes in their work practices and work environment.
- Infer innovation by comparing whether the investigated practice was used (or used to the same extent) at the time of the survey and, say, three years before.
- Ask respondents their opinion about the impact of these practices (or change in these practices) on different educational goals (e.g. learning outcomes, equity, access, cost-efficiency).
- Capture the sources and objectives of planned innovations, to what extent these planned improvements are implemented and perceived on the ground, and the extent of unplanned innovations.
- Cover the broad innovation areas: products and services offered by educational organisations to their users/clients (e.g. textbooks, study programmes); pedagogic practice (e.g. pedagogies, introduction of new teaching or administrative equipment); organisational practice (e.g. organisational routines, human resource practices, knowledge management practices; support for the introduction of new ideas and practices, participation in training and retraining courses); external relations (e.g. relationships with parents, employers, research organisations, other academic institutions, advertisement practices).
- Collect information about the broader environment in which these practices take place, such as information about size of establishment and classrooms, number of classes, competition with other schools in the neighbourhood, regulation and regulatory changes.

With support from the European Commission, the OECD Centre for Educational Research and Innovation plans to continue to develop new methodologies and instruments to address this important measurement gap for policy making and provide countries to monitor their innovation ecosystem in education.

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# Part I.
# Innovation (and stability) in 150 educational practices

# Chapter 2.
# Innovation in practices to develop technical skills in mathematics

*This chapter presents the change in maths education teaching and learning practices aimed at developing student content and procedural knowledge. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 1. Memorising rules, procedures and facts as a pedagogical technique in mathematics

### Why it matters

Memorising facts, rules and procedures is part of all learning strategies. Often associated to "traditional" and relatively "teacher-centred" approaches to teaching and learning, memorisation should be seen as part of the mix of pedagogical practices that teachers should use. Good teachers will find the right dosage with other, more active learning practices. An increase of these practices is often related to the existence of high-stakes exams or assessments in education systems.

## Primary education

### Change at the OECD level: large

In primary education, this practice has mainly expanded in the OECD area. On average it has increased by 21 percentage points, with 43% of mathematics students being asked to memorise facts and procedures in at least half of their lessons in 2015 against 22% in 2007. The absolute change of also 21 percentage points, including both positive and negative changes, corresponds to a large effect size of 0.5. There are large disparities in the shares of students regularly asked to memorise for learning: from 22% in Germany in 2015, to almost 80% in Slovenia.

### Countries where there has been the most change

Turkey is by far the country that has experienced the largest decrease in this pedagogical practice, with a decrease of over 33.5 percentage points between 2007 and 2015. In Slovenia the share of students concerned has increased by more than 50 percentage points. Lithuania, the Netherlands, England (United Kingdom) and Quebec (Canada) have also highly innovated in the use of this practice with increases by more than 30 percentage points.

## Secondary education

### Change at the OECD level: large

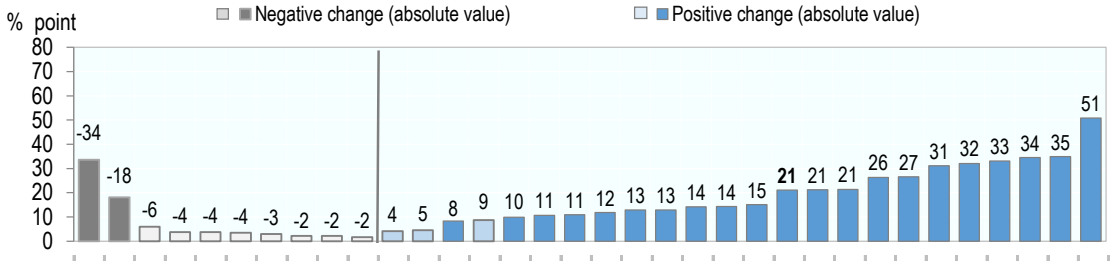
In secondary education, most OECD countries have experienced an expansion of this practice resulting in an average increase of 14 percentage points. The change, be it positive or negative, has amounted to 19 percentage points on average, corresponding to a large effect size of 0.4. In 8th grade mathematics, this practice is common across countries in spite of large variations. For instance, 32% of 8th grade students were asked to memorise rules, procedures and facts in at least half of their mathematics lessons in Ontario (Canada) in 2015, compared to 80% in Slovenia.

### Countries where there has been the most change

Secondary education presents similar patterns as primary education. Turkey shows the largest decrease in this pedagogical practice with a contraction of over 29 percentage points between 2007 and 2015. Italy and Slovenia registered the largest increases, over 40 percentage points. The spread of this practice in Sweden, England, Australia and Indonesia was also remarkable.

**Figure 2.1. 4th grade students memorising rules, procedures and facts in maths**

Change in and share of students whose teachers ask them to memorize rules, procedures and facts in at least half the lessons, 2007-2015, teachers report



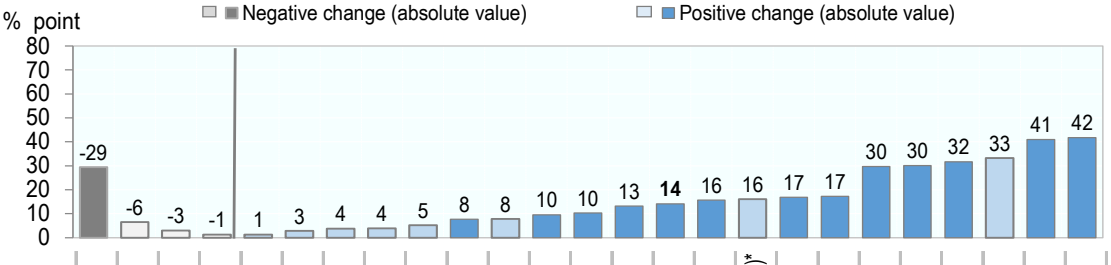

| | | Turkey* | Spain* | Northern Ireland (UK)* | Ireland* | Hong Kong, China | Chile* | Belgium (Fl.)* | Korea* | Japan | Finland* | Alberta (CAN)* | Austria* | Singapore | Portugal* | Denmark | United States | New Zealand | Ontario (CAN) | Hungary | Germany | Poland* | Italy | Russian Federation | **OECD average** | Czech Republic | Norway | Slovak Republic | Australia | Sweden | Quebec (CAN) | England (UK) | Netherlands | Lithuania | Slovenia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 49 | 48 | 58 | 68 | 22 | 63 | 25 | 67 | 71 | 43 | m | m | 41 | 74 | 22 | 46 | 24 | 30 | 31 | 22 | 71 | 68 | 61 | **43** | 29 | 30 | 37 | 43 | 37 | 54 | 55 | 62 | 79 | 79 |
| | 2011 | 82 | 66 | 64 | 72 | 17 | 67 | 28 | 69 | 77 | 45 | 22 | 14 | 45 | 66 | 29 | 62 | 35 | 33 | 29 | 22 | 57 | 64 | 64 | **42** | 22 | 34 | 35 | 45 | 30 | 66 | 55 | 46 | 78 | 27 |
| | 2007 | m | m | m | m | 26 | m | m | m | 73 | m | 18 | 10 | 33 | m | 12 | 35 | 13 | 18 | 18 | 9 | m | 54 | 46 | **22** | 8 | 9 | 10 | 16 | 6 | 22 | 22 | 28 | 45 | 28 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

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**Figure 2.2. 8th grade students memorising rules, procedures and facts in maths**

Change in and share of students whose teachers ask them to memorize rules, procedures and facts in at least half the lessons, 2007-2015, teachers report




| | | Turkey | New Zealand* | Ontario (CAN) | Korea | Minnesota (USA)* | Russian Federation | United States | South Africa* | Hungary | Lithuania | Quebec (CAN) | Chile* | Israel | Japan | **OECD average** | Hong Kong, China | Massachusetts (USA)* | Singapore | Norway | Sweden | England (UK) | Australia | Indonesia* | Italy | Slovenia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 35 | 39 | 32 | 60 | m | 75 | 41 | 69 | 46 | 84 | 47 | 64 | 54 | 71 | **52** | 40 | m | 44 | 32 | 40 | 52 | 63 | m | 74 | 80 |
| | 2011 | 90 | 45 | 35 | 80 | 37 | 78 | 57 | 65 | 49 | 84 | 65 | 55 | 64 | 83 | **60** | 39 | 44 | 55 | 41 | 50 | 47 | 65 | 85 | 85 | 35 |
| | 2007 | 65 | m | 35 | 61 | 35 | 72 | 37 | m | 40 | 76 | 39 | m | 43 | 57 | **38** | 24 | 28 | 27 | 15 | 10 | 22 | 31 | 51 | 33 | 39 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903650

## 2. Practising skills and procedures in computers in mathematics

### Why it matters

Practice makes perfect. Part of the mastery of mathematics relies on implementing and practising the procedural knowledge one has acquired. While computers can now make complex calculations with perfect accuracy, part of this procedural knowledge allows students to understand how mathematicians think and assess how to deal with mathematical problems. This pedagogical practice needs to be supplemented by other pedagogical practices requiring more thinking from the student, but computers are a good medium for this kind of learning.

### Primary education

#### Change at the OECD level: large

Across the OECD area, the share of students using computers regularly for practising skills and procedures during 4th grade mathematics lessons increased by 42 percentage points on average between 2007 and 2015. The average absolute change during this time period is also at 42 percentage points, corresponding to a very large effect size of 1. The extent to which students are exposed to this practice varies significantly across countries, from 5% in Japan to over 77% in the Netherlands in 2015.

#### Countries where there has been the most change

This practice has been a significant pedagogical innovation in New Zealand, where it expanded the most between 2007 and 2015 (74 percentage points), followed by Australia and the United States (over 60 percentage points). Korea, Chile, Belgium (Fl.) and Portugal have experienced declines above 12 percentage points in this practice, although these more modest negative changes were only measured between 2011 and 2015.

### Secondary education

#### Change at the OECD level: large

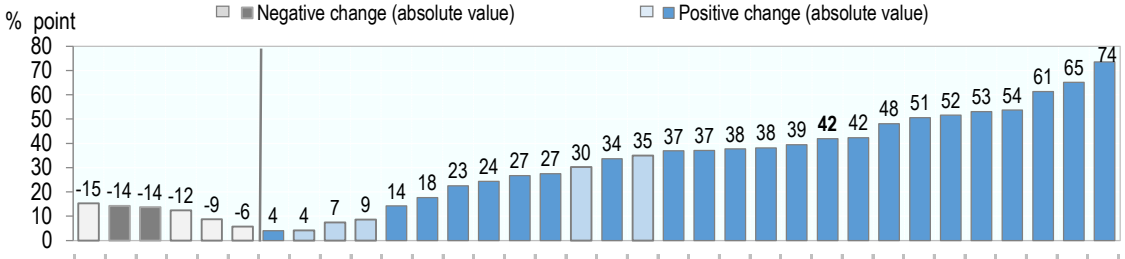
The share of students frequently using computers for practising skills and procedures during 8th grade mathematics lessons has expanded by 23 percentage points on average. Only Chilean students experienced a contraction in this domain (between 2011 and 2015). The average change between 2007 and 2015 has been positive for all OECD countries, around 23 percentage points, corresponding to a very large effect size of 0.6. At the OECD level, the share of 8th grade students regularly using this learning strategy ranged from nearly 8% in Slovenia to over 57% in the United States in 2015.

#### Countries where there has been the most change

The share of students using this practice has increased by 44 percentage points in Australia and the United States between 2007 and 2015. Chile is the only country where it has contracted, by 15 percentage points between 2011 and 2015.

**Figure 2.3. 4th grade students using computers to practice skills and procedures in maths**

Change in and share of students who frequently practise skills and procedures on computers during mathematics lessons, 2007-2015, teachers report



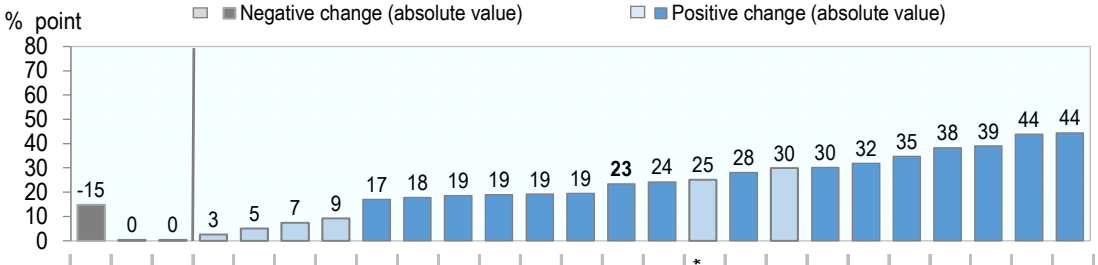

| | | Korea* | Chile* | Belgium (Fl.)* | Portugal* | Spain* | Northern Ireland (UK)* | Japan | Ireland* | Turkey* | Poland* | Finland* | Germany | Slovenia | Hong Kong, China | Singapore | Czech Republic | Austria* | England (UK) | Alberta (CAN)* | Sweden | Hungary | Italy | Denmark | Lithuania | **OECD average** | Russian Federation | Slovak Republic | Quebec (CAN) | Norway | Netherlands | Ontario (CAN) | United States | Australia | New Zealand |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 13 | 25 | 29 | 31 | 39 | 52 | 5 | 50 | 83 | 29 | 29 | 24 | 28 | 30 | 43 | 39 | m | 47 | m | 43 | 40 | 39 | 47 | 42 | **51** | 56 | 57 | 53 | 56 | 89 | 59 | 79 | 75 | 87 |
| | 2011 | 28 | 40 | 43 | 43 | 48 | 58 | 2 | 46 | 76 | 20 | 15 | 31 | 29 | 40 | 39 | 37 | 35 | 31 | 40 | 44 | 31 | 42 | 22 | 31 | **41** | 41 | 31 | 31 | 51 | 84 | 25 | 61 | 59 | 81 |
| | 2007 | m | m | m | m | m | m | 1 | m | m | m | m | 7 | 5 | 6 | 16 | 11 | 5 | 13 | 5 | 6 | 3 | 1 | 8 | 2 | **9** | 14 | 9 | 3 | 5 | 36 | 5 | 18 | 10 | 13 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

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**Figure 2.4. 8th grade students using computers to practice skills and procedures in maths**

Change in and share of students who frequently practise skills and procedures on computers during mathematics lessons, 2007-2015, teachers report




| | | Chile* | Lithuania | Japan | Hong Kong, China | Slovenia | Turkey | Indonesia* | Singapore | Korea | Israel | Sweden | Norway | Italy | **OECD average** | England (UK) | Massachusetts (USA)* | New Zealand* | Minnesota (USA)* | South Africa* | Ontario (CAN) | Russian Federation | Hungary | Quebec (CAN) | United States | Australia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 11 | 4 | 1 | 22 | 8 | 32 | m | 29 | 26 | 41 | 21 | 26 | 25 | **31** | 31 | m | 47 | m | 55 | 32 | 42 | 42 | 44 | 57 | 48 |
| | 2011 | 26 | 14 | m | 12 | 5 | 42 | 13 | 9 | 25 | 39 | 11 | 2 | 15 | **20** | 18 | 27 | 19 | 35 | 24 | 22 | 24 | 17 | 17 | 29 | 41 |
| | 2007 | m | 4 | 2 | 20 | 3 | 24 | 3 | 12 | 8 | 22 | 2 | 7 | 6 | **8** | 7 | 2 | m | 5 | m | 1 | 7 | 4 | 5 | 13 | 4 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

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## 3. Using digital devices for practising and drilling such as for foreign language learning and mathematics

### Why it matters

Computers and digital devices are well suited to support the acquisition of procedural knowledge through repetition and drilling. This is true in a variety of domains where computers represent very good tutors: mathematics, algorithmic, but also some aspects of foreign and domestic language acquisition. Computers also already support more or less complex forms of adaptive learning, for example by automatically adjusting the difficulty of the proposed tasks to the current level of mastery of the student.

### Change at the OECD level: moderate

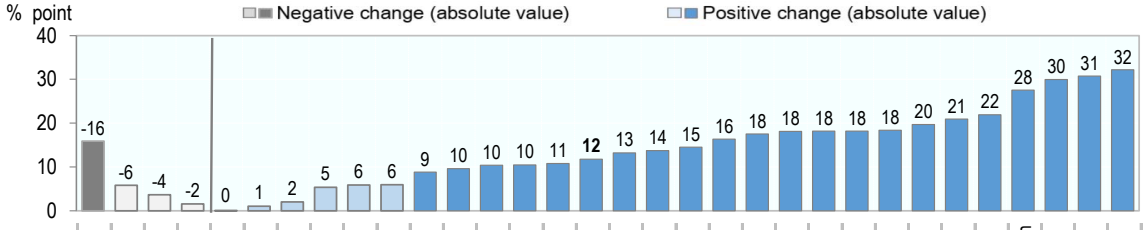
Students in most OECD countries have experienced an increase in the use of digital devices for practising and drilling. Between 2009 and 2015, the share of 15-year-old students using this learning practice at least once a month has increased by 12 percentage points on average. Only in Finland, Spain and Switzerland has it decreased, albeit to a lesser extent. Whether through expansion or contraction, change in the use of this practice was over 14 percentage points on average and represented a moderate effect size of 0.28. This pedagogical activity is frequent in most countries although levels strongly vary across the sample. For instance, in 2015, 10% of students in Japan used it at least once a month, against 74% in Denmark.

### Countries where there has been the most change

Large expansions of this practice were experienced in Latvia, Denmark and Sweden, all three with increases above 30 percentage points. Finland recorded the largest decline in this domain, of about 16 percentage points.

**Figure 2.5. 15 year old students using digital devices for practising and drilling**

Change in and share of students using digital devices at school for practising and drilling, such as for foreign language learning or mathematics, at least once a month, 2006-2015, students report




| | | Finland | Spain | Hong Kong, China | Switzerland | Belgium | Korea | Italy | Germany | Greece | Japan | Estonia | Ireland | Singapore | Czech Republic | Chile | **OECD average** | Portugal | Slovenia | Israel | Iceland | Netherlands | Austria | Poland | New Zealand | Hungary | Slovak Republic | Australia | Lithuania | Russian Federation | Sweden | Denmark | Latvia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 42 | 48 | 34 | 49 | 38 | 16 | 54 | 32 | 40 | 10 | 38 | 32 | 41 | 54 | 46 | **46** | 47 | 43 | 49 | 58 | 67 | 48 | 47 | 43 | 46 | 59 | 47 | 56 | 62 | 65 | 74 | 59 |
| | 2006 | 58 | 54 | 38 | 50 | 38 | 15 | 52 | 26 | 34 | 4 | 30 | 23 | 31 | 43 | 35 | **35** | 34 | 29 | 34 | 41 | 50 | 30 | 29 | 25 | 28 | 39 | 26 | 34 | 34 | 35 | 44 | 27 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933903707

## 4. Solving problems without an immediately obvious method of solution

### Why it matters

Many real life problems do not have an immediately obvious solution. Increasingly, most problems people will have to solve in their working life will be certain forms of complex problems: computers and robots will take care of simple problems – and actually some complex ones as well. The preparation to complex problem solving has thus become critical – and is also often more interesting to students.

### Change at the OECD level: moderate-low

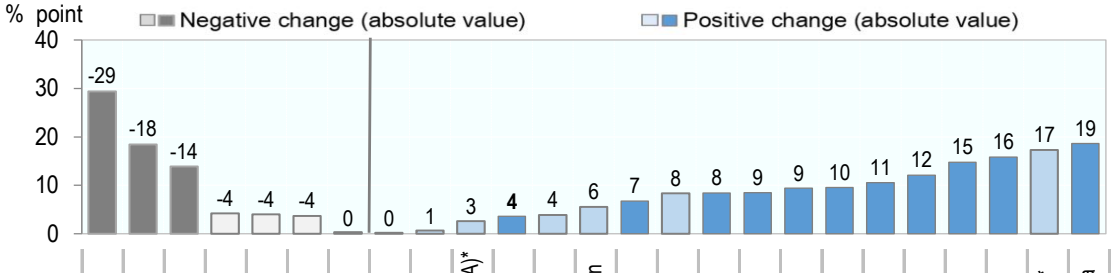
At the OECD level, the use of this practice increased on average by 4 percentage points between 2007 and 2015. With a modest effect size of 0.21, positive and negative changes led to an average absolute change of 9 percentage points. In 2015, this teaching and learning practice was not used in a systematic way in 8th grade mathematics lessons, concerning about 29% of the students on average.

### Countries where there has been the most change

Chile recorded the largest decline in the use of this practice, by almost 30 percentage points (measured between 2011 and 2015). Following Chile, Quebec (Canada) and Turkey registered declines of 18 and 14 percentage points respectively. Positive changes are of a great magnitude in Hong Kong, Minnesota (United States), Australia and Italy, all of them recording increases above 15 percentage points.

**Figure 2.6. 8th grade students solving problems without an immediately obvious method of solution in maths**

Change in and share of students whose teachers ask them to work on problems with no immediately obvious method of solution in at least half the lessons, 2007-2015, teachers report




| | | Chile* | Quebec (CAN) | Turkey | Ontario (CAN) | New Zealand* | Hungary | Lithuania | Sweden | South Africa* | Massachusetts (USA)* | **OECD average** | Japan | Russian Federation | Norway | Indonesia* | Israel | Slovenia | United States | Singapore | Korea | England (UK) | Italy | Australia | Minnesota (USA)* | Hong Kong, China |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 38 | 32 | 23 | 32 | 18 | 18 | 11 | 14 | 37 | m | **29** | 30 | 14 | 17 | m | 32 | 34 | 35 | 20 | 38 | 25 | 51 | 26 | m | 31 |
| | 2011 | 67 | 31 | 52 | 42 | 22 | 20 | 12 | 18 | 36 | 30 | **31** | 27 | 7 | 15 | 27 | 42 | 34 | 37 | 21 | 36 | 24 | 36 | 24 | 36 | 29 |
| | 2007 | m | 50 | 37 | 36 | m | 22 | 11 | 14 | m | 28 | **25** | 26 | 8 | 10 | 18 | 24 | 26 | 25 | 10 | 28 | 13 | 36 | 11 | 18 | 13 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903726

## 5. Processing and analysing data on computers

### Why it matters

Nowadays most of the computing and a lot of data processing in mathematics tend to be handled by computers. After all, they have a clear competitive advantage when it comes to computing power. While it does not have to fully replace other forms of data processing in maths, being able to use computers for those purposes has become an important technical skill in mathematics.

### Change at the OECD level: large

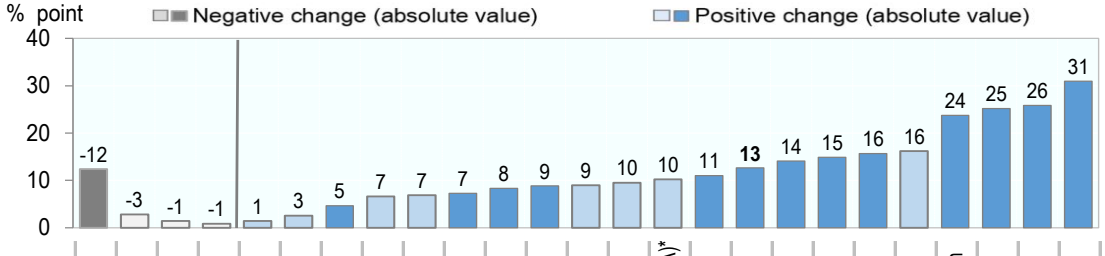
The share of students regularly using computers for processing and analysing data in 8th grade mathematics lessons increased by 13 percentage points on average. The positive and negative variations together amounted to a total absolute change of 13 percentage points, corresponding to a large effect size of 0.44. In most countries, only a small share of students systematically participated in this pedagogical activity in 2015, ranging from 6% in Sweden to 35% in the United States.

### Countries where there has been the most change

This pedagogical activity was a big innovation in the United States where the share of students using it increased by 31 percentage points between 2007 and 2015. In Australia and Ontario (Canada), the prevalence of this practice expanded by about 25 percentage points during the same period. By contrast, Chile registered the only significant decline in this domain, with a contraction by 12 percentage points between 2011 and 2015.

**Figure 2.7. 8th grade students using computers to process and analyse data in math**

Change in and share of students who frequently use computers to process and analyse data during mathematics lessons, 2007-2015, teachers report




| | | Chile* | Hong Kong, China | Lithuania | Japan* | Slovenia | Minnesota (USA)* | Sweden | Israel | Indonesia* | Singapore | Korea | Italy | England (UK) | South Africa* | Massachusetts (USA)* | Norway | **OECD average** | Quebec (CAN)* | New Zealand* | Hungary | Turkey | Russian Federation | Ontario (CAN) | Australia | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 11 | 8 | 5 | m | 7 | m | 6 | 25 | m | 14 | 16 | 15 | 12 | 30 | m | 16 | **18** | 14 | 25 | 22 | 34 | 26 | 27 | 26 | 35 |
| | 2011 | 24 | 9 | 10 | 1 | 4 | 5 | 5 | 26 | 20 | 3 | 17 | 12 | 5 | 21 | 12 | 4 | **12** | 6 | 10 | 7 | 41 | 15 | 13 | 16 | 14 |
| | 2007 | m | 11 | 7 | 1 | 6 | 2 | 2 | 18 | 14 | 7 | 8 | 7 | 3 | m | 1 | 5 | **6** | m | m | 6 | 18 | 3 | 2 | 0 | 4 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903745

**Table 2.1. Effect sizes for changes in practices to develop technical skills in mathematics**

| | Memorising rules, procedures and facts as a pedagogical technique | | Practising skills and procedures on computers | | Use of digital devices for practising and drilling | Solving problems with no obvious method of solution | Processing and analysing data on computers |
|---|---|---|---|---|---|---|---|
| | 4th grade | 8th Grade | 4th grade | 8th Grade | 8th grade | 8th Grade | 8th Grade |
| Australia | 0.60 | 0.64 | 1.46 | 1.14 | 0.44 | 0.42 | 1.01 |
| Austria | 0.14 | m | 0.82 | m | 0.37 | m | m |
| Belgium | m | m | m | m | 0.00 | m | m |
| Belgium (Fl.) | -0.07 | m | -0.29 | m | m | m | m |
| Canada (Alberta) | 0.10 | m | 0.91 | m | m | m | m |
| Canada (Ontario) | -0.07 | -0.06 | 0.71 | 1.06 | m | -0.09 | 0.80 |
| Canada (Quebec) | -0.25 | 0.16 | 1.30 | 1.01 | m | -0.38 | 0.77 |
| Chile | -0.07 | 0.20 | -0.31 | -0.39 | 0.22 | -0.60 | -0.33 |
| Czech Republic | 0.58 | m | 0.66 | m | 0.21 | m | m |
| Denmark | 0.27 | m | 0.91 | m | 0.64 | m | m |
| Estonia | m | m | m | m | 0.19 | m | m |
| Finland | -0.03 | m | 0.35 | m | -0.32 | m | m |
| Germany | 0.36 | m | 0.51 | m | 0.12 | m | m |
| Greece | m | m | m | m | 0.12 | m | m |
| Hungary | 0.30 | 0.11 | 1.01 | 1.02 | 0.38 | -0.09 | 0.47 |
| Iceland | m | m | m | m | 0.33 | m | m |
| Ireland | -0.08 | m | 0.08 | m | 0.22 | m | m |
| Israel | m | 0.21 | m | 0.40 | 0.30 | 0.19 | 0.16 |
| Italy | 0.29 | 0.85 | 1.15 | 0.57 | 0.04 | 0.30 | 0.29 |
| Japan | -0.05 | 0.28 | 0.25 | -0.02 | 0.24 | 0.09 | -0.18 |
| Korea | -0.05 | -0.03 | -0.39 | 0.50 | 0.03 | 0.23 | 0.26 |
| Latvia | m | m | m | m | 0.66 | m | m |
| Lithuania | 0.74 | 0.20 | 1.09 | -0.02 | 0.44 | -0.01 | -0.06 |
| Netherlands | 0.71 | m | 1.18 | m | 0.36 | m | m |
| New Zealand | 0.29 | -0.13 | 1.65 | 0.61 | 0.39 | -0.10 | 0.00 |
| Norway | 0.56 | 0.41 | 1.26 | 0.55 | m | 0.20 | 0.37 |
| Poland | 0.30 | m | 0.20 | m | 0.38 | m | m |
| Portugal | 0.19 | m | -0.26 | m | 0.27 | m | m |
| Slovak Republic | 0.64 | m | 1.10 | m | 0.40 | m | m |
| Slovenia | 1.07 | 0.88 | 0.65 | 0.24 | 0.29 | 0.19 | 0.06 |
| Spain | -0.37 | m | -0.18 | m | -0.12 | m | m |
| Sweden | 0.81 | 0.71 | 0.94 | 0.67 | 0.61 | 0.01 | 0.25 |
| Switzerland | m | m | m | m | -0.03 | m | m |
| Turkey | -0.73 | -0.60 | 0.19 | 0.17 | m | -0.30 | 0.37 |

| | Memorising rules, procedures and facts as a pedagogical technique | | Practising skills and procedures on computers | | Use of digital devices for practising and drilling | Solving problems with no obvious method of solution | Processing and analysing data on computers |
|---|---|---|---|---|---|---|---|
| | 4th grade | 8th Grade | 4th grade | 8th Grade | 8th Grade | 8th Grade | 8th Grade |
| UK (England) | m | 0.64 | 0.77 | 0.65 | m | 0.31 | 0.36 |
| UK (Northern Ireland) | -0.12 | m | -0.11 | m | m | m | m |
| United States | 0.22 | 0.08 | 1.32 | 0.97 | m | 0.21 | 0.85 |
| US (Massachusetts) | m | 0.34 | m | 0.84 | m | 0.06 | 0.46 |
| US (Minnesota) | m | 0.03 | m | 0.80 | m | 0.39 | 0.14 |
| **OECD (average)** | **0.45** | **0.28** | **0.98** | **0.62** | **0.24** | **0.08** | **0.40** |
| **OECD (average absolute)** | **0.49** | **0.40** | **1.02** | **0.64** | **0.28** | **0.21** | **0.44** |
| Hong Kong, China | -0.09 | 0.34 | 0.68 | 0.06 | -0.08 | 0.46 | -0.09 |
| Indonesia | m | 0.74 | m | 0.35 | m | 0.20 | 0.18 |
| Russian Federation | 0.30 | 0.06 | 0.93 | 0.86 | 0.56 | 0.18 | 0.75 |
| Singapore | 0.17 | 0.36 | 0.60 | 0.43 | 0.22 | 0.27 | 0.24 |
| South Africa | m | 0.08 | m | 0.63 | m | 0.01 | 0.22 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PISA (2006, 2009 and 2015).

StatLink https://doi.org/10.1787/888933903764

# Chapter 3.
# Innovation in practices to develop technical skills in science

*This chapter presents the change in science education teaching and learning practices aimed at developing student content and procedural knowledge: memorising rules and facts, using formulas, practising, watching teachers conducting an experiment and doing it oneself, etc. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 6. Memorising rules, procedures and facts as a pedagogical technique in science

### Why it matters

Memorising facts, rules and procedures is part of all learning strategies. Often associated to "traditional" and relatively "teacher-centred" approaches to teaching and learning, memorisation should be seen as part of the mix of pedagogical practices that teachers should use. Good teachers will find the right dosage with other, more active learning practices. An increase of these practices is often related to the existence of high-stakes exams or assessments in education systems.

## Primary education

### Change at the OECD level: moderate

OECD countries have increased the use of these memorisation exercises in 4th grade science lessons, from an average of 24% of students exposed to it in at least half their lessons in 2007 to 33% in 2015. Positive and negative trends together amount to an average absolute change of 10 percentage points, corresponding to a moderate effect size of 0.26. The frequency of its use varies significantly between countries. For instance, Northern Ireland had 7% of its 4th grade students regularly memorising rules, procedures and facts in their science lessons in 2015, against 76% in Lithuania.

### Countries where there has been the most change

Lithuania stands out with an increase in the use of this learning technique by 29 percentage points between 2007 and 2015, trailed closely by Slovenia (25 percentage points). A few large declines in the use of this practice were also witnessed, especially in Turkey with a decrease of 32 percentage points between 2011 and 2015.

## Secondary education

### Change at the OECD level: moderate

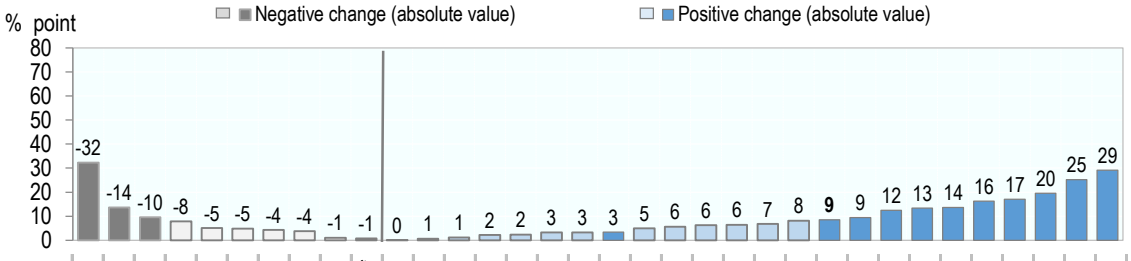
Most OECD education systems have seen greater use of memorisation of rules, procedures and facts during 8th grade science lessons, resulting on an average increase of 15 percentage points in the share of students regularly exposed to it between 2007 and 2015. Regardless of the direction of innovation, the absolute change in the use of this pedagogical technique amounted to 15 percentage points as well, with a rather large effect size of 0.34. In 2015, the share of 8th grade students exposed to this learning practice in at least half their lessons ranged from 23% in Norway against 78% in Lithuania.

### Countries where there has been the most change

Italy experienced the largest increase in the use of this learning technique in 8th grade science, of 42 percentage points. Moreover, strong positive changes of around 30 percentage points were also witnessed in Quebec (Canada) and Singapore. Only two negative changes in this practice were recorded, none of which was above 10 percentage points.

**Figure 3.1. 4th grade students memorising rules, procedures and facts in science**

Change in and share of students whose teachers ask them to memorise rules, procedures and facts in at least half the lessons, 2007-2015, teachers report



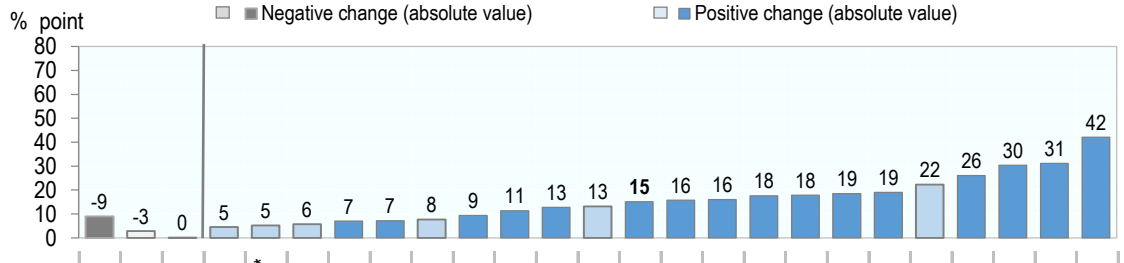

| | | Turkey* | Poland* | United States | Korea* | Germany | Chile* | Belgium (Fl.)* | Spain* | Alberta (CAN)* | Northern Ireland (UK)* | Finland* | Singapore | Russian Federation | Australia | Austria* | Ontario (CAN) | Portugal* | New Zealand | Denmark | Ireland* | Hungary | Netherlands | Italy | Hong Kong, China | **OECD average** | England (UK) | Sweden | Czech Republic | Japan | Slovak Republic | Norway | Quebec (CAN) | Slovenia | Lithuania |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 38 | 52 | 25 | 62 | 16 | 53 | 26 | 55 | m | 7 | 30 | 41 | 62 | 13 | m | 18 | 63 | 8 | 14 | 24 | 73 | 24 | 73 | 46 | **33** | 20 | 26 | 22 | 69 | 33 | 21 | 38 | 63 | 76 |
| | 2011 | 70 | 66 | 33 | 69 | 17 | 58 | 30 | 58 | 9 | 8 | 30 | 51 | 68 | 10 | 7 | 16 | 60 | 4 | 17 | 18 | 67 | 24 | 69 | 56 | **31** | 12 | 17 | 19 | 74 | 31 | 20 | 31 | 66 | 71 |
| | 2007 | m | m | 34 | m | 21 | m | m | m | 10 | m | m | 40 | 61 | 11 | 4 | 15 | m | 5 | 9 | m | 67 | 18 | 67 | 38 | **24** | 10 | 14 | 9 | 55 | 17 | 4 | 18 | 37 | 47 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903783

**Figure 3.2. 8th grade students memorising rules, procedures and facts in science**

Change in and share of students whose teachers ask them to memorise rules, procedures and facts in at least half the lessons, 2007-2015, teachers report




| | | New Zealand* | Chile* | Israel | Hungary | Massachusetts (USA)* | South Africa* | Lithuania | United States | Ontario (CAN) | England (UK) | Slovenia | Japan | Minnesota (USA)* | **OECD average** | Sweden | Turkey | Norway | Australia | Russian Federation | Korea | Indonesia* | Hong Kong, China | Singapore | Quebec (CAN) | Italy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 23 | 46 | 31 | 69 | m | 64 | 78 | 31 | 27 | 31 | 75 | 75 | m | **47** | 32 | 37 | 23 | 36 | 74 | 75 | m | 60 | 54 | 62 | 58 |
| | 2011 | 32 | 49 | 33 | 76 | 29 | 59 | 80 | 38 | 27 | 36 | 67 | 84 | 36 | **54** | 45 | 77 | 31 | 36 | 76 | 74 | 67 | 59 | 52 | 59 | 78 |
| | 2007 | m | m | 31 | 64 | 24 | m | 71 | 24 | 20 | 22 | 64 | 62 | 23 | **32** | 16 | 21 | 6 | 18 | 55 | 56 | 45 | 34 | 24 | 31 | 16 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903802

## 7. Using scientific formulas and laws to solve routine problems

### Why it matters

In science, applying formulas and laws in the right way and for the appropriate problems is part of the technical knowledge students have to learn. Memorising the rules would mean nothing if they cannot apply them in simple problems. This practice is important for understanding the concepts learnt and should typically be considered as one tool among others in teachers' "directed teaching" repertoire.

### Change at the OECD level: moderate

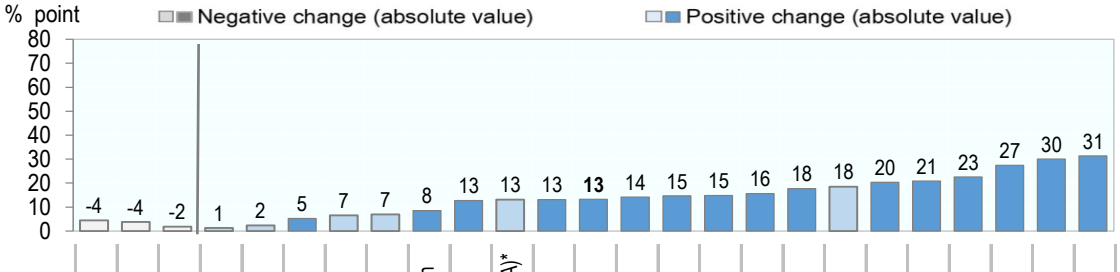
In secondary education, this pedagogical practice spread in almost all OECD countries covered. Between 2007 and 2015, the percentage of students frequently asked to apply scientific formulas to routine problems rose by 13 percentage points on average. Only in New Zealand and Slovenia was there a small contraction. The mean change, be it positive or negative, reached 14 percentage points on average, corresponding to a moderate effect size of 0.31. The use of this pedagogical exercise widely varied across OECD education systems in 2015. For instance, this practice is very common in Korea, but rather unusual in Sweden.

### Countries where there has been the most change

This practice has been an area of strong innovation in Hong Kong, China, Singapore and England with increases above 25 percentage points. Only three countries in the sample recorded negative changes, all of them below 5 percentage points.

**Figure 3.3. 8th grade science students using formulas and laws to solve routine problems**

Change in and share of students whose teachers ask them to use scientific formulas and laws to solve routine problems in at least half the lessons, 2007-2015, teachers report




| % of students | New Zealand* | Indonesia* | Slovenia | Chile* | Turkey | Hungary | South Africa* | Israel | Russian Federation | United States | Massachusetts (USA)* | Australia | **OECD average** | Sweden | Ontario (CAN) | Japan | Italy | Norway | Minnesota (USA)* | Quebec (CAN) | Lithuania | Korea | England (UK) | Singapore | Hong Kong, China |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 28 | m | 46 | 54 | 64 | 57 | 70 | 40 | 68 | 48 | m | 26 | **46** | 20 | 36 | 61 | 55 | 24 | m | 41 | 71 | 84 | 48 | 62 | 50 |
| 2011 | 33 | 65 | 36 | 53 | 63 | 54 | 63 | 38 | 63 | 51 | 32 | 28 | **44** | 26 | 33 | 66 | 55 | 19 | 36 | 39 | 66 | 77 | 35 | 59 | 44 |
| 2007 | m | 69 | 48 | m | 62 | 52 | m | 33 | 59 | 36 | 19 | 13 | **33** | 6 | 21 | 46 | 39 | 6 | 18 | 21 | 50 | 61 | 20 | 32 | 18 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903821

## 8. Processing and analysing data on computers in science

### Why it matters

Analysing scientific data on computers allows students to acquire both computer and scientific skills. While they have other tools at their disposal, most scientists now use computers to identify patterns in their observations or see if they fit a theory. While the use of computer could only involve computations, with pedagogical imagination much more could now easily be done to allow students to reason like scientists.

### Change at the OECD level: moderate

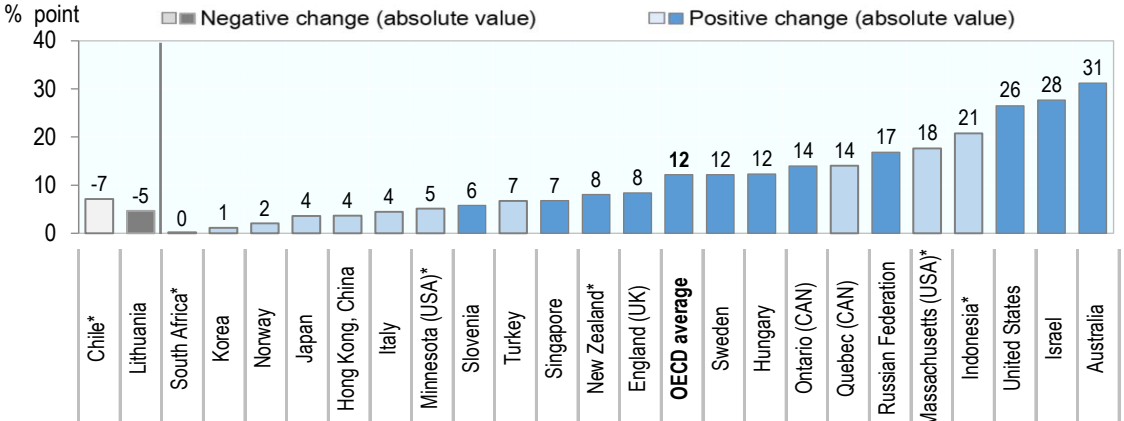
The share of students systematically using computers to process and analyse data during 8th grade science lessons increased by 12 percentage points on average in OECD education systems between 2015 and 2007. The overall absolute change, regardless of change direction, amounted to 12 percentage points as well, corresponding to a moderate effect size of 0.34. This practice remains uncommon, with large disparities observed across systems: 7% of students were exposed to it in Lithuania against 44 in Turkey.

### Countries where there has been the most change

Australia experienced the most innovation in this domain: the share of students exposed to the practice gained ground by 31 percentage points between 2007 and 2015. Similarly, Israel and the United States saw increases above 25 percentage points.

**Figure 3.4. 8th grade science students processing and analysing data on computers**

Change in and share of students who frequently process and analyse data on computers during science lessons, 2007-2015, teachers report




| | | Chile* | Lithuania | South Africa* | Korea | Norway | Japan | Hong Kong, China | Italy | Minnesota (USA)* | Slovenia | Turkey | Singapore | New Zealand* | England (UK) | **OECD average** | Sweden | Hungary | Ontario (CAN) | Quebec (CAN) | Russian Federation | Massachusetts (USA)* | Indonesia* | United States | Israel | Australia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 25 | 7 | 22 | 21 | 7 | 5 | 19 | 12 | m | 13 | 44 | 12 | 16 | 12 | **23** | 15 | 20 | 22 | 25 | 24 | m | m | 39 | 39 | 40 |
| | 2011 | 32 | 12 | 22 | 27 | 4 | 3 | 15 | 10 | 11 | 6 | 46 | 6 | 8 | 12 | **14** | 9 | 16 | 10 | 6 | 12 | 20 | 30 | 20 | 15 | 18 |
| | 2007 | m | 12 | m | 20 | 5 | 1 | 15 | 8 | 6 | 8 | 37 | 6 | m | 3 | **10** | 3 | 8 | 8 | 11 | 7 | 3 | 9 | 12 | 11 | 9 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903916

## 9. Practising skills and procedures on computers in science

### Why it matters

Practice makes perfect. In science, the use of computers can allow students to repeat and apply the scientific knowledge they have learnt in class to multiple problems and contexts. The use of computers is compelling for such "drilling" activities, which is part of the understanding process. And it also develops computer skills.

## Primary education

### Change at the OECD level: large

At the OECD level, much greater use of computers for practising skills and procedures in 4th grade science lessons was observed. Between 2007 and 2015, the proportion of students regularly involved in this activity has increased by 15 percentage points on average. 15 percentage points stands also for the overall absolute change in the use this practice during this period, corresponding to a large effect size of 0.44. This computer-based practice is not very widespread among OECD systems. Only in Turkey and Italy were more than 50% of 4th grade students frequently learning this way during their science lessons in 2015.

### Countries where there has been the most change

Change has taken the form of expansion in most of the education systems. This is particularly true for Italy (48 percentage points), the Netherlands (37 percentage points) and the Russian Federation (37 percentage points). Significant contraction happened observed in Portugal with a decline in this pedagogical practice by 28 percentage points (between 2011 and 215). A significant innovation in all these cases.

## Secondary education

### Change at the OECD level: large

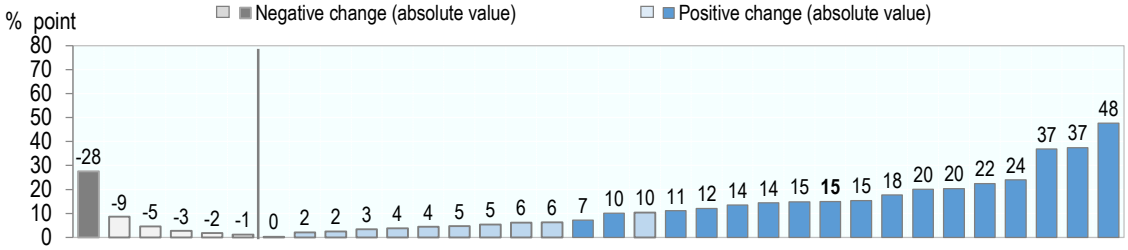
The share of students frequently using computers for practising skills and procedures in 8th grade science lessons through has increased by 17 percentage points on average between 2007 and 2015. The absolute change taking into account increases and decreases was the same, corresponding to a large effect size of 0.48. Like in primary education, the use of this learning practice remains low. Only in Turkey were more than 50% of the students using it in 2015.

### Countries where there has been the most change

Innovation has been large and corresponded to an expansion of this practice. Students in Quebec (Canada), Australia, Israel and the United States have experienced the most innovation in this domain, with expansions above 30 percentage points in each case.

### Figure 3.5. 4th grade science students practising skills and procedures on computers

Change in and share of students who frequently practise skills and procedures on computers during science lessons, 2007-2015, teachers report



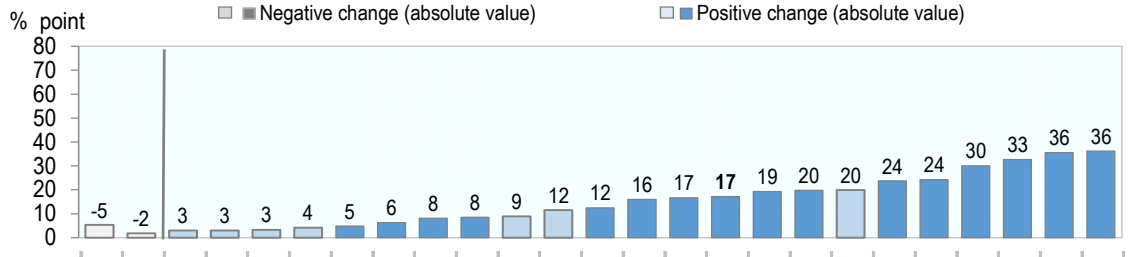

| | | Portugal* | Korea* | Ireland* | Chile* | Northern Ireland (UK)* | Spain* | Japan | Germany | England (UK) | Alberta (CAN)* | Belgium (Fl.)* | Slovenia | Finland* | Denmark | Hong Kong, China | Austria* | Sweden | Czech Republic | Quebec (CAN) | Ontario (CAN) | Singapore | New Zealand | Norway | Poland* | **OECD average** | Turkey* | Lithuania | Slovak Republic | Australia | United States | Hungary | Russian Federation | Netherlands | Italy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 24 | 27 | 5 | 24 | 13 | 30 | 1 | 5 | 13 | m | 18 | 11 | 15 | 17 | 20 | m | 10 | 16 | 18 | 23 | 34 | 19 | 15 | 28 | **22** | 88 | 25 | 32 | 28 | 32 | 32 | 46 | 38 | 58 |
| | 2011 | 51 | 36 | 9 | 27 | 15 | 31 | 2 | 7 | 9 | 13 | 14 | 7 | 11 | 9 | 28 | 10 | 9 | 23 | 18 | 8 | 34 | 14 | 9 | 14 | **14** | 73 | 32 | 24 | 18 | 23 | 17 | 41 | 9 | 32 |
| | 2007 | m | m | m | m | m | m | 0 | 3 | 10 | 10 | m | 7 | m | 12 | 14 | 4 | 3 | 5 | 8 | 12 | 22 | 6 | 1 | m | **7** | m | 7 | 11 | 8 | 10 | 8 | 9 | 0 | 10 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903840

### Figure 3.6. 8th grade science students practising skills and procedures on computers

Change in and share of students who frequently practise skills and procedures on computers during science lessons, 2007-2015, teachers report




| | | Chile* | South Africa* | Slovenia | Korea | Lithuania | Norway | Japan* | England (UK) | Singapore | Italy | Minnesota (USA)* | Indonesia* | New Zealand* | Ontario (CAN) | Sweden | **OECD average** | Hungary | Hong Kong, China | Massachusetts (USA)* | Turkey | Russian Federation | United States | Israel | Australia | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 16 | 28 | 7 | 19 | 15 | 9 | 5 | 10 | 14 | 16 | m | m | 22 | 23 | 18 | **26** | 25 | 30 | m | 58 | 34 | 44 | 48 | 43 | 41 |
| | 2011 | 21 | 30 | 6 | 30 | 20 | 7 | 4 | 6 | 9 | 9 | 13 | 27 | 10 | 10 | 9 | **16** | 21 | 21 | 31 | 50 | 25 | 19 | 29 | 21 | 9 |
| | 2007 | m | m | 5 | 16 | 12 | 5 | m | 3 | 6 | 8 | 4 | 16 | m | 7 | 1 | **9** | 6 | 10 | 11 | 34 | 9 | 14 | 15 | 8 | 5 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903859

## 10. Studying natural phenomena through computer simulations

### Why it matters

Computer simulations allow students to work on phenomena that they could not necessarily study in their classroom or school lab, for example because they are dangerous for their health (radioactivity) or not available in their immediate environment. They can also be a good substitute for expensive observation material. Remote and virtual labs and relevant pedagogical resources are not widely available.

## Primary education

### Change at the OECD level: moderate

This practice expanded in most OECD systems. The share of students regularly using computer simulations increased by 8 percentage points on average between 2007 and 2015. The absolute change amounted to almost 9 percentage points, including positive and negative variations, corresponding to a moderate effect size of 0.32. Using computer simulations at the primary level remains uncommon. This activity is especially rare in Germany and Ireland where less than 4% students carried out simulations on a regular basis in 2015. In contrast, it is quite common in Turkey (52% of students do it weekly).

### Countries where there has been the most change

The use of computer simulations to study natural phenomena has increased simultaneously in several countries. Italy stands out with a large increase of 30 percentage points. Increase has also been notable in the United States (over 15 percentage points). By contrast, Ireland and Chile saw a decreased use of this science education practice (8 percentage point contraction between 2011 and 2015).

## Secondary education

### Change at the OECD level: large

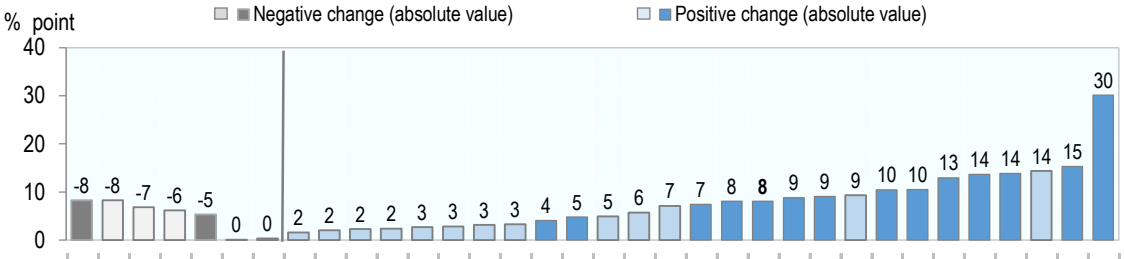
With the exception of Korea, all OECD systems made greater use of computer simulations to study natural phenomena in science lessons. The share of students frequently participating in this pedagogical activity rose by 12 percentage points on average between 2007 and 2015. Positive and negative variations resulted in a mean absolute change of 13 percentage points, that is, a large effect size of 0.43. The share of students regularly participating in these simulations remained low within OECD countries in 2015, but with relatively large differences between them, ranging from 7% of students in Norway to 48% in Turkey.

### Countries where there has been the most change

Secondary schools innovated mainly by adopting this teaching practice. Notably Israel, Indonesia and the United States experienced expansions above 25 percentage points (the change being between 2007 and 2011 for Indonesia). Korea experienced the only observed contraction of the practice, which contracted by 9 percentage points.

**Figure 3.7. 4th grade science students studying natural phenomena by computer simulations**

Change in and share of students who frequently study natural phenomena through computer simulations during science lessons, 2007-2015, teachers report



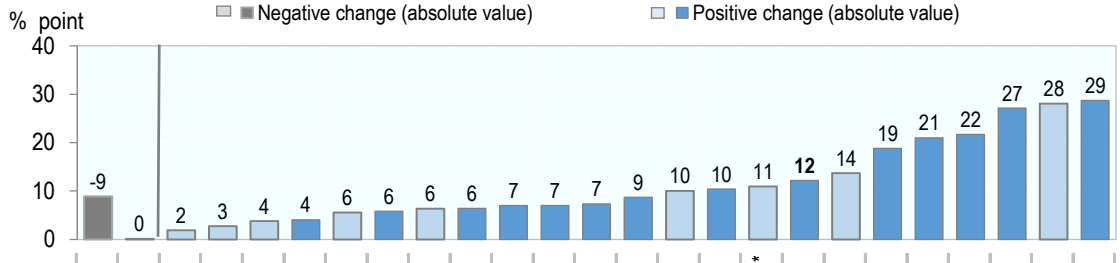

| | | Ireland* | Chile* | Korea* | Spain* | Japan | Austria* | Portugal* | Northern Ireland (UK)* | Turkey* | England (UK) | Germany | Hong Kong, China | Norway | Finland* | Belgium (Fl.)* | Netherlands | Denmark | Slovenia | Russian Federation | Quebec (CAN) | Lithuania* | Sweden | **OECD average** | Hungary | Czech Republic | Ontario (CAN) | Australia | New Zealand | Slovak Republic | Poland* | Singapore | Alberta (CAN)* | United States | Italy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 4 | 12 | 35 | 10 | 4 | m | 25 | 15 | 52 | 15 | 4 | 13 | 6 | 6 | 5 | 4 | 8 | 7 | 17 | 14 | 7 | 9 | **13** | 10 | 10 | 23 | 15 | 17 | 15 | 21 | 23 | m | 21 | 43 |
| | 2011 | 12 | 21 | 42 | 16 | 1 | 2 | 25 | 13 | 50 | 9 | 1 | 21 | 6 | 3 | 2 | 2 | 6 | 6 | 16 | 7 | 6 | 2 | **8** | 3 | 3 | 7 | 19 | 16 | 6 | 8 | 21 | 19 | 16 | 27 |
| | 2007 | m | m | m | m | 10 | 2 | m | m | m | 12 | 2 | 10 | 3 | m | m | 0 | 3 | 3 | 11 | 7 | m | 1 | **5** | 1 | 1 | 14 | 4 | 7 | 2 | m | 9 | 5 | 6 | 13 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903878

**Figure 3.8. 8th grade science students studying natural phenomena by computer simulations**

Change in and share of students who frequently study natural phenomena through computer simulations during science lessons, 2007-2015, teachers report




| | | Korea | Minnesota (USA)* | South Africa* | Chile* | New Zealand* | Lithuania | Japan | England (UK) | Ontario (CAN) | Norway | Sweden | Italy | Singapore | Russian Federation | Hong Kong, China | Slovenia | Massachusetts (USA)* | **OECD average** | Turkey | Hungary | Australia | Quebec (CAN) | United States | Indonesia* | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 19 | m | 21 | 21 | 16 | 8 | 9 | 11 | 12 | 7 | 7 | 13 | 12 | 14 | 24 | 13 | m | **20** | 48 | 22 | 24 | 26 | 34 | m | 35 |
| | 2011 | 27 | 5 | 19 | 18 | 13 | 6 | 4 | 11 | 11 | 5 | 4 | 7 | 7 | 9 | 13 | 5 | 18 | **15** | 60 | 16 | 14 | 7 | 18 | 32 | 16 |
| | 2007 | 28 | 5 | m | m | m | 4 | 3 | 5 | 6 | 0 | 0 | 6 | 5 | 5 | 14 | 3 | 7 | **8** | 34 | 3 | 3 | 4 | 7 | 4 | 6 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903897

## 11. Watching teachers demonstrate experiments

### Why it matters

Watching teachers demonstrate an experiment or investigation should happen in a good science classroom. Imitation is an important way to learn, that should precede or balance (rather than substitute for) students trying by themselves to carry out an even design experiments – a more active way of learning.

## Primary education

### Change at the OECD level: large

The share of primary students watching their teachers demonstrating a experiment in at least half of their science lessons increased by 21 percentage points on average between 2007 and 2015. This increase represents a significant innovation, amounting to a large effect size of 0.54. The extent to which students are systematically exposed to this practice ranged from 7% in Belgium (Fl.) to 78% in Turkey in 2015.

### Countries where there has been the most change

The direction of change is rather consistent with almost all education systems registering greater use of this teaching practice. Quebec (Canada) stands out with a large increase of about 38 percentage points, followed closely by Hungary and England recording around 35 percentage point increases. Poland also registered an increase of similar magnitude between 2011 and 2015 (instead of 2007-2015).

## Secondary education

### Change at the OECD level: moderate

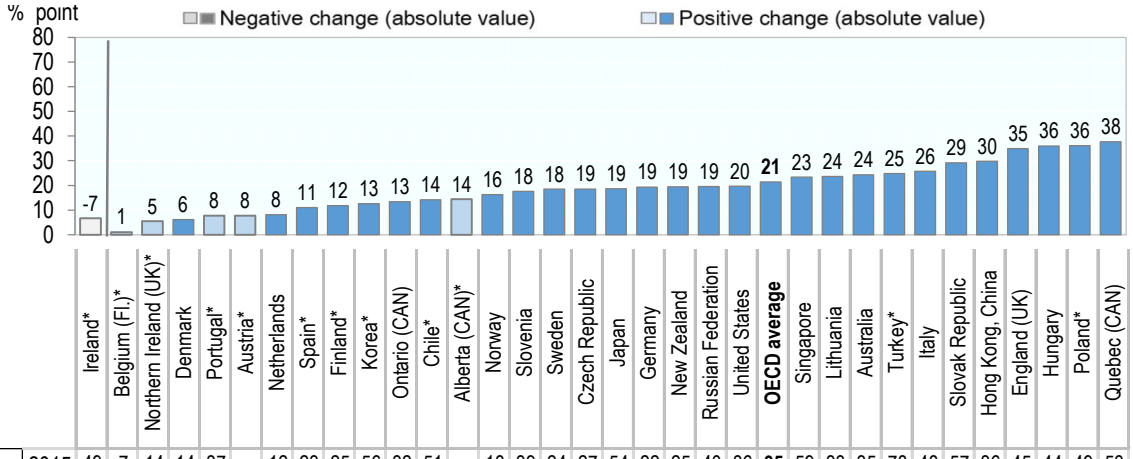
This teaching practice is increasingly being used in secondary schools within OECD countries or systems. The average share of students regularly exposed to it has risen by 15 percentage points between 2007 and 2015. The magnitude of the change, including expansions and contractions, amounted to 16 percentage points and corresponded to a moderate effect size of 0.34. This teaching method is evenly used across countries, with medium and relatively large shares of students exposed to it.

### Countries where there has been the most change

Innovation mainly took the form of a spread of this teaching practice, particularly in Hong Kong, China, Israel, Singapore and Australia where it gained ground by over 25 percentage points. Contractions never exceeded 10 percentage points, showing more stability in that direction.

**Figure 3.9. 4th grade science students watching their teachers demonstrate an experiment**

Change in and share of students who watch their teachers demonstrate an experiment or investigation in at least half the lessons, 2007-2015, teachers report



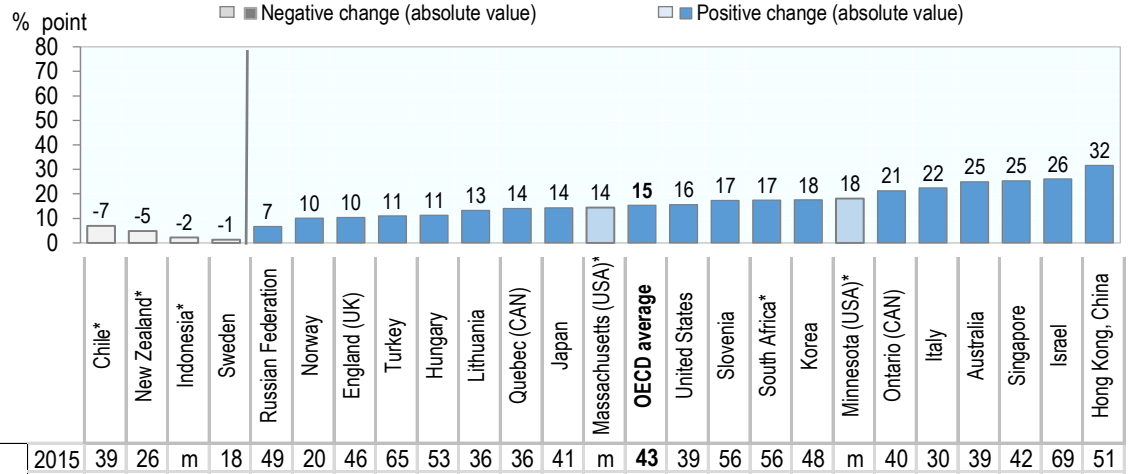

| % of students | Ireland* | Belgium (Fl.)* | Northern Ireland (UK)* | Denmark | Portugal* | Austria* | Netherlands | Spain* | Finland* | Korea* | Ontario (CAN) | Chile* | Alberta (CAN)* | Norway | Slovenia | Sweden | Czech Republic | Japan | Germany | New Zealand | Russian Federation | United States | **OECD average** | Singapore | Lithuania | Australia | Turkey* | Italy | Slovak Republic | Hong Kong, China | England (UK) | Hungary | Poland* | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 49 | 7 | 14 | 14 | 37 | m | 12 | 23 | 25 | 56 | 32 | 51 | m | 18 | 39 | 24 | 27 | 54 | 22 | 25 | 40 | 36 | **35** | 59 | 33 | 35 | 78 | 48 | 57 | 36 | 45 | 44 | 49 | 53 |
| 2011 | 56 | 6 | 9 | 15 | 30 | 10 | 10 | 12 | 13 | 43 | 34 | 37 | 33 | 7 | 33 | 21 | 14 | 51 | 13 | 20 | 27 | 37 | **27** | 56 | 23 | 33 | 53 | 36 | 31 | 17 | 26 | 28 | 13 | 45 |
| 2007 | m | m | m | 8 | m | 3 | 4 | m | m | m | 19 | m | 18 | 2 | 21 | 6 | 9 | 36 | 3 | 5 | 20 | 16 | **13** | 36 | 9 | 10 | m | 23 | 28 | 6 | 10 | 8 | m | 16 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903935

**Figure 3.10. 8th grade science students watching their teachers demonstrate an experiment**

Change in and share of students who watch their teachers demonstrate an experiment or investigation in at least half the lessons, 2007-2015, teachers report




| % of students | Chile* | New Zealand* | Indonesia* | Sweden | Russian Federation | Norway | England (UK) | Turkey | Hungary | Lithuania | Quebec (CAN) | Japan | Massachusetts (USA)* | **OECD average** | United States | Slovenia | South Africa* | Korea | Minnesota (USA)* | Ontario (CAN) | Italy | Australia | Singapore | Israel | Hong Kong, China |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 39 | 26 | m | 18 | 49 | 20 | 46 | 65 | 53 | 36 | 36 | 41 | m | **43** | 39 | 56 | 56 | 48 | m | 40 | 30 | 39 | 42 | 69 | 51 |
| 2011 | 46 | 31 | 44 | 34 | 57 | 16 | 52 | 64 | 50 | 30 | 40 | 47 | 33 | **41** | 43 | 43 | 39 | 42 | 32 | 27 | 19 | 34 | 36 | 61 | 49 |
| 2007 | m | m | 46 | 19 | 42 | 10 | 36 | 54 | 42 | 23 | 22 | 27 | 19 | **28** | 23 | 39 | m | 30 | 14 | 18 | 8 | 14 | 16 | 43 | 19 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903954

## 12. Students conducting experiments and investigations

### Why it matters

Conducting experiments and investigations gives students an entry point into the work life of scientists, and a better understanding of its empirical dimension. Depending on whether the conducted experiments and investigations have been designed by the students themselves, or are just an application of learnt science concepts, they can have more or less value to students' learning. But conducting experiments and investigations in science is a valuable learning strategy.

## Primary education

### Change at the OECD level: moderate

With the exception of Chile, all OECD systems registered an increase in the share of students conducting experiments and investigations in at least half of their science lessons, from an average of 33% in 2007 to 46% in 2015. The average absolute change was of a similar magnitude, i.e. 13 percentage points, corresponding to a modest effect size of 0.3. Large cross-country disparities in the use of this pedagogical technique are observed, from only 11% of 4th grade students being regularly exposed to this pedagogy in the Netherlands in 2015, to 96% in Japan.

### Countries where there has been the most change

Innovation took the form of the spread of this science learning method. Australia and Singapore saw increases of 31 and 28 percentage points respectively, closely followed by Poland and Norway (24 percentage points). No covered country registered a significant contraction of the practice between 2007 and 2015.

## Secondary education

### Change at the OECD level: moderate-low

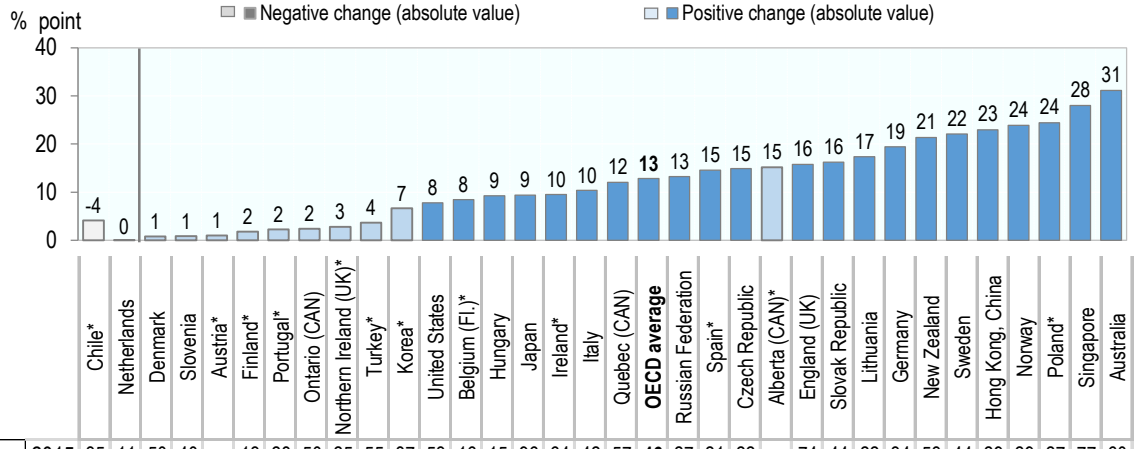
Expansions have outweighed contractions of the practice in the OECD area, leading on average to a 5 percentage point increase in the share of students participating in these activities in half of their science classes or more. When increases and decreases are accounted for, innovation in this learning practice amounted to 11 percentage points between 2007 and 2015, corresponding to a moderate-low effect size of 0.24. Concerning about 45% of students on average in 2015, disparities marked OECD countries: from 17% of students in Lithuania through to almost 72% in Japan conducted experiments.

### Countries where there has been the most change

Although the majority of countries saw an increase in this practice between 2007 and 2015, the direction of innovation was not fully consistent. Sweden and Quebec (Canada) saw considerable declines in the use of this pedagogy, of above 15 percentage points between 2007 and 2015. On the contrary, South Africa registered a large increase of 27 percentage points between 2011 and 2015, followed by Italy and Ontario (Canada) with respective increases of 19 and 18 percentage points during the 2007-2015 period.

**Figure 3.11. 4th grade students conducting experiments and investigations in science**

Change in and share of students whose teachers ask them to conduct experiments or investigations in at least half the lessons, 2007-2015, teachers report



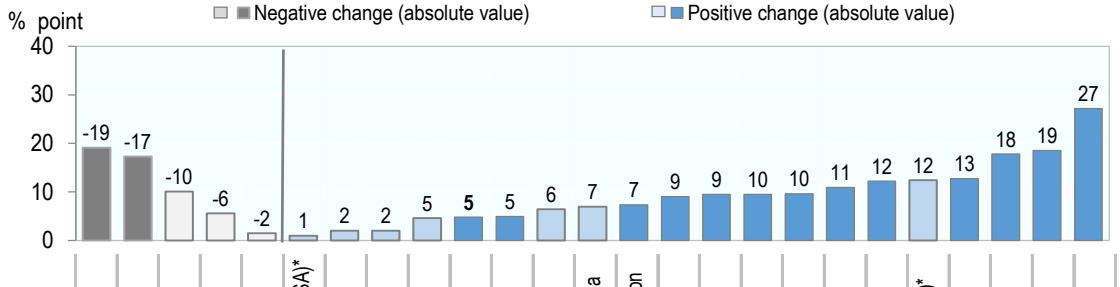

| | | Chile* | Netherlands | Denmark | Slovenia | Austria* | Finland* | Portugal* | Ontario (CAN) | Northern Ireland (UK)* | Turkey* | Korea* | United States | Belgium (Fl.)* | Hungary | Japan | Ireland* | Italy | Quebec (CAN) | **OECD average** | Russian Federation | Spain* | Czech Republic | Alberta (CAN)* | England (UK) | Slovak Republic | Lithuania | Germany | New Zealand | Sweden | Hong Kong, China | Norway | Poland* | Singapore | Australia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 35 | 11 | 50 | 40 | m | 13 | 28 | 50 | 25 | 55 | 87 | 53 | 16 | 15 | 96 | 64 | 42 | 57 | **46** | 27 | 21 | 22 | m | 74 | 44 | 22 | 34 | 53 | 44 | 29 | 29 | 27 | 77 | 60 |
| | 2011 | 39 | 7 | 53 | 36 | 7 | 11 | 26 | 46 | 23 | 51 | 80 | 48 | 7 | 9 | 91 | 55 | 44 | 57 | **39** | 16 | 7 | 18 | 68 | 69 | 23 | 16 | 23 | 39 | 44 | 20 | 6 | 2 | 71 | 51 |
| | 2007 | m | 11 | 50 | 39 | 6 | m | m | 48 | m | m | m | 45 | m | 6 | 86 | m | 31 | 45 | **33** | 13 | m | 7 | 53 | 58 | 28 | 4 | 15 | 31 | 22 | 6 | 5 | m | 49 | 29 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903973

**Figure 3.12. 8th grade students conducting experiments and investigations in science**

Change in and share of students whose teachers ask them to conduct experiments or investigations in at least half the lessons, 2007-2015, teachers report




| | | Sweden | Quebec (CAN) | Indonesia* | Korea | Chile* | Massachusetts (USA)* | Singapore | Turkey | Australia | **OECD average** | Hungary | Japan | Hong Kong, China | Russian Federation | New Zealand* | England (UK) | United States | Lithuania | Slovenia | Norway | Minnesota (USA)* | Israel | Ontario (CAN) | Italy | South Africa* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 37 | 38 | m | 31 | 36 | m | 37 | 52 | 70 | **45** | 17 | 72 | 78 | 25 | 70 | 67 | 57 | 17 | 24 | 40 | m | 40 | 56 | 27 | 54 |
| | 2011 | 58 | 50 | 20 | 32 | 38 | 48 | 38 | 38 | 68 | **43** | 11 | 74 | 73 | 23 | 61 | 71 | 60 | 15 | 17 | 30 | 64 | 35 | 43 | 16 | 27 |
| | 2007 | 57 | 56 | 30 | 36 | m | 47 | 35 | 50 | 66 | **40** | 12 | 66 | 71 | 17 | m | 58 | 48 | 7 | 13 | 28 | 52 | 27 | 38 | 9 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933903992

## 13. Students doing practical experiments in laboratories

### Why it matters

Science lessons sometimes take place in laboratories equipped for practical experiments. Doing practical experiments in laboratories is a critical activity of scientific reasoning and practice, which should ideally be balanced with experiments in real-life settings. Computers now also allow students and teachers to use remote or virtual labs, another way to expand the topics addressed by this widespread teaching practice.

### Change at the OECD level: small

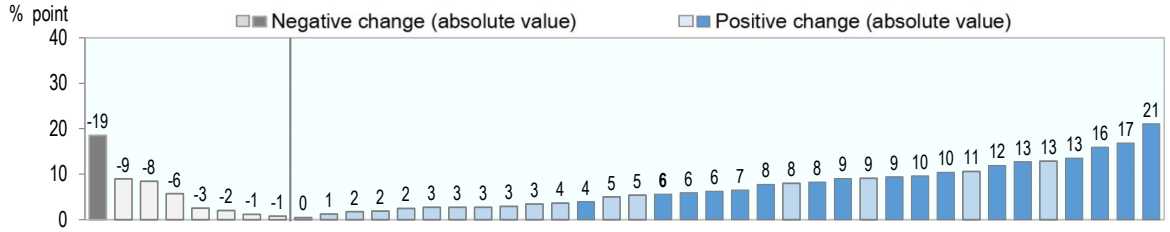
Doing practical experiments in laboratories became a more widespread practice in most OECD systems, with a 6-percentage point expansion on average between 2006 and 2015. Innovation has been modest in this area, with positive and negative changes amounting to 7 percentage points in the change of students' exposure to this activity, representing a small effect size of 0.14. Doing practical experiments in all or most of the lessons is relatively common among the OECD countries covered: on average, 69% of students do it, with levels ranging from 44% in Korea to almost 84% in Portugal in 2015.

### Countries where there has been the most change

In most countries these practical laboratory experiments expanded. Korea stands out with an increase of 21 percentage points, followed by the Slovak Republic (17 percentage points) and Hong Kong, China (16 percentage points). On the contrary, Israel and to a less extend Indonesia and Colombia registered declines of 19, 9 and 8 percentage points respectively.

**Figure 3.13. 15 year old science students doing practical experiments in laboratories**

Change in and share of students doing practical experiments in the laboratory in all or most of the their lessons, 2006-2015, students report




| | | Israel | Colombia | Indonesia | Brazil | Belgium | Mexico | Italy | Chile | United States | Turkey | Slovenia | United Kingdom | Estonia | Australia | Spain | Latvia | New Zealand | Czech Republic | Russian Federation | Canada | Hungary | Netherlands | **OECD average** | Norway | Switzerland | Lithuania | Finland | France | Austria | Sweden | Poland | Greece | Portugal | Iceland | Germany | Ireland | Denmark | Japan | Luxembourg | Hong Kong, China | Slovak Republic | Korea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 60 | 70 | 60 | 44 | 65 | 76 | 75 | 71 | 74 | 75 | 72 | 74 | 70 | 74 | 71 | 68 | 74 | 73 | 68 | 77 | 62 | 53 | **69** | 67 | 72 | 73 | 72 | 74 | 62 | 72 | 59 | 69 | 84 | 72 | 70 | 63 | 67 | 47 | 73 | 57 | 68 | 44 |
| | 2006 | 79 | 79 | 68 | 50 | 68 | 78 | 76 | 71 | 74 | 74 | 71 | 72 | 68 | 71 | 69 | 65 | 71 | 70 | 65 | 73 | 57 | 48 | **63** | 61 | 65 | 67 | 64 | 66 | 54 | 63 | 50 | 59 | 74 | 62 | 59 | 51 | 54 | 34 | 59 | 42 | 51 | 23 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933904011

**Table 3.1. Effect sizes for changes in practices to develop technical skills in science**

| | Memorising rules, procedures and facts as a pedagogical technique | | Watching teachers demonstrate an experiment | | Students conducting scientific experiments and investigations | | Using scientific formulas & laws to solve routine problems | Students doing practical experiments in laboratories |
|---|---|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 8th Grade | 8th grade |
| Australia | 0.07 | 0.41 | 0.60 | 0.58 | 0.64 | 0.10 | 0.33 | 0.06 |
| Austria | 0.10 | m | 0.32 | m | 0.04 | m | m | 0.17 |
| Belgium | m | m | m | m | m | m | m | -0.05 |
| Belgium (Fl.) | -0.10 | m | 0.04 | m | 0.27 | m | m | m |
| Canada | m | m | m | m | m | m | m | 0.09 |
| Canada (Alberta) | -0.03 | m | 0.34 | m | 0.31 | m | m | m |
| Canada (Ontario) | 0.09 | 0.18 | 0.31 | 0.48 | 0.05 | 0.36 | 0.33 | m |
| Canada (Quebec) | 0.44 | 0.64 | 0.83 | 0.31 | 0.24 | -0.35 | 0.44 | m |
| Chile | -0.10 | -0.06 | 0.29 | -0.14 | -0.09 | -0.03 | 0.02 | -0.02 |
| Czech Republic | 0.38 | m | 0.50 | m | 0.43 | m | m | 0.08 |
| Denmark | 0.15 | m | 0.19 | m | 0.02 | m | m | 0.26 |
| Estonia | m | m | m | m | m | m | m | 0.05 |
| Finland | 0.00 | m | 0.30 | m | 0.06 | m | m | 0.17 |
| France | m | m | m | m | m | m | m | 0.17 |
| Germany | -0.13 | m | 0.64 | m | 0.46 | m | m | 0.22 |
| Greece | m | m | m | m | m | m | m | 0.20 |
| Hungary | 0.14 | 0.10 | 0.87 | 0.23 | 0.31 | 0.14 | 0.11 | 0.10 |
| Iceland | m | m | m | m | m | m | m | 0.22 |
| Ireland | 0.14 | m | -0.13 | m | 0.19 | m | m | 0.24 |
| Israel | m | 0.00 | m | 0.53 | m | 0.27 | 0.14 | -0.41 |
| Italy | 0.15 | 0.91 | 0.55 | 0.59 | 0.22 | 0.50 | 0.31 | -0.03 |
| Japan | 0.28 | 0.28 | 0.38 | 0.30 | 0.34 | 0.14 | 0.30 | 0.26 |
| Korea | -0.16 | 0.40 | 0.25 | 0.36 | 0.18 | -0.12 | 0.51 | 0.45 |
| Latvia | m | m | m | m | m | m | m | 0.06 |
| Lithuania | 0.61 | 0.16 | 0.60 | 0.29 | 0.55 | 0.30 | 0.43 | 0.14 |
| Luxembourg | m | m | m | m | m | m | m | 0.29 |
| Mexico | m | m | m | m | m | m | m | -0.05 |
| Netherlands | 0.16 | m | 0.31 | m | 0.00 | m | m | 0.11 |
| New Zealand | 0.13 | -0.20 | 0.57 | -0.11 | 0.44 | 0.19 | -0.09 | 0.06 |
| Norway | 0.56 | 0.52 | 0.61 | 0.29 | 0.68 | 0.26 | 0.52 | 0.12 |
| Poland | -0.28 | m | 0.82 | m | 0.78 | m | m | 0.18 |
| Portugal | 0.07 | m | 0.16 | m | 0.05 | m | m | 0.24 |
| Slovak Republic | 0.38 | m | 0.60 | m | 0.34 | m | m | 0.34 |

| | Memorising rules, procedures and facts as a pedagogical technique | | Watching teachers demonstrate an experiment | | Students conducting scientific experiments and investigations | | Using scientific formulas & laws to solve routine problems | Students doing practical experiments in laboratories |
|---|---|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 8th Grade | 8th Grade |
| Slovenia | 0.51 | 0.25 | 0.39 | 0.35 | 0.02 | 0.28 | -0.04 | 0.04 |
| Spain | -0.08 | m | 0.29 | m | 0.43 | m | m | 0.06 |
| Sweden | 0.31 | 0.38 | 0.54 | -0.03 | 0.47 | -0.39 | 0.44 | 0.19 |
| Switzerland | m | m | m | m | m | m | m | 0.13 |
| Turkey | -0.66 | 0.36 | 0.53 | 0.22 | 0.07 | 0.04 | 0.05 | 0.03 |
| United Kingdom | m | m | m | m | m | m | m | 0.04 |
| UK (England) | 0.27 | 0.22 | 0.82 | 0.21 | 0.33 | 0.20 | 0.59 | m |
| UK (Northern Ireland) | -0.03 | m | 0.17 | m | 0.07 | m | m | m |
| United States | -0.21 | 0.16 | 0.46 | 0.34 | 0.16 | 0.19 | 0.26 | 0.01 |
| US (Massachusetts) | m | 0.12 | m | 0.33 | m | 0.02 | 0.30 | m |
| US (Minnesota) | m | 0.29 | m | 0.44 | m | 0.25 | 0.42 | m |
| **OECD (average)** | **0.19** | **0.31** | **0.51** | **0.32** | **0.26** | **0.10** | **0.27** | **0.12** |
| **OECD (av. absolute)** | **0.26** | **0.34** | **0.54** | **0.34** | **0.30** | **0.24** | **0.31** | **0.15** |
| Brazil | m | m | m | m | m | m | m | -0.11 |
| Colombia | m | m | m | m | m | m | m | -0.21 |
| Hong Kong, China | 0.16 | 0.53 | 0.79 | 0.68 | 0.64 | 0.16 | 0.68 | 0.32 |
| Indonesia | m | 0.45 | m | -0.04 | m | -0.23 | -0.08 | -0.18 |
| Russian Federation | 0.02 | 0.39 | 0.43 | 0.13 | 0.33 | 0.18 | 0.18 | 0.08 |
| Singapore | 0.01 | 0.64 | 0.47 | 0.57 | 0.59 | 0.04 | 0.61 | m |
| South Africa | m | 0.12 | m | 0.35 | m | 0.56 | 0.14 | m |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PISA (2006, 2009 and 2015).

StatLink https://doi.org/10.1787/888933904030

**Table 3.2. Effect sizes for changes in ICT-based practices to develop technical skills in science**

| | Practising skills and procedures on computers | | Study natural phenomena through simulations on computers | | Processing and analysing data on computers |
|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 8th Grade |
| Australia | 0.55 | 0.87 | 0.37 | 0.68 | 0.76 |
| Austria | 0.25 | m | 0.00 | m | m |
| Belgium | m | m | m | m | m |
| Belgium (Fl.) | 0.10 | m | 0.18 | m | m |
| Canada | m | m | m | m | m |
| Canada (Alberta) | 0.10 | m | 0.46 | m | m |
| Canada (Ontario) | 0.30 | 0.46 | 0.24 | 0.23 | 0.40 |
| Canada (Quebec) | 0.31 | 0.94 | 0.23 | 0.66 | 0.37 |
| Chile | -0.06 | -0.14 | -0.22 | 0.07 | -0.16 |
| Czech Republic | 0.34 | m | 0.43 | m | m |
| Denmark | 0.15 | m | 0.21 | m | m |
| Estonia | m | m | m | m | m |
| Finland | 0.14 | m | 0.16 | m | m |
| France | m | m | m | m | m |
| Germany | 0.10 | m | 0.15 | m | m |
| Greece | m | m | m | m | m |
| Hungary | 0.63 | 0.56 | 0.43 | 0.62 | 0.37 |
| Iceland | m | m | m | m | m |
| Ireland | -0.18 | m | -0.32 | m | m |
| Israel | m | 0.73 | m | 0.77 | 0.66 |
| Italy | 1.08 | 0.26 | 0.70 | 0.24 | 0.15 |
| Japan | 0.04 | 0.44 | -0.21 | 0.24 | 0.24 |
| Korea | -0.19 | 0.08 | -0.14 | -0.21 | 0.03 |
| Latvia | m | m | m | m | m |
| Lithuania | 0.51 | 0.10 | 0.55 | 0.17 | -0.16 |
| Mexico | m | m | m | m | m |
| Netherlands | 1.20 | m | 0.30 | m | m |
| New Zealand | 0.42 | 0.35 | 0.33 | 0.11 | 0.25 |
| Norway | 0.60 | 0.17 | 0.14 | 0.40 | 0.09 |
| Poland | 0.37 | m | 0.40 | m | m |
| Portugal | -0.58 | m | 0.01 | m | m |
| Slovak Republic | 0.50 | m | 0.49 | m | m |
| Slovenia | 0.15 | 0.13 | 0.23 | 0.41 | 0.19 |

| | Practising skills and procedures on computers | | Study natural phenomena through simulations on computers | | Processing and analysing data on computers |
|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 8th Grade |
| Spain | -0.03 | m | -0.19 | m | m |
| Sweden | 0.31 | 0.65 | 0.41 | 0.44 | 0.46 |
| Switzerland | m | m | m | m | m |
| Turkey | 0.39 | 0.48 | 0.04 | 0.28 | 0.14 |
| United Kingdom | m | m | m | m | m |
| UK (England) | 0.08 | 0.27 | 0.07 | 0.21 | 0.33 |
| UK (Northern Ireland) | -0.05 | m | 0.04 | m | m |
| United States | 0.57 | 0.69 | 0.47 | 0.71 | 0.63 |
| US (Massachusetts) | m | 0.50 | m | 0.34 | 0.60 |
| US (Minnesota) | m | 0.34 | m | 0.00 | 0.19 |
| **OECD (average)** | **0.44** | **0.46** | **0.29** | **0.36** | **0.33** |
| **OECD (av. absolute)** | **0.44** | **0.48** | **0.32** | **0.43** | **0.34** |
| Hong Kong, China | 0.16 | 0.51 | 0.08 | 0.26 | 0.10 |
| Indonesia | m | 0.28 | m | 0.80 | 0.54 |
| Russian Federation | 0.88 | 0.62 | 0.17 | 0.31 | 0.49 |
| Singapore | 0.27 | 0.27 | 0.38 | 0.27 | 0.24 |
| South Africa | m | -0.04 | m | 0.05 | 0.01 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PISA (2006, 2009 and 2015).

StatLink https://doi.org/10.1787/888933904049

# Chapter 4.
# Innovation in practices to develop reading and language art skills

*This chapter presents the change in teaching and learning practices in reading and text understanding. Practices covered go from strategies to decode words and sound or the systematic learning of vocabulary to writing, text understanding or text summarising. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 14. Teaching strategies for decoding sounds and words

### Why it matters

Decoding letter-word-sound relationships is a key dimension of learning to read. Understanding these relationships helps children to recognise familiar words quickly and to figure out words they have not seen before. While some children have an intuitive grasp of those relationships, phonics, air writing, associating images to letters and sounds are some of the explicit teaching strategies for decoding sounds and words.

### Change at the OECD level: small

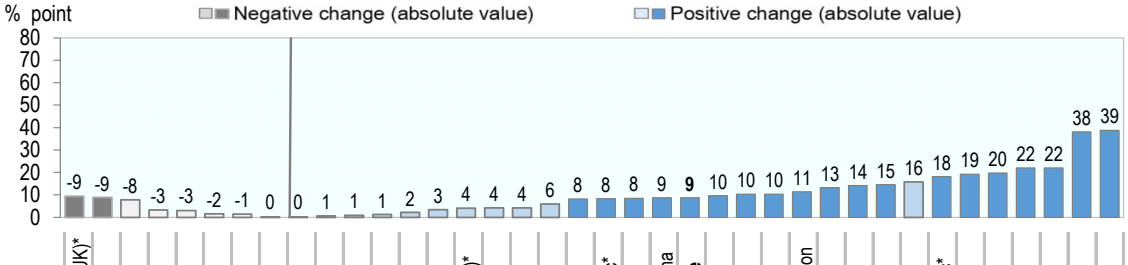
On average, the share of students frequently taught with these strategies increased by 9 percentage points between 2006 and 2016. Taking both directions of change into account, the average absolute change between 2006 and 2016 amounted to 10 percentage points, corresponding to a small effect size of 0.22. The share of 4th grade students exposed to this exercise on a regular basis varies a lot across OECD countries, going from 31% in Finland to 95% in Hungary in 2016.

### Countries where there has been the most change

In most countries this practice has spread. Among the few contractions, Northern Ireland (United Kingdom) and Canada stand out, with decreases by 9 percentage points, although the prevalence of the practice remains above average. On the other hand, the spread of this practice has been a big innovation in the Netherlands (+39 percentage points) and Lithuania (+38).

**Figure 4.1. 4th grade students in reading being taught strategies to decode sounds and words**

Change in and share of students whose teachers teach them strategies for decoding sounds at least once a week, 2006-2016, teachers report




| % of students | Northern Ireland (UK)* | Canada* | Hungary | Norway | Ontario (CAN) | Poland | Australia* | United States | England (UK) | Israel | Ireland* | South Africa* | New Zealand | Singapore | Andalusia (ESP)* | Denmark | Indonesia* | Finland* | Portugal* | Slovak Republic* | Slovenia | Hong Kong, China | **OECD average** | Sweden | France | Italy | Russian Federation | Austria | Latvia | Belgium Fl. | Alberta (CAN)* | Czech Republic* | Belgium Fr. | Germany | Spain | Quebec (CAN) | Lithuania | Netherlands |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 85 | 65 | 55 | 40 | 66 | 82 | 91 | 79 | 73 | 68 | 85 | m | 84 | 60 | 56 | 40 | m | 31 | 90 | 61 | 34 | 95 | **57** | 25 | 32 | 80 | 84 | 51 | 59 | 34 | m | 43 | 40 | 49 | 61 | 54 | 89 | 74 |
| 2011 | 94 | 74 | 61 | 57 | 73 | 86 | 92 | 82 | 77 | 72 | 84 | 58 | 86 | 57 | 52 | 39 | 79 | 25 | 82 | 52 | 36 | 91 | **59** | 28 | 26 | 76 | 83 | 44 | m | m | 83 | 25 | 26 | 48 | 58 | 67 | 84 | 73 |
| 2006 | m | m | 63 | 43 | 69 | 84 | m | 79 | 73 | 68 | m | 57 | 82 | 57 | m | 35 | 75 | m | m | m | 25 | 86 | **49** | 15 | 21 | 70 | 72 | 37 | 45 | 19 | 68 | m | 21 | 30 | 39 | 32 | 51 | 35 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904068

## 15. Teaching new vocabulary systematically

### Why it matters

When they enter school, the gap in vocabulary between children from a lower and higher socio-economic background is huge: for many children, school must be the place where they expand their vocabulary. This is also essential to reading, not just for better understanding, but also to have the ability to quickly decipher and recognise words.

### Change at the OECD level: small

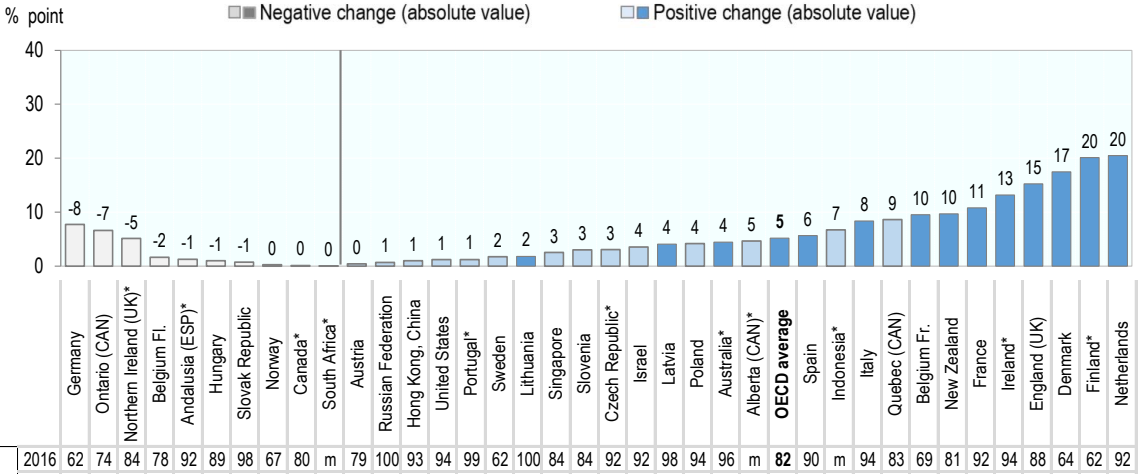
Positive and negative changes in the systematic teaching of new vocabulary were small or modest for most OECD systems. On average, the share of 4th grade students exposed to the practice every week increased by 5 percentage points between 2006 and 2016. The overall innovation in this domain represented an absolute change of 7 percentage points in the use of this practice, corresponding to a small effect size of 0.17. This is already a widespread practice in most OECD education systems, concerning 82% pupils on average. In 2016, virtually all students learnt new vocabulary systematically on a regular basis in Lithuania, Portugal and the Slovak Republic.

### Countries where there has been the most change

There were only few small contractions, all below 10 percentage points. The spread of the practice was also generally small or modest. The increases by 20 percentage points in the Netherlands and Finland stand out, the change being measured between 2011 and 2016 only for Finland.

**Figure 4.2. 4th grade students in reading being taught new vocabulary systematically**

Change in and share of students whose teachers teach them new vocabulary systematically at least once a week, 2006-2016, teachers report




| | | Germany | Ontario (CAN) | Northern Ireland (UK)* | Belgium Fl. | Andalusia (ESP)* | Hungary | Slovak Republic | Norway | Canada* | South Africa* | Austria | Russian Federation | Hong Kong, China | United States | Portugal* | Sweden | Lithuania | Singapore | Slovenia | Czech Republic* | Israel | Latvia | Poland | Australia* | Alberta (CAN)* | **OECD average** | Spain | Indonesia* | Italy | Quebec (CAN) | Belgium Fr. | New Zealand | France | Ireland* | England (UK) | Denmark | Finland* | Netherlands |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 62 | 74 | 84 | 78 | 92 | 89 | 98 | 67 | 80 | m | 79 | 100 | 93 | 94 | 99 | 62 | 100 | 84 | 84 | 92 | 92 | 98 | 94 | 96 | m | **82** | 90 | m | 94 | 83 | 69 | 81 | 92 | 94 | 88 | 64 | 62 | 92 |
| | 2011 | 72 | 73 | 89 | m | 94 | 82 | 97 | 63 | 80 | 83 | 77 | 100 | 94 | 95 | 98 | 65 | 99 | 80 | 82 | 89 | 96 | m | 95 | 92 | 88 | **81** | 91 | 76 | 89 | 83 | 53 | 89 | 91 | 81 | 84 | 53 | 41 | 87 |
| | 2006 | 70 | 80 | m | 79 | m | 90 | 99 | 67 | m | 83 | 79 | 99 | 92 | 93 | m | 61 | 98 | 81 | 81 | m | 88 | 94 | 90 | m | 83 | **77** | 85 | 69 | 86 | 75 | 59 | 71 | 81 | m | 73 | 46 | m | 71 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904087

## 16. Students explaining their understanding of a text

### Why it matters

Reading without understanding what one reads is not really reading. It is good teaching practice to check rather than assume that students actually understand what they read. Asking students to explain their understanding of a text is one straightforward practice among other possible ones to make students' learning visible.

### Change at the OECD level: small

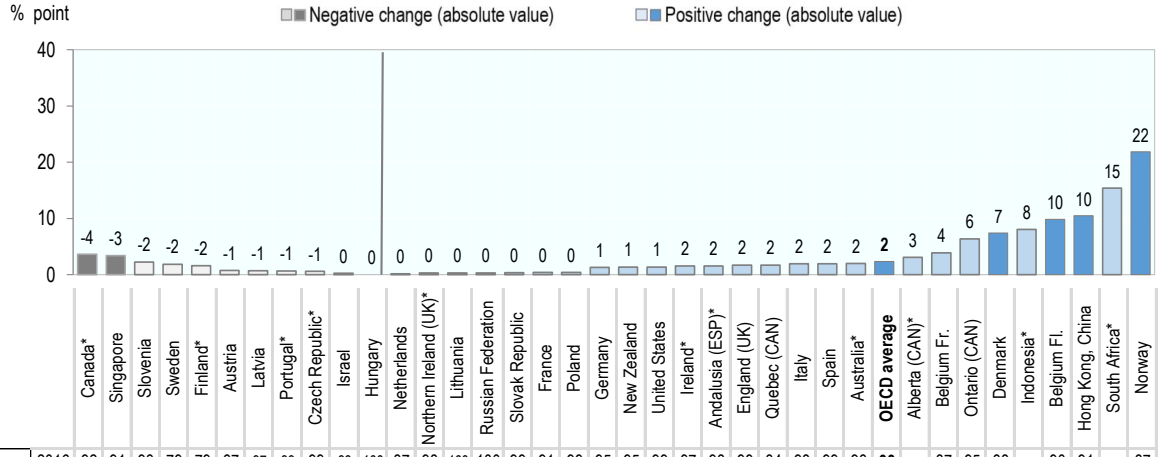
Most countries in the sample saw very little change in the use of this nearly universal practice between 2006 and 2016. At the OECD level, the share of 4th grade students who had a teacher asking them to explain their understanding of a text at least once a week increased by 2 percentage points on average to reach 93%. The mean absolute change taking into account increases and decreases was 3 percentage points, corresponding to a very small effect size of 0.1.

### Countries where there has been the most change

The few changes worth noting are a 22 percentage point increase in Norway and increases above 10 percentage points in South Africa and Honk Kong, China, albeit the change in South Africa was only measured between 2006 and 2011. All decreases in the use of this practice were less than 5 percentage points.

**Figure 4.3. 4th grade students explaining their understanding of a text in reading lessons**

Change in and share of students whose teachers ask them to explain or support their understanding of a text at least once a week, 2006-2016, teachers report




| | | Canada* | Singapore | Slovenia | Sweden | Finland* | Austria | Latvia | Portugal* | Czech Republic* | Israel | Hungary | Netherlands | Northern Ireland (UK)* | Lithuania | Russian Federation | Slovak Republic | France | Poland | Germany | New Zealand | United States | Ireland* | Andalusia (ESP)* | England (UK) | Quebec (CAN) | Italy | Spain | Australia* | **OECD average** | Alberta (CAN)* | Belgium Fr. | Ontario (CAN) | Denmark | Indonesia* | Belgium Fl. | Hong Kong, China | South Africa* | Norway |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 92 | 91 | 93 | 79 | 79 | 87 | 97 | 99 | 99 | 99 | 100 | 87 | 98 | 100 | 100 | 99 | 91 | 99 | 95 | 95 | 99 | 97 | 98 | 99 | 84 | 98 | 99 | 98 | **93** | m | 87 | 95 | 88 | m | 90 | 91 | m | 87 |
| | 2011 | 96 | 95 | 98 | 77 | 80 | 95 | m | 100 | 99 | 100 | 100 | 90 | 98 | 100 | 99 | 99 | 92 | 97 | 95 | 97 | 99 | 96 | 97 | 95 | 92 | 99 | 97 | 96 | **94** | 96 | 83 | 99 | 86 | 95 | m | 96 | 94 | 91 |
| | 2006 | m | 95 | 95 | 81 | m | 88 | 98 | m | m | 99 | 100 | 87 | m | 100 | 100 | 99 | 91 | 99 | 94 | 94 | 97 | m | m | 97 | 82 | 96 | 97 | m | **91** | 93 | 83 | 89 | 80 | 87 | 81 | 80 | 79 | 66 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904106

## 17. Students explaining the style and structure of a text

### Why it matters

Understanding and being able to explain the style and structure of a text is a key element of language art. While this contributes to the joys of reading literature and other kinds of text, and prepares to creative writing, there is a more basic function to it as well. Research evidence shows that understanding the style and structure of a text benefits reading comprehension. This is why many curricula make it a key reading competency.

### Change at the OECD level: moderate

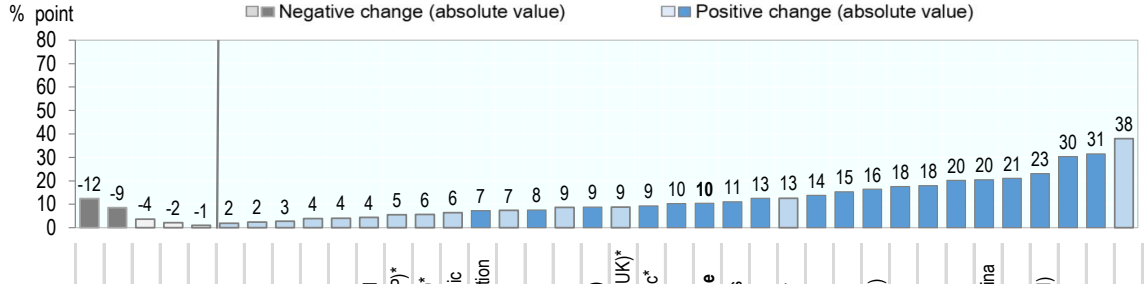
Most OECD education systems experienced an increase in the use of this practice (10 percentage points on average). Downward and upward changes taken into account, the absolute change between 2006 and 2016 amounted to 13 percentage points on average, corresponding to a moderate effect size of 0.29. The share of students being asked to explain the style and structure of a text at least once a week remains very disparate across countries, going from 20% in Finland to 98% in Portugal in 2016.

### Countries where there has been the most change

Only a handful of countries witnessed a decrease in this practice, particularly Hungary (12 percentage points) and Slovenia (9 percentage points). On the other hand, it expanded in Poland, Sweden and Indonesia (by over 30 percentage points). The 38-percentage point increase in Indonesia was measured between 2006 and 2011 and does not fully compare with other systems.

**Figure 4.4. 4th grade students explaining the style and structure of a text in reading lessons**

Change in and share of students whose teachers ask them to explain the style and structure of a text at least once a week, 2006-2016, teachers report




| % of students | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 75 | 47 | 20 | 24 | 83 | 66 | 98 | 37 | 61 | 92 | 70 | 61 | m | 62 | 90 | 41 | 25 | 66 | 83 | 73 | 41 | 49 | **58** | 82 | 83 | m | 48 | 45 | 69 | 29 | 90 | 55 | 71 | 61 | 62 | 86 | 36 | m |
| 2011 | 74 | 61 | 24 | 30 | 84 | 78 | 96 | 48 | 57 | 98 | 72 | 56 | 51 | 64 | 83 | 41 | 27 | 58 | 82 | 64 | 32 | 41 | **57** | 81 | 83 | 59 | m | 32 | 71 | 29 | 91 | m | 77 | 58 | 48 | 74 | 19 | 82 |
| 2006 | 88 | 55 | m | 26 | m | 64 | m | 34 | m | 88 | 65 | m | 45 | 56 | 82 | 34 | 17 | m | 74 | m | m | 39 | **48** | 71 | 70 | 46 | 34 | 30 | 53 | 11 | 73 | 35 | 51 | 39 | 39 | 56 | 5 | 44 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904125

## 18. Students drawing inferences and generalisations from a text

### Why it matters

Drawing inferences and making generalisations from a text represents one of the key dimensions of reading comprehension, one that should be practiced and taught explicitly. This allows students to make conclusions and go beyond what is written, either because some elements remain implicit rather than explicit, or because further connections can be made. This practice also strengthens higher order skills, including creative and critical thinking skills.

### Change at the OECD level: moderate

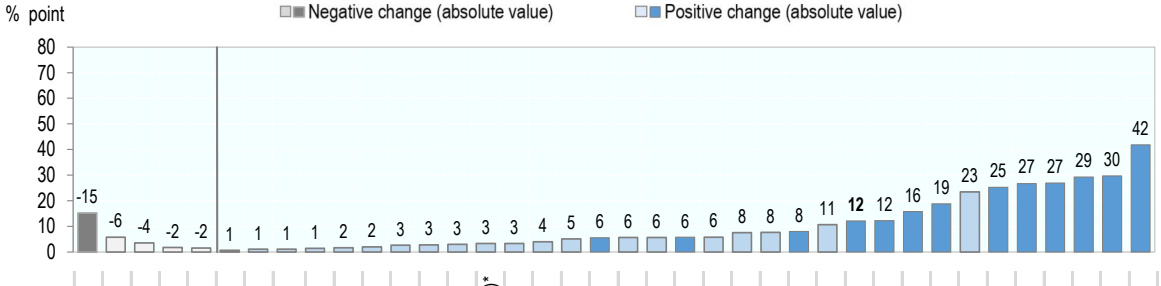
Between 2006 and 2016, this practice spread by 12 percentage points on average in the OECD area. The average absolute change, grouping positive and negative variations, was 13 percentage points, translating into a moderate effect size of 0.3. Over half of the students were asked to draw inferences and generalisations from a text at least once a week in all covered systems, with a relatively high average of 77% students concerned in the OECD area in 2016.

### Countries where there has been the most change

Contractions of the practice were not really notable, except in Finland where it declined by 15 percentage points between 2011 and 2016. This was a large innovation in Sweden where it gained ground by 42 percentage points, but also in Belgium (Fr.) and France where it expanded by about 30 percentage points.

**Figure 4.5. 4th grade students in reading drawing inferences and generalisations from a text**

Change and share of students whose teachers ask them to draw inferences and generalisations from a text at least once a week, 2006-2016, teachers report




| | | Finland* | Germany | Slovenia | Canada* | Hungary | Lithuania | Australia* | Russian Federation | Austria | Andalusia (ESP)* | Israel | United States | New Zealand | Alberta (CAN)* | Northern Ireland (UK)* | Portugal* | Singapore | Czech Republic* | Latvia | Ireland* | England (UK) | Poland | Slovak Republic | Netherlands | Belgium Fl. | Ontario (CAN) | South Africa* | **OECD average** | Denmark | Hong Kong, China | Italy | Indonesia* | Spain | Quebec (CAN) | Norway | France | Belgium Fr. | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 51 | 63 | 71 | 86 | 94 | 97 | 93 | 100 | 50 | 76 | 95 | 96 | 90 | m | 86 | 92 | 87 | 72 | 94 | 88 | 94 | 98 | 85 | 73 | 59 | 90 | m | **77** | 64 | 80 | 78 | m | 71 | 82 | 54 | 64 | 56 | 71 |
| | 2011 | 66 | 64 | 81 | 88 | 96 | 99 | 92 | 98 | 56 | 74 | 96 | 98 | 94 | 89 | 82 | 89 | 90 | 67 | m | 83 | 93 | 98 | 88 | 79 | m | 94 | 65 | **76** | 54 | 84 | 69 | 81 | 73 | 76 | 52 | 55 | 45 | 53 |
| | 2006 | m | 69 | 74 | m | 96 | 97 | m | 99 | 49 | m | 93 | 93 | 87 | 86 | m | m | 83 | m | 89 | m | 89 | 92 | 79 | 66 | 51 | 82 | 54 | **65** | 52 | 64 | 59 | 57 | 46 | 55 | 28 | 35 | 27 | 29 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904144

## 19. Students identifying the main ideas of a text

### Why it matters

Identifying the main ideas of a text is a key strategy for text comprehension and reading. Making students notice where those main ideas are placed (often at the beginning or end of a paragraph) and then move from going from the explicit main ideas to the implied ones are the main teaching strategies of this competency that remains essential at all levels of reading proficiency.

### Change at the OECD level: small

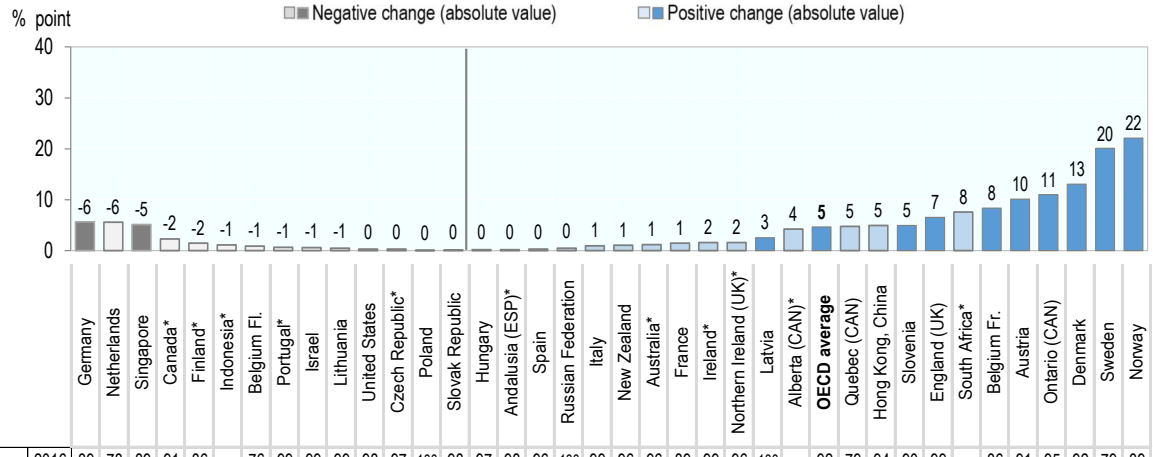
Most education systems saw little changes in the use of this nearly universal practice, on average it had a small net increase of 5 percentage points between 2006 and 2016. The overall change (including expansions and contractions) was 6 percentage points, equating a small effect size of 0.17. In 2016, 92% of 4th grade students were asked to identify the main ideas of a text at least once a week on average in an OECD system – and it was true for all students in Latvia and Poland.

### Countries where there has been the most change

This practice spread in most systems, and was an innovation in three Nordic European countries with an expansion by 22 percentage points in Norway, 20 percentage points in Sweden and 13 percentage points in Denmark. Germany, the Netherlands and Singapore registered negative changes of around 5 percentage points.

**Figure 4.6. 4th grade students identifying the main ideas of a text in reading lessons**

Change in and share of students whose teachers ask them to identify the main ideas of a text at least once a week, 2006-2016, teachers report




| % of students | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 89 | 78 | 89 | 91 | 86 | m | 76 | 99 | 99 | 99 | 98 | 97 | 100 | 98 | 97 | 98 | 96 | 100 | 99 | 96 | 96 | 89 | 99 | 96 | 100 | m | 92 | 79 | 94 | 90 | 99 | m | 86 | 91 | 95 | 92 | 79 | 89 |
| | 2011 | 90 | 88 | 95 | 94 | 88 | 85 | m | 100 | 100 | 100 | 99 | 97 | 99 | 99 | 99 | 98 | 97 | 99 | 100 | 98 | 95 | 91 | 97 | 94 | m | 94 | **93** | 89 | 96 | 91 | 97 | 86 | 78 | 92 | 97 | 86 | 78 | 90 |
| | 2006 | 95 | 84 | 95 | m | m | 86 | 77 | m | 99 | 100 | 98 | m | 100 | 97 | 97 | m | 95 | 100 | 98 | 95 | m | 87 | m | m | 97 | 90 | **87** | 74 | 89 | 85 | 92 | 79 | 77 | 80 | 84 | 79 | 59 | 67 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904163

## 20. Students using computers to write stories and texts during reading lessons

### Why it matters

Whether students should still learn to write (as opposed to type) is a hot debate, and perhaps the next one is whether they should just orally dictate text to computers. Students still learn to write with pens. Writing stories is a good way to take advantage of computers, as the ease of improving and polishing a text makes the drafting process easier – as adults spending time writing for work or fun know well.

### Change at the OECD level: moderate

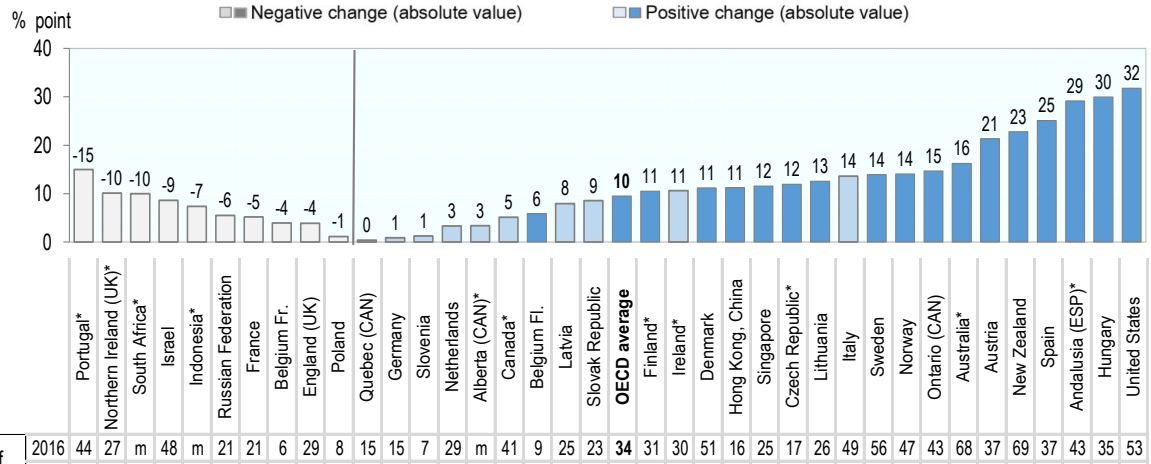
This relatively uncommon practice has spread more often than it has receded and expanded by 10 percentage points on average in the OECD area. The absolute change was a little less than 12 percentage points between 2006 and 2016, corresponding to a moderate effect size of 0.27. In 2016, on average, only 34% of 4th grade students used computers to write stories and texts at least once a week during their reading lessons. In Belgium (Fr.) and Poland, less than 8% of the students are concerned.

### Countries where there has been the most change

Students in Hungary and the United States experienced the most innovation between 2006 and 2016, with an expansion by 30 and 32 percentage points of students concerned respectively. Andalusia (Spain) also showed an increase of about 30 percentage points between 2011 and 2016 – while the practice decreased by 15 percentage points in Portugal.

**Figure 4.7. 4th grade students using computers to write stories and texts in reading lessons**

Change in and share of students who use computers to write stories and texts at least once a week, 2006-2016, teachers report




*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904182

## 21. Oral explanation and summarisation of a text

### Why it matters

Asking students to answer oral questions on a text or to summarise it is an old and effective practice to assess formatively (or summatively) their understanding. It is a key practice to make learning visible to the teachers and students. Other good teaching practices may achieve the same, but this practice is an economical one time wise in a teacher-directed classroom.

### Change at the OECD level: small

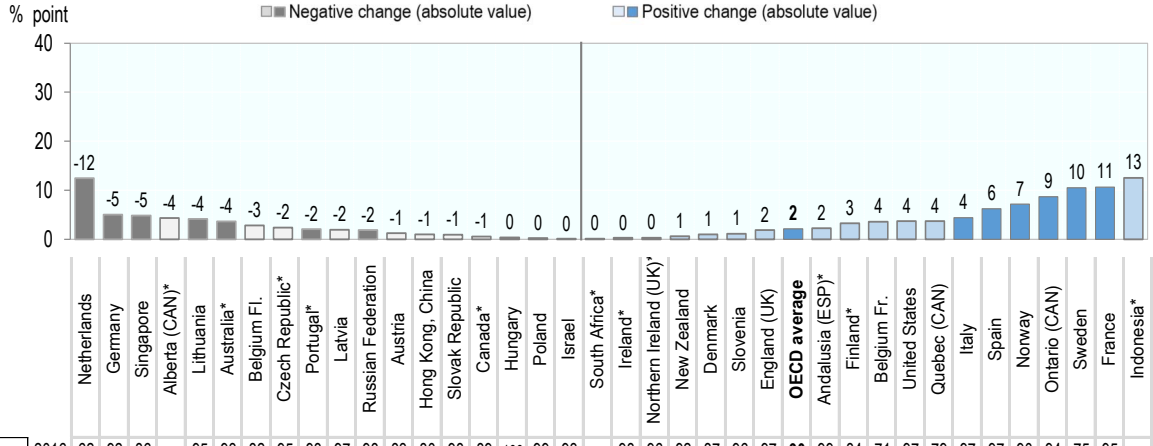
This practice has remained stable between 2006 and 2016, with a slight increase by 2 percentage points. Ignoring change direction, the absolute change has amounted to 4 percentage points, associated to a small effect size of 0.14. Orally explaining or summarising a text at least once a week in 2016 concerned 9 out of 10 4th grade students in the OECD area: this is a widespread practice. In Hungary, Poland and Andalusia (Spain), almost all 4th grade students were exposed to this teaching method in 2016.

### Countries where there has been the most change

Changes did not exceed 10 percentage points in either direction, with just a few exceptions. In the Netherlands there was a 12-percentage point contraction, while students in Sweden and France experienced a spread around 10 percentage points between 2006 and 2016. In Indonesia students experienced a 13-percentage point increase between 2006 and 2011.

**Figure 4.8. 4th grade students in reading orally examined about a text**

Change in and share of students whose teacher ask them to answer oral questions about or orally summarise a text at least once a week, 2006-2016, teachers report.




*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904201

**Table 4.1. Effect sizes for changes in practices to develop language art skills**

| | Teaching strategies for decoding sounds and words | Teaching new vocabulary systematically | Students explaining their understanding of text | Students explaining style and structure of text | Students drawing inferences and generalisations from text | Students identifying main ideas of text | Students using computers to write stories and texts | Oral examination and summarising of text |
|---|---|---|---|---|---|---|---|---|
| | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade |
| Australia | -0.05 | 0.19 | 0.12 | -0.03 | 0.04 | 0.06 | 0.33 | -0.16 |
| Austria | 0.27 | 0.01 | -0.02 | 0.18 | 0.03 | 0.29 | 0.50 | -0.03 |
| Belgium (Fl.) | 0.33 | -0.04 | 0.28 | 0.28 | 0.15 | -0.02 | 0.26 | -0.08 |
| Belgium (Fr.) | 0.42 | 0.20 | 0.11 | 0.32 | 0.61 | 0.22 | -0.15 | 0.08 |
| Canada | -0.19 | 0.00 | -0.15 | 0.08 | -0.05 | -0.09 | 0.10 | -0.02 |
| Canada (Alberta) | 0.37 | 0.13 | 0.14 | 0.11 | 0.09 | 0.16 | 0.07 | -0.14 |
| Canada (Ontario) | -0.07 | -0.16 | 0.24 | 0.34 | 0.24 | 0.36 | 0.31 | 0.29 |
| Canada (Quebec) | 0.45 | 0.21 | 0.05 | 0.47 | 0.59 | 0.11 | 0.01 | 0.09 |
| Czech Republic | 0.39 | 0.11 | -0.06 | 0.19 | 0.11 | -0.02 | 0.40 | -0.13 |
| Denmark | 0.09 | 0.35 | 0.20 | 0.21 | 0.25 | 0.38 | 0.23 | 0.03 |
| Finland | 0.13 | 0.41 | -0.04 | -0.09 | -0.31 | -0.04 | 0.24 | 0.09 |
| France | 0.23 | 0.32 | 0.01 | 0.15 | 0.59 | 0.05 | -0.12 | 0.37 |
| Germany | 0.41 | -0.16 | 0.06 | -0.05 | -0.12 | -0.21 | 0.03 | -0.22 |
| Hungary | -0.16 | -0.03 | 0.00 | -0.32 | -0.07 | 0.01 | 0.81 | -0.11 |
| Ireland | 0.02 | 0.42 | 0.08 | 0.18 | 0.16 | 0.11 | 0.25 | 0.02 |
| Israel | 0.01 | 0.12 | -0.02 | 0.14 | 0.08 | -0.06 | -0.17 | 0.00 |
| Italy | 0.24 | 0.28 | 0.12 | 0.30 | 0.41 | 0.08 | 0.28 | 0.20 |
| Latvia | 0.29 | 0.23 | -0.04 | 0.41 | 0.20 | 0.22 | 0.20 | -0.14 |
| Lithuania | 0.87 | 0.27 | 0.07 | 0.47 | 0.04 | -0.14 | 0.32 | -0.27 |
| Netherlands | 0.80 | 0.54 | 0.00 | 0.06 | 0.16 | -0.14 | 0.08 | -0.27 |
| New Zealand | 0.06 | 0.23 | 0.06 | 0.09 | 0.09 | 0.05 | 0.47 | 0.02 |
| Norway | -0.07 | -0.01 | 0.53 | 0.45 | 0.55 | 0.55 | 0.29 | 0.21 |
| Poland | -0.04 | 0.15 | 0.05 | 0.69 | 0.28 | -0.01 | -0.04 | -0.02 |
| Portugal | 0.24 | 0.12 | -0.08 | 0.14 | 0.11 | -0.08 | -0.30 | -0.19 |
| Slovak Republic | 0.17 | -0.06 | 0.04 | 0.13 | 0.15 | 0.01 | 0.22 | -0.07 |
| Slovenia | 0.19 | 0.08 | -0.09 | -0.17 | -0.08 | 0.15 | 0.05 | 0.06 |
| Spain | 0.44 | 0.17 | 0.13 | 0.43 | 0.52 | 0.02 | 0.60 | 0.27 |
| Spain (Andalusia) | 0.08 | -0.05 | 0.10 | 0.11 | 0.04 | 0.02 | 0.67 | 0.15 |
| Sweden | 0.24 | 0.04 | -0.05 | 0.85 | 0.86 | 0.44 | 0.28 | 0.23 |
| UK (England) | 0.00 | 0.39 | 0.13 | 0.22 | 0.21 | 0.34 | -0.08 | 0.10 |
| UK (Northern Ireland) | -0.31 | -0.15 | 0.02 | 0.19 | 0.09 | 0.07 | -0.22 | 0.02 |
| United States | 0.00 | 0.05 | 0.10 | 0.26 | 0.11 | -0.02 | 0.67 | 0.18 |
| **OECD (average)** | **0.17** | **0.13** | **0.09** | **0.21** | **0.27** | **0.15** | **0.21** | **0.07** |
| **OECD (av. absolute)** | **0.22** | **0.18** | **0.10** | **0.29** | **0.30** | **0.18** | **0.27** | **0.14** |
| Hong Kong, China | 0.30 | 0.04 | 0.30 | 0.42 | 0.35 | 0.18 | 0.39 | -0.02 |
| Indonesia | 0.10 | 0.15 | 0.30 | 0.81 | 0.51 | -0.03 | -0.20 | 0.49 |
| Russian Federation | 0.28 | 0.16 | 0.11 | 0.21 | 0.21 | 0.14 | -0.13 | -0.27 |
| Singapore | 0.07 | 0.07 | -0.14 | 0.04 | 0.11 | -0.19 | 0.30 | -0.15 |
| South Africa | 0.03 | 0.00 | 0.47 | 0.25 | 0.22 | 0.20 | -0.24 | 0.00 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on PIRLS (2006, 2011 and 2016).

StatLink https://doi.org/10.1787/888933904220

# Chapter 5.
# Innovation in practices to develop cross-disciplinary technical skills

*This chapter presents the change in education teaching and learning practices aimed at developing student content and procedural knowledge. It is mainly about searching information and acquiring knowledge in any domain. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 22. Reading textbooks and resource materials in science

### Why it matters

Reading science textbooks and materials during lessons (or outside class) is one way of acquiring knowledge about science. In primary education, this strengthens students' reading skills as much their knowledge about science. In secondary education, many other resources should supplement textbooks, but enquiring about scientific phenomena requires some reading as opposed to merely listening to one's teacher.

## Primary education

### Change at the OECD level: small

In primary education, this practice has spread in most OECD countries, by 7 percentage points on average. The absolute change was 9 percentage points on average, corresponding to an effect size of 0.19. This pedagogical practice is common in many countries, especially in Hungary where 97% of 4th grade students were asked to read textbooks and resource materials in half or more of their science lessons in 2015. By contrast, no more than 20 % of students did so in England.

### Countries where there has been the most change

Innovation took the form of increases and to a lesser extent reductions in the use of this practice. Students in Norway experienced the largest expansion of this practice between 2007 and 2015 (37 percentage points) whereas the Dutch students experienced the largest decline (9 percentage points).

## Secondary education

### Change at the OECD level: large

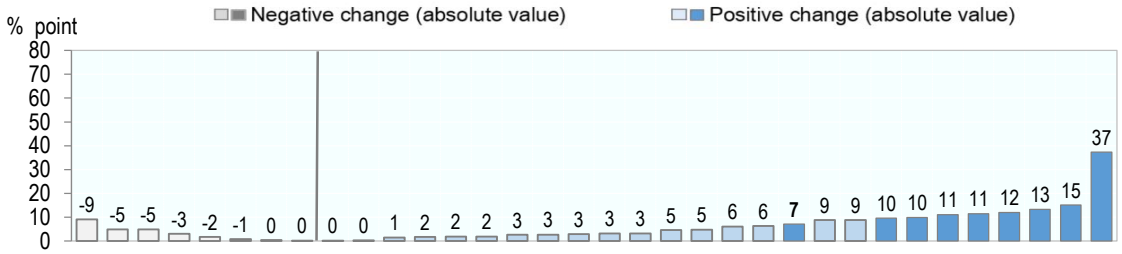
The average share of 8th grade students regularly being asked to read textbooks or resource materials during science lesson went up from 43 % in 2007 to 63% in 2015. This 20-percentage point absolute change between 2007 and 2015 corresponds to a large effect size of 0.41, a high level of innovation. In 2015, 63% of students are exposed to this practice in 8th grade science on average in the OECD area, ranging from 86% of in Hungary to 35% in England.

### Countries where there has been the most change

Slovenia is by far the country that experienced the largest innovation in this practice: it expanded by 45 percentage points between 2007 and 2015. During the same period, Quebec (Canada), Israel and Korea highly innovated in the same direction with an increase by about 30 percentage points. Chile saw the only contraction in this pedagogical activity (13 percentage points between 2011 and 2015).

**Figure 5.1. 4th grade students reading textbooks and resource materials in science**

Change in and share of students whose teachers ask them to read textbooks or other resource materials in at least half the lessons, 2007-2015, teachers report

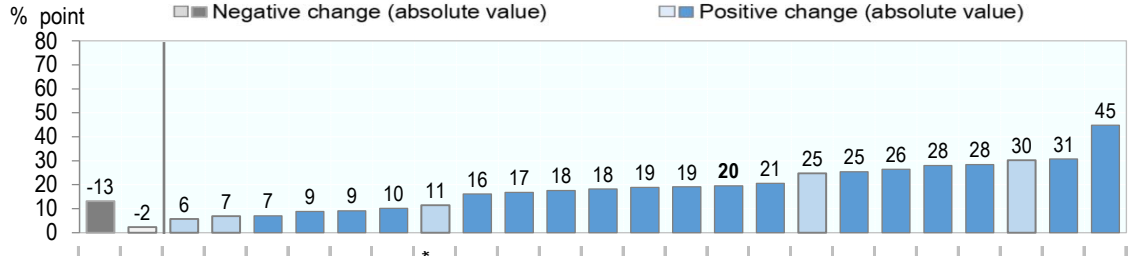



| | Netherlands | Russian Federation | Denmark | Finland* | Northern Ireland (UK)* | Singapore | Belgium (Fl.)* | Chile* | New Zealand | Hong Kong, China | Ireland* | Slovak Republic | Turkey* | Spain* | Czech Republic | United States | Germany | Alberta (CAN)* | England (UK) | Poland* | Korea* | Italy | Austria* | **OECD average** | Ontario (CAN) | Quebec (CAN) | Australia | Sweden | Lithuania | Portugal* | Hungary | Slovenia | Japan | Norway |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students 2015 | 70 | 87 | 51 | 91 | 21 | 51 | 70 | 82 | 20 | 49 | 66 | 78 | 85 | 76 | 71 | 60 | 59 | m | 20 | 80 | 89 | 82 | m | **60** | 54 | 55 | 26 | 49 | 86 | 80 | 97 | 68 | 78 | 74 |
| 2011 | 83 | 97 | 60 | 94 | 23 | 58 | 70 | 82 | 17 | 59 | 64 | 82 | 84 | 74 | 82 | 61 | 64 | 20 | 12 | 75 | 85 | 84 | 57 | **62** | 58 | 54 | 21 | 48 | 93 | 68 | 94 | 79 | 78 | 76 |
| 2007 | 79 | 92 | 56 | m | m | 52 | m | m | 20 | 49 | m | 76 | m | m | 68 | 58 | 56 | 17 | 17 | m | m | 76 | 50 | **52** | 46 | 47 | 17 | 39 | 75 | m | 85 | 55 | 63 | 36 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904239

**Figure 5.2. 8th grade students reading textbooks and resource materials in science**




| | Chile* | New Zealand* | Ontario (CAN) | Australia | England (UK) | Italy | South Africa* | United States | Massachusetts (USA)* | Japan | Lithuania | Hungary | Turkey | Singapore | Russian Federation | **OECD average** | Hong Kong, China | Indonesia* | Sweden | Norway | Korea | Israel | Minnesota (USA)* | Quebec (CAN) | Slovenia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students 2015 | 79 | 47 | 49 | 49 | 35 | 71 | 79 | 49 | m | 67 | 76 | 86 | 76 | 50 | 72 | **63** | 55 | m | 53 | 60 | 81 | 75 | m | 65 | 60 |
| 2011 | 92 | 49 | 63 | 60 | 39 | 71 | 70 | 53 | 42 | 66 | 82 | 91 | 79 | 63 | 73 | **62** | 56 | 91 | 43 | 58 | 75 | 73 | 55 | 60 | 39 |
| 2007 | m | m | 44 | 42 | 28 | 63 | m | 39 | 30 | 51 | 60 | 68 | 58 | 31 | 53 | **43** | 34 | 66 | 28 | 34 | 53 | 47 | 25 | 34 | 15 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904258

## 23. Reading non-fiction work

### Why it matters

While adults often associate reading in primary education with fiction, fairy tales and bed stories, young students benefit from reading non-fiction texts to improve their reading and understanding skills, to gain knowledge about different topics, and become aware of the power of reading all kinds of texts to acquire information and knowledge. This is a practice that one would in principle not see decline.

### Change at the OECD level: large

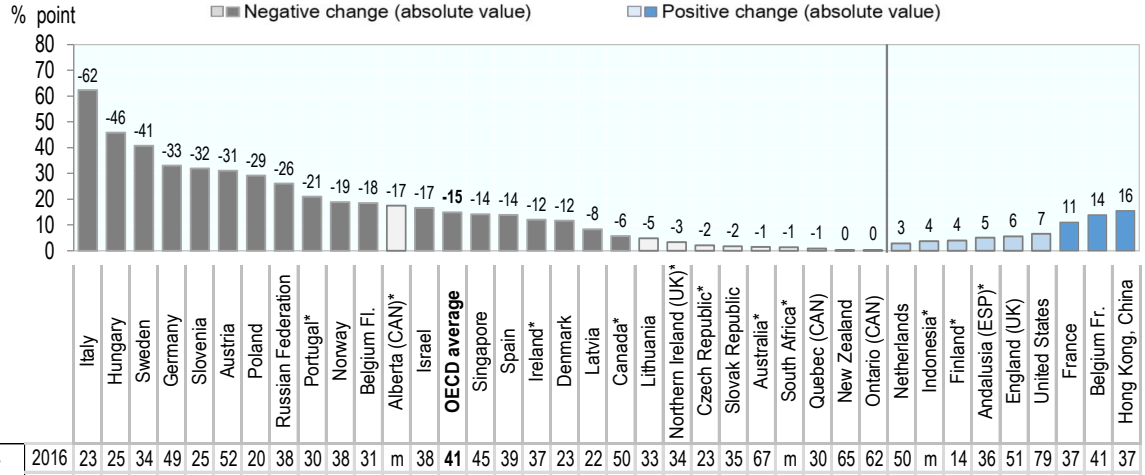
This practice has overwhelmingly declined across OECD countries. Between 2006 and 2016, there was a 15 percentage point decrease in the average proportion of 4th grade students regularly asked to read non-fiction – while the absolute change in both direction amounted to 19 percentage points, corresponding to a large effect size of 0.4. In 2016, 41% of 4th grade students were asked to read non-fiction at least once a week. In the United States, this practice is the most widespread with 79% of students concerned.

### Countries where there has been the most change

Innovation in this domain has taken the form of a significant recession of this practice, most notably in Italy (62 percentage points), Hungary (46 percentage points) and Sweden (41 percentage points). Noticeable expansions occurred in France (11 percentage points), Belgium Fr. (14 percentage points) and Hong Kong, China (16 percentage points).

**Figure 5.3. 4th grade students reading non-fiction work for reading lessons**

Change in and share of students whose teachers ask them to read non-fiction articles at least once a week, 2006-2016, teachers report




| | | Italy | Hungary | Sweden | Germany | Slovenia | Austria | Poland | Russian Federation | Portugal* | Norway | Belgium Fl. | Alberta (CAN)* | Israel | **OECD average** | Singapore | Spain | Ireland* | Denmark | Latvia | Canada* | Lithuania | Northern Ireland (UK)* | Czech Republic* | Slovak Republic | Australia* | South Africa* | Quebec (CAN) | New Zealand | Ontario (CAN) | Netherlands | Indonesia* | Finland* | Andalusia (ESP)* | England (UK) | United States | France | Belgium Fr. | Hong Kong, China |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 23 | 25 | 34 | 49 | 25 | 52 | 20 | 38 | 30 | 38 | 31 | m | 38 | **41** | 45 | 39 | 37 | 23 | 22 | 50 | 33 | 34 | 23 | 35 | 67 | m | 30 | 65 | 62 | 50 | m | 14 | 36 | 51 | 79 | 37 | 41 | 37 |
| | 2011 | 33 | 32 | 42 | 43 | 18 | 44 | 30 | 41 | 51 | 38 | m | 54 | 42 | **40** | 36 | 35 | 49 | 28 | m | 56 | 28 | 38 | 25 | 28 | 69 | 51 | 41 | 63 | 65 | 54 | 41 | 10 | 31 | 39 | 60 | 40 | 25 | 22 |
| | 2006 | 85 | 71 | 75 | 82 | 57 | 83 | 50 | 64 | m | 56 | 50 | 71 | 55 | **56** | 60 | 53 | m | 34 | 30 | m | 38 | m | m | 36 | m | 53 | 30 | 65 | 62 | 47 | 38 | m | m | 45 | 72 | 26 | 27 | 21 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904277

## 24. Using computers to look for information in reading

### Why it matters

Computers and other digital screens are often seen as the rivals, if not the enemies, of books and reading. On the other end, books often appear as a self-contained world of words and meanings. Looking up for information and ideas on computers in reading class helps break these two misconceptions, and help students learn to find information about the authors, contexts as well as other ideas and perspectives about what they read and their understanding of it.

### Change at the OECD level: large

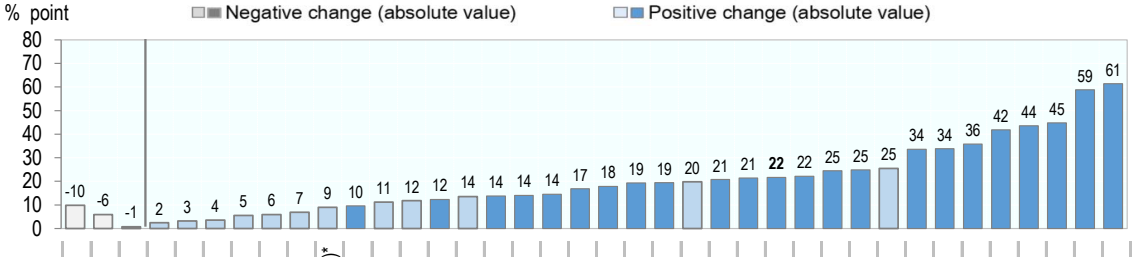
This practice has gained significant ground in OECD countries. Between 2006 and 2016, the share of 4th grade students regularly asked to look for information in reading increased by 22 percentage points on average. The absolute change was 22 percentage points as well, corresponding to a large effect size of 0.48. In 2016, on average, 52% of 4th grade students used computers to look up for information in reading lessons at least once a week, with shares ranging from 84% and 78% in New Zealand and Australia (respectively) to 25% in Quebec (Canada).

### Countries where there has been the most change

Between 2006 and 2016, the Russian Federation and Italy experienced the largest increases in this practice (61 and 59 percentage points respectively). In Latvia, New Zealand and Slovenia, it also expanded by over 40 percentage points.

**Figure 5.4. 4th grade students using computers to look up for information in reading lessons**

Change in and share of students who use computers to look up for ideas and information during lessons at least once a week, 2006-2016, teachers report




| | | Portugal* | Netherlands | Hong Kong, China | Quebec (CAN) | Czech Republic* | Sweden | Canada* | Singapore | Belgium Fr. | Northern Ireland (UK)* | Finland* | Ireland* | Andalusia (ESP)* | England (UK) | Indonesia* | Australia* | Austria | Germany | Belgium Fl. | United States | France | Poland | Alberta (CAN)* | Israel | Norway | **OECD average** | Denmark | Ontario (CAN) | Slovak Republic | South Africa* | Hungary | Spain | Lithuania | Latvia | New Zealand | Slovenia | Italy | Russian Federation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 63 | 53 | 34 | 25 | 42 | 39 | 56 | 43 | 15 | 70 | 44 | 56 | 55 | 73 | m | 78 | 37 | 32 | 38 | 56 | 33 | 41 | m | 77 | 50 | **52** | 56 | 67 | 50 | m | 64 | 52 | 65 | 55 | 84 | 62 | 66 | 75 |
| | 2011 | 73 | 61 | 51 | 47 | 39 | 47 | 51 | 43 | 29 | 61 | 34 | 45 | 43 | 57 | 27 | 64 | 33 | 23 | m | 43 | 47 | 50 | 61 | 60 | 33 | **43** | 32 | 43 | 34 | 39 | 42 | 38 | 53 | m | 65 | 44 | 28 | 52 |
| | 2006 | m | 58 | 35 | 22 | m | 36 | m | 37 | 8 | m | m | m | m | 61 | 13 | m | 23 | 18 | 21 | 39 | 14 | 21 | 41 | 56 | 29 | **30** | 34 | 42 | 25 | 14 | 30 | 18 | 29 | 14 | 41 | 17 | 7 | 13 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904372

## 25. Using computers to look up for ideas and information in mathematics

### Why it matters

Students can easily find some solution to their calculation problems on the Internet – or just their scientific calculator. Making them use their computers to look up for ideas and information during the maths lesson can potentially develop their student agency, and also give them a better grasp of how to use computers to better understand this symbolic world that is often alien to their daily life. A practice to be encouraged.

## Primary education

### Change at the OECD level: large

Across OECD countries, on average 31% of students used computers to look up for ideas and information during 4th grade mathematics lessons in 2015, against less than 4% in 2007. With an absolute change by 27 percentage points, associated to a very large effect size of 0.8, this is a large innovation and novelty. This practice remains emergent in primary education, touching a range of student going from 66% in Turkey to merely 3% in Japan in 2015.

### Countries where there has been the most change

The emergence of this pedagogical activity has been a significant innovation in several countries. This is especially the case in New Zealand, with an increase by 50 percentage points between 2007 and 2015, but also in Australia, the Slovak Republic, the Russian Federation and Lithuania with expansions between 49 and 41 percentage points.

## Secondary education

### Change at the OECD level: large

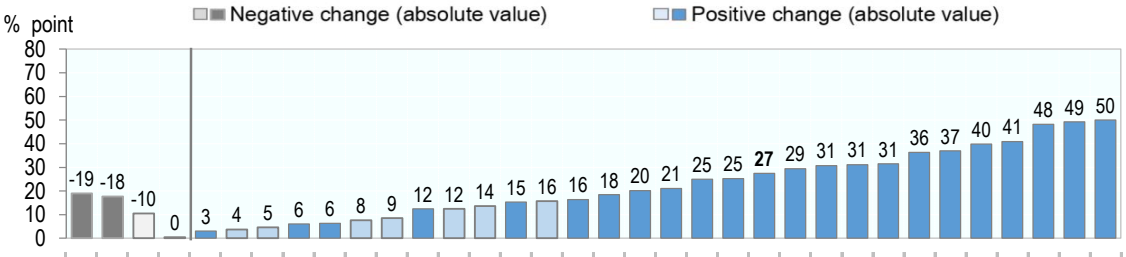
Like in primary education, the share of 8th grade students using computers to look up for ideas and information in mathematics lessons each week increased, this time by 18 percentage points. With an absolute change also equal to 18 percentage points between 2007 and 2015, corresponding to a very large effect size of 0.57, this has been a large innovation. The practice remains relatively uncommon across OECD countries: on average 23% of 8th grade students regularly looked for information in maths in 2015.

### Countries where there has been the most change

Students in the United States experienced the most innovation in this domain where the practice gained significant ground between 2007 and 2015 (+39 percentage points). The Russian Federation, Australia, Ontario (Canada) and Turkey also strongly innovated by registering increases of over 30 percentage points. The single negative change is recorded in Chile, a decline of 14 percentage points measured between 2011 and 2015.

**Figure 5.5. 4th grade students using computers to look up for ideas and information in maths**

Change in and share of students who use computers to look up for ideas and information during lessons at least once a week, 2007-2015, teachers report



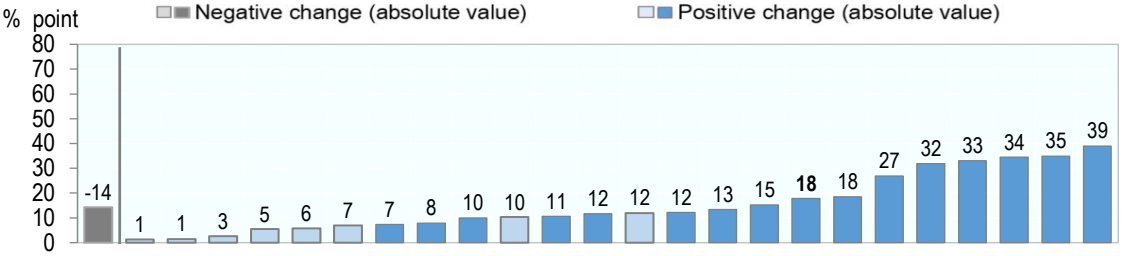

| | | Poland* | Korea* | Chile* | Belgium (Fl.)* | Japan* | Portugal* | Turkey* | Finland* | Sweden | Northern Ireland (UK)* | Ireland* | Hungary | Austria* | Spain* | Denmark | Alberta (CAN)* | Germany* | Hong Kong, China | Czech Republic | Singapore | Slovenia | England (UK) | **OECD average** | Ontario (CAN) | Norway | Quebec (CAN) | Italy | Netherlands | United States | Lithuania | Russian Federation | Slovak Republic | Australia | New Zealand |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 14 | 13 | 20 | 19 | 3 | 45 | 66 | 9 | 7 | 44 | 23 | 16 | m | 36 | 18 | m | 16 | 27 | 23 | 26 | 27 | 30 | **31** | 33 | 32 | 36 | 37 | 43 | 43 | 45 | 55 | 52 | 54 | 54 |
| | 2011 | 32 | 31 | 30 | 19 | m | 41 | 61 | 3 | 10 | 37 | 14 | 15 | 15 | 23 | 10 | 21 | 11 | 28 | 12 | 23 | 10 | 12 | **19** | 18 | 11 | 16 | 34 | 32 | 29 | 28 | 33 | 24 | 35 | 40 |
| | 2007 | m | m | m | m | m | m | m | m | 1 | m | m | 3 | 3 | m | 2 | 5 | m | 8 | 3 | 5 | 2 | 5 | **3** | 4 | 2 | 5 | 5 | 7 | 6 | 5 | 15 | 4 | 5 | 4 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904296

**Figure 5.6. 8th grade students using computers to look up for ideas and information in maths**

Change in and share of students who use computers to look up for ideas and information during lessons at least once a week, 2007-2015, teachers report




| | | Chile* | Japan* | Indonesia* | Minnesota (USA)* | Lithuania | Massachusetts (USA) | Hong Kong, China | Singapore | Norway | Hungary | Israel | Sweden | Korea | South Africa* | Slovenia | Quebec (CAN)* | England (UK) | **OECD average** | Italy | New Zealand* | Turkey | Ontario (CAN) | Australia | Russian Federation | United States |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 13 | 1 | m | m | 11 | m | 23 | 15 | 11 | 14 | 21 | 12 | 18 | 33 | 13 | 13 | 20 | **23** | 27 | 37 | 54 | 36 | 36 | 42 | 42 |
| | 2011 | 27 | m | 17 | 5 | 16 | 7 | 11 | 6 | 2 | 13 | 23 | 9 | 19 | 21 | 6 | 14 | 9 | **14** | 16 | 10 | 44 | 17 | 14 | 37 | 16 |
| | 2007 | m | m | 15 | 2 | 6 | 2 | 16 | 8 | 3 | 4 | 11 | 1 | 6 | m | 1 | m | 5 | **5** | 8 | m | 22 | 3 | 2 | 8 | 3 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904315

## 26. Using computers to look up for ideas and information in science

### Why it matters

In the past students had encyclopaedias, well, some of them. Some schools as well. Today, they still exist online, but there are so many other ways to look up for ideas and information on the Internet. Using computers during class to enquire about a scientific phenomenon or watch a video is one potential way to get students more interested and more active learners in science. It also helps learn how to find information about science.

## Primary education

### Change at the OECD level: large

On average, the share of 4th grade students exposed to this pedagogical activity at least once a week increased by 17 percentage points between 2007 and 2015. The absolute change, be it positive or negative, amounted to 18 percentage points, corresponding to a large effect size of 0.42. With an OECD mean at 39% in 2015, we observe large disparities across countries, with the range of students using computers to look up for information and ideas during their science lessons once a week or more going from 91% in Turkey to less than 2% in Japan.

### Countries where there has been the most change

Large increases above 30 percentage points in the share of science students exposed to this practice are observed in Italy, the Slovak Republic and the Russian Federation. On the contrary, innovation in Hong Kong, China took the form of a contraction of this practice by 19 percentage points.

## Secondary education

### Change at the OECD level: large

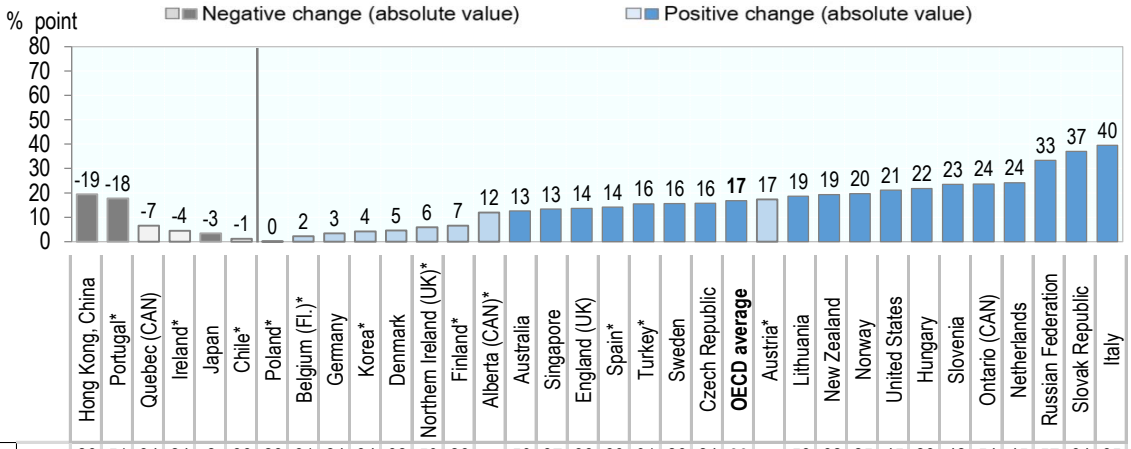
As in primary education, the use of computers to look up for ideas and information in science lessons has gained ground across secondary schools. The average share of 8th grade students regularly participating in this exercise has increased by 21 percentage points between 2007 and 2015 in OECD systems. The absolute change equates the net change in the use of this practice, corresponding to a large effect size of 0.49. At the OECD level, 38% of students are exposed to this practice on average, with a span ranging from 60% in Turkey to 7% in Japan in 2015.

### Countries where there has been the most change

In Australia, the share of students participating in this science pedagogy on a regular basis increased from 16% in 2007 to almost 60% in 2015. Ontario (Canada) and the Russian Federation also experienced large increases, by over 38 percentage points between 2007 and 2015. Minnesota (United States) and Chile experienced a moderate decline over 11 percentage points between 2011 and 2015.

**Figure 5.7. 4th grade students using computers to look up for ideas and information in science**

Change in and share of students who use computers to look up for ideas and information during lessons at least once a week, 2007-2015, teachers report



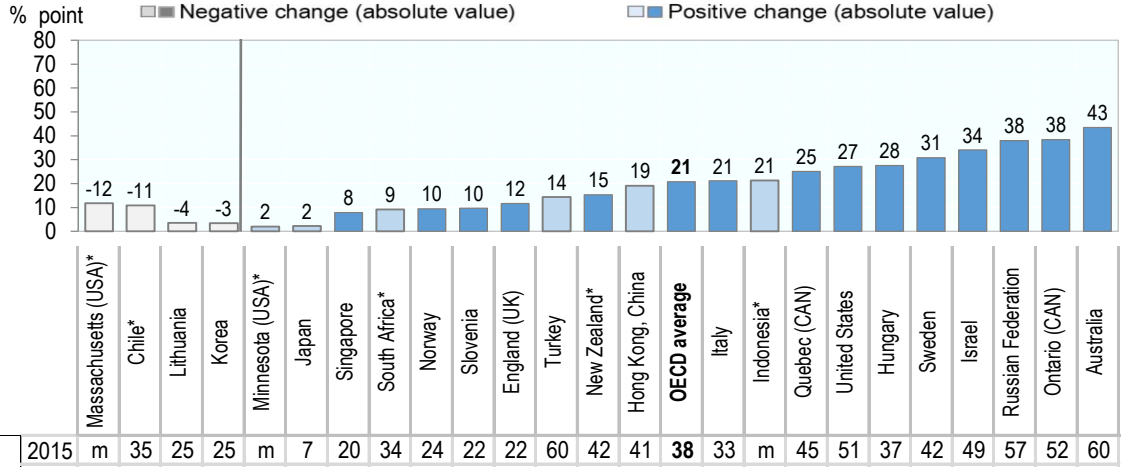

| | | Hong Kong, China | Portugal* | Quebec (CAN) | Ireland* | Japan | Chile* | Poland* | Belgium (Fl.)* | Germany | Korea* | Denmark | Northern Ireland (UK)* | Finland* | Alberta (CAN)* | Australia | Singapore | England (UK) | Spain* | Turkey* | Sweden | Czech Republic | **OECD average** | Austria* | Lithuania | New Zealand | Norway | United States | Hungary | Slovenia | Ontario (CAN) | Netherlands | Russian Federation | Slovak Republic | Italy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 26 | 51 | 34 | 24 | 2 | 36 | 28 | 31 | 24 | 34 | 32 | 50 | 26 | m | 50 | 37 | 36 | 39 | 91 | 26 | 24 | **39** | m | 53 | 62 | 25 | 45 | 28 | 42 | 54 | 45 | 57 | 64 | 65 |
| | 2011 | 29 | 69 | 23 | 28 | 1 | 38 | 28 | 29 | 25 | 30 | 19 | 44 | 19 | 33 | 48 | 36 | 17 | 25 | 76 | 16 | 28 | **27** | 32 | 51 | 51 | 17 | 27 | 29 | 23 | 26 | 35 | 49 | 34 | 38 |
| | 2007 | 46 | m | 41 | m | 5 | m | m | m | 20 | m | 27 | m | m | 21 | 38 | 24 | 22 | m | m | 10 | 8 | **22** | 15 | 34 | 43 | 5 | 24 | 6 | 19 | 31 | 21 | 24 | 27 | 25 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

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**Figure 5.8. 8th grade students using computers to look up for ideas and information in science**

Change in and share of students who use computers to look up for ideas and information during lessons at least once a week, 2007-2015, teachers report




| | | Massachusetts (USA)* | Chile* | Lithuania | Korea | Minnesota (USA)* | Japan | Singapore | South Africa* | Norway | Slovenia | England (UK) | Turkey | New Zealand* | Hong Kong, China | **OECD average** | Italy | Indonesia* | Quebec (CAN) | United States | Hungary | Sweden | Israel | Russian Federation | Ontario (CAN) | Australia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 35 | 25 | 25 | m | 7 | 20 | 34 | 24 | 22 | 22 | 60 | 42 | 41 | **38** | 33 | m | 45 | 51 | 37 | 42 | 49 | 57 | 52 | 60 |
| | 2011 | 15 | 45 | 27 | 33 | 17 | 3 | 14 | 25 | 16 | 11 | 19 | 62 | 27 | 19 | **25** | 16 | 29 | 20 | 27 | 36 | 20 | 26 | 42 | 28 | 35 |
| | 2007 | 27 | m | 29 | 29 | 15 | 5 | 12 | m | 14 | 12 | 11 | 46 | m | 22 | **17** | 11 | 8 | 19 | 24 | 10 | 11 | 15 | 19 | 14 | 16 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904353

**Table 5.1. Effect sizes for changes in practices to develop cross-disciplinary technical skills**

| | Reading textbooks and resource materials in science | | Reading non-fiction books | Using computers to look up for ideas and information | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4th grade | 8th grade | 4th grade | 4th grade Maths | 8th grade Maths | 4th grade Science | 8th grade Science | 4th grade Reading |
| Australia | 0.23 | 0.14 | -0.03 | 1.21 | 1.03 | 0.25 | 0.94 | 0.31 |
| Austria | 0.13 | m | -0.68 | 0.47 | m | 0.42 | m | 0.31 |
| Belgium (Fl.) | -0.01 | m | -0.38 | -0.01 | m | 0.05 | m | 0.37 |
| Belgium (Fr.) | m | m | 0.29 | m | m | m | m | 0.21 |
| Canada | m | m | -0.12 | m | m | m | m | 0.11 |
| Canada (Alberta) | 0.08 | m | -0.36 | 0.50 | m | 0.27 | m | 0.40 |
| Canada (Ontario) | 0.18 | 0.12 | -0.01 | 0.83 | 0.93 | 0.48 | 0.85 | 0.50 |
| Canada (Quebec) | 0.18 | 0.63 | -0.02 | 0.85 | 0.75 | -0.14 | 0.55 | 0.06 |
| Chile | 0.00 | -0.39 | m | -0.24 | -0.36 | -0.02 | -0.22 | m |
| Czech Republic | 0.06 | m | -0.05 | 0.66 | m | 0.44 | m | 0.07 |
| Denmark | -0.10 | m | -0.26 | 0.56 | m | 0.10 | m | 0.45 |
| Finland | -0.11 | m | 0.12 | 0.26 | m | 0.16 | m | 0.20 |
| France | m | m | 0.24 | m | m | m | m | 0.47 |
| Germany | 0.06 | m | -0.71 | 0.83 | m | 0.08 | m | 0.34 |
| Hungary | 0.45 | 0.42 | -0.95 | 0.45 | 0.37 | 0.61 | 0.68 | 0.69 |
| Ireland | 0.03 | m | -0.24 | 0.22 | m | -0.10 | m | 0.23 |
| Israel | m | 0.59 | -0.34 | m | 0.28 | m | 0.76 | 0.44 |
| Italy | 0.15 | 0.19 | -1.35 | 0.84 | 0.50 | 0.82 | 0.52 | 1.36 |
| Japan | 0.33 | 0.33 | m | 0.35 | 0.23 | -0.20 | 0.09 | m |
| Korea | 0.14 | 0.61 | m | -0.44 | 0.37 | 0.09 | -0.08 | m |
| Latvia | m | m | -0.19 | m | m | m | m | 0.92 |
| Lithuania | 0.28 | 0.36 | -0.10 | 1.00 | 0.20 | 0.38 | -0.08 | 0.73 |
| Netherlands | -0.21 | m | 0.06 | 0.90 | m | 0.52 | m | -0.12 |
| New Zealand | 0.00 | -0.05 | -0.01 | 1.25 | 0.66 | 0.39 | 0.32 | 0.94 |
| Norway | 0.77 | 0.54 | -0.38 | 0.96 | 0.32 | 0.59 | 0.25 | 0.44 |
| Poland | 0.11 | m | -0.62 | -0.46 | m | 0.00 | m | 0.42 |
| Portugal | 0.26 | m | -0.43 | 0.07 | m | -0.36 | m | -0.21 |
| Slovak Republic | 0.04 | m | -0.04 | 1.21 | m | 0.76 | m | 0.52 |
| Slovenia | 0.27 | 0.97 | -0.66 | 0.83 | 0.54 | 0.52 | 0.26 | 0.96 |
| Spain | 0.04 | m | -0.28 | 0.30 | m | 0.30 | m | 0.73 |
| Spain (Andalusia) | m | m | 0.11 | m | m | m | m | 0.24 |
| Sweden | 0.20 | 0.52 | -0.84 | 0.35 | 0.47 | 0.41 | 0.73 | 0.07 |
| Turkey | 0.05 | 0.39 | m | 0.10 | 0.67 | 0.43 | 0.29 | m |
| UK (England) | 0.08 | 0.15 | 0.11 | 0.72 | 0.49 | 0.30 | 0.32 | 0.26 |
| UK (Northern Ireland) | -0.04 | m | -0.07 | 0.16 | m | 0.12 | m | 0.19 |
| United States | 0.05 | 0.21 | 0.15 | 0.93 | 1.06 | 0.45 | 0.57 | 0.36 |
| US (Massachusetts) | m | 0.24 | m | m | 0.30 | m | -0.29 | m |
| US (Minnesota) | m | 0.63 | m | m | 0.14 | m | 0.06 | m |
| **OECD (average)** | **0.14** | **0.39** | **-0.30** | **0.81** | **0.55** | **0.37** | **0.48** | **0.44** |
| **OECD (av. absolute)** | **0.20** | **0.41** | **0.40** | **0.81** | **0.57** | **0.42** | **0.49** | **0.48** |

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| | Reading textbooks and resource materials in science | | Reading non-fiction books | Using computers to look up for ideas and information | | | | |
|---|---|---|---|---|---|---|---|---|
| | 4th grade | 8th grade | 4th grade | 4th grade Maths | 8th grade Maths | 4th grade Science | 8th grade Science | 4th grade Reading |
| Hong Kong, China | 0.01 | 0.42 | 0.35 | 0.50 | 0.18 | -0.41 | 0.42 | -0.02 |
| Indonesia | m | 0.62 | 0.08 | m | 0.04 | m | 0.58 | 0.35 |
| Russian Federation | -0.16 | 0.40 | -0.53 | 0.90 | 0.86 | 0.69 | 0.81 | 1.34 |
| Singapore | -0.02 | 0.39 | -0.28 | 0.62 | 0.23 | 0.29 | 0.22 | 0.12 |
| South Africa | m | 0.21 | -0.03 | m | 0.27 | m | 0.20 | 0.59 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PIRLS (2006, 2011 and 2016).

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# Chapter 6.
# Innovation in practices to develop higher order skills in science and reading

*This chapter presents the change in teaching and learning practices in science and in reading aimed at developing student's higher order skills. They include observing, imagining, designing an experiment, drawing conclusions and making inferences and making connections with real life, including one's own experience. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 27. Observing and describing natural phenomena

### Why it matters

Observing carefully what one sees and being able to describe it constitutes one of the foundations of the scientific mindset (and of domains such as the arts). This is also a key skill for personal improvement. Observing with empathy, with different lenses on, is also one habit of mind that is critical to develop students' creative and critical thinking skills.

## Primary education

### Change at the OECD level: large

Between 2007 and 2015, the share of 4th grade students observing and describing natural phenomena in at least half of their science lessons has increased by 27 percentage points. The absolute change was also 27 percentage points (changes in both directions taken into account), corresponding to a large effect size of 0.59. There has thus been substantial innovation in this domain. In 2015, on average half of the 4th grade students practised their observation skills, with a span ranging from 26% in Norway to 76% in the Slovak Republic.

### Countries where there has been the most change

Singapore stands out with an increase in the use of this practice by 44 percentage points between 2007 and 2015, followed closely by the Czech Republic, Germany and Hungary (40 percentage points). Poland also recorded a substantial increase by 44 percentage points between 2011 and 2015. In all these countries, the spread of this practice has been an innovation.

## Secondary education

### Change at the OECD level: large

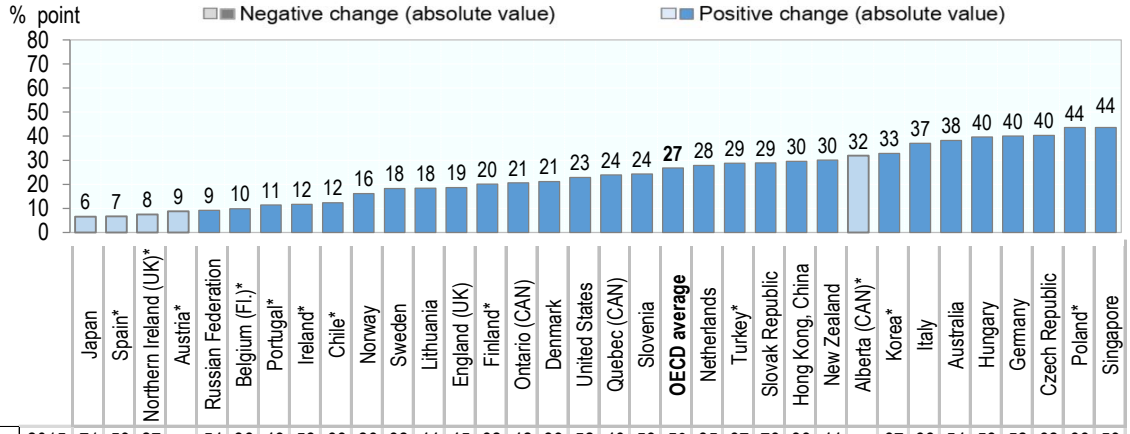
As in primary education, the share of secondary students regularly observing and describing natural phenomena during science lessons saw a net increase and an absolute change of 26 percentage points, corresponding to a very large effect size of 0.57. This has also been a substantial innovation. In 2015, 55% of students were asked to observe and describe natural phenomena in science lessons on average, with a span ranging from 81% in Turkey to 26% in Sweden.

### Countries where there has been the most change

Innovation in this practice took the form of a large expansion in the adoption of this pedagogical activity. In particular, Hong Kong, China, Hungary and Australia registered notable increases in the share of students exposed to the practice (over 40 percentage points).

**Figure 6.1. 4th grade students observing and describing natural phenomena in science lessons**

Change in and share of students whose teachers ask them to observe and describe natural phenomena in at least half the lessons, 2007-2015, teachers report



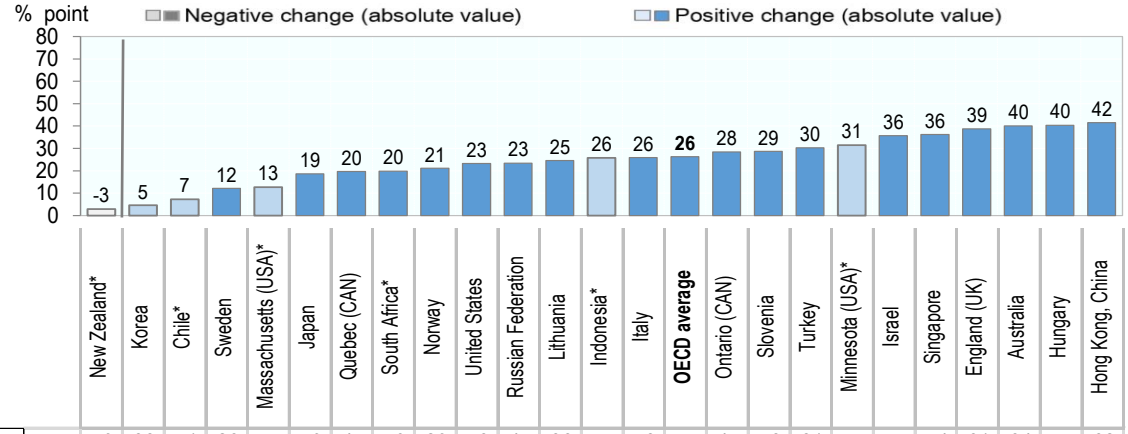

| % of students | Japan | Spain* | Northern Ireland (UK)* | Austria* | Russian Federation | Belgium (Fl.)* | Portugal* | Ireland* | Chile* | Norway | Sweden | Lithuania | England (UK) | Finland* | Ontario (CAN) | Denmark | United States | Quebec (CAN) | Slovenia | **OECD average** | Netherlands | Turkey* | Slovak Republic | Hong Kong, China | New Zealand | Alberta (CAN)* | Korea* | Italy | Australia | Hungary | Germany | Czech Republic | Poland* | Singapore |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 71 | 59 | 27 | m | 54 | 36 | 49 | 53 | 68 | 26 | 32 | 44 | 45 | 62 | 42 | 39 | 52 | 40 | 59 | **50** | 35 | 67 | 76 | 36 | 44 | m | 67 | 66 | 54 | 58 | 52 | 62 | 66 | 59 |
| 2011 | 58 | 52 | 19 | 17 | 49 | 26 | 38 | 42 | 55 | 9 | 29 | 41 | 36 | 42 | 33 | 43 | 48 | 28 | 47 | **37** | 14 | 38 | 51 | 10 | 24 | 58 | 34 | 57 | 40 | 35 | 27 | 47 | 23 | 48 |
| 2007 | 64 | m | m | 9 | 45 | m | m | m | m | 10 | 13 | 25 | 26 | m | 21 | 18 | 29 | 16 | 34 | **23** | 8 | m | 47 | 7 | 14 | 26 | m | 29 | 16 | 18 | 12 | 21 | m | 15 |

*Notes*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904410

**Figure 6.2. 8th grade students observing and describing natural phenomena in science lessons**

Change in and share of students whose teachers ask them to observe and describe natural phenomena in at least half the lessons, 2007-2015, teachers report




| % of students | New Zealand* | Korea | Chile* | Sweden | Massachusetts (USA)* | Japan | Quebec (CAN) | South Africa* | Norway | United States | Russian Federation | Lithuania | Indonesia* | Italy | **OECD average** | Ontario (CAN) | Slovenia | Turkey | Minnesota (USA)* | Israel | Singapore | England (UK) | Australia | Hungary | Hong Kong, China |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 59 | 38 | 71 | 26 | m | 59 | 47 | 70 | 29 | 53 | 47 | 36 | m | 73 | **55** | 47 | 78 | 81 | m | 57 | 54 | 61 | 64 | 55 | 62 |
| 2011 | 62 | 45 | 63 | 30 | 51 | 55 | 39 | 50 | 21 | 61 | 45 | 24 | 49 | 62 | **49** | 45 | 63 | 70 | 69 | 41 | 45 | 56 | 56 | 40 | 45 |
| 2007 | m | 34 | m | 14 | 38 | 40 | 28 | m | 8 | 29 | 23 | 11 | 23 | 48 | **29** | 19 | 49 | 51 | 38 | 22 | 18 | 23 | 24 | 14 | 20 |

*Notes*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904429

## 28. Asking students to design and plan science experiments

### Why it matters

Scientists use experiments as a key tool to test their assumptions and just to observe natural phenomena. Acquiring scientific skills or understanding the nature of science includes the ability to design and plan science experiments, to take measures and understand which experiments could cast light on specific scientific questions. This is a key practice in both teacher- and student-centred science learning environments.

## Primary education

### Change at the OECD level: large

Between 2007 and 2015, the practice gained ground in all OECD systems, with a net increase and absolute change of 17 percentage points in the proportion of 4th grade students systematically being asked to design and plan science experiments. This corresponds to a large absolute effect size of 0.43, a big change in the use of this practice. In 2015, 37% of 4th grade students were regularly using this pedagogical activity on average.

### Countries where there has been the most change

This practice particularly spread in Australia, where the share of students doing this exercise in at least half the lessons increased by 32 percentage points between 2007 and 2015. During the same time period, Denmark and Singapore also strongly innovated and recorded increases of 27 percentage points.

## Secondary education

### Change at the OECD level: moderate

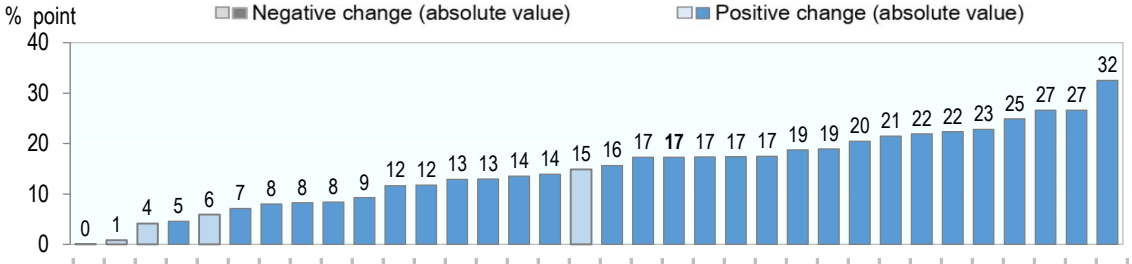
At the secondary level, the practice has also spread across OECD systems with the average share of 8th grade students regularly designing or planning experiments in science going from 19% in 2007 to 31% in 2015. The absolute change, taking into account expansions and retractions, amounted to 14 percentage points, corresponding to a moderate effect size of 0.33. In most OECD countries, the use of this pedagogy is low or moderate. Turkey stands out with 50% of the 8th grade students constantly exposed to these science exercises.

### Countries where there has been the most change

Innovation has mainly taken the form of a dissemination of this science practice. Between 2007 and 2015, important increases of 29, 24 and 23 percentage points were witnessed in Minnesota (United States), Australia and England (United Kingdom). The only contraction of the practice was experienced by Quebec (Canada) where it declined by 11 percentage points.

**Figure 6.3. 4th grade students designing and planning experiments in science**

Change in and share of students whose teachers ask them to design or plan experiments or investigation in at least half the lessons, 2007-2015, teachers report



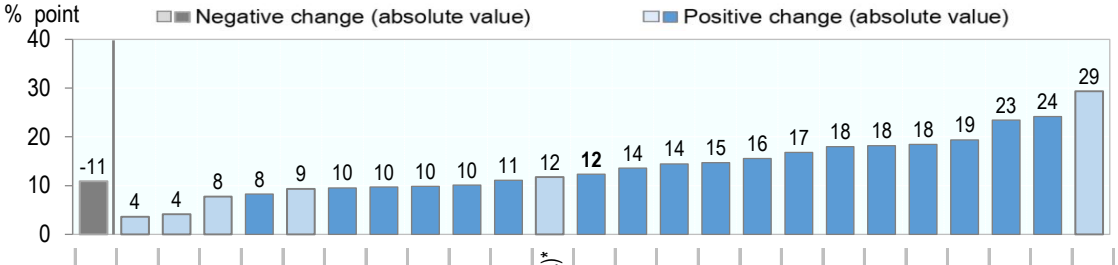

| | | Portugal* | Austria* | Northern Ireland (UK)* | Finland* | Chile* | Hungary | Belgium (Fl.)* | Ireland* | Netherlands | Turkey* | Quebec (CAN) | Japan | Spain* | Slovenia | England (UK) | Korea* | Alberta (CAN)* | Czech Republic | Sweden | **OECD average** | Germany | Norway | Lithuania | Ontario (CAN) | United States | New Zealand | Slovak Republic | Russian Federation | Italy | Hong Kong, China | Poland* | Singapore | Denmark | Australia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 30 | m | 23 | 8 | 40 | 13 | 12 | 53 | 12 | 53 | 40 | 68 | 22 | 30 | 66 | 76 | m | 19 | 29 | **37** | 24 | 20 | 23 | 39 | 40 | 42 | 43 | 32 | 47 | 27 | 30 | 40 | 42 | 50 |
| | 2011 | 30 | 3 | 18 | 3 | 34 | 8 | 4 | 45 | 3 | 44 | 37 | 70 | 9 | 22 | 66 | 62 | 43 | 12 | 33 | **30** | 17 | 7 | 13 | 32 | 36 | 34 | 16 | 16 | 40 | 18 | 5 | 38 | 44 | 39 |
| | 2007 | m | 2 | m | m | m | 6 | m | m | 3 | m | 28 | 56 | m | 17 | 53 | m | 29 | 3 | 12 | **19** | 7 | 3 | 6 | 20 | 21 | 22 | 21 | 10 | 25 | 4 | m | 13 | 15 | 18 |

*Notes*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904448

**Figure 6.4. 8th grade students designing and planning experiments in science**

Change in and share of students whose teachers ask them to design or plan experiments or investigation in at least half the lessons, 2007-2015, teachers report




| | | Quebec (CAN) | Sweden | Korea | New Zealand* | Japan | Indonesia* | Russian Federation | Norway | Chile* | Hungary | Lithuania | Massachusetts (USA)* | **OECD average** | Singapore | Turkey | Ontario (CAN) | Israel | South Africa* | Slovenia | Hong Kong, China | United States | Italy | England (UK) | Australia | Minnesota (USA)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 24 | 19 | 24 | 37 | 26 | m | 23 | 24 | 46 | 17 | 17 | m | **31** | 18 | 50 | 36 | 40 | 53 | 29 | 31 | 42 | 28 | 39 | 40 | m |
| | 2011 | 36 | 25 | 27 | 29 | 43 | 30 | 22 | 21 | 36 | 12 | 13 | 31 | **29** | 16 | 37 | 31 | 27 | 37 | 16 | 23 | 41 | 15 | 37 | 34 | 37 |
| | 2007 | 35 | 15 | 20 | m | 17 | 21 | 13 | 14 | m | 7 | 6 | 19 | **19** | 5 | 36 | 21 | 25 | m | 11 | 13 | 23 | 8 | 16 | 16 | 8 |

*Notes*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904467

## 29. Asking students to draw conclusions from an experiment in science

### Why it matters

Hands-on, experiential education is not just about doing things. The most important step of a science experiment lies in its conclusion (including the impossibility to conclude). While classes commonly involve experiments done by students, exercising this last step is key to better conclude. To make it interesting and challenging, conclusions should not be straightforward though, which they sometimes are in teacher-directed learning practices.

### Change at the OECD level: moderate

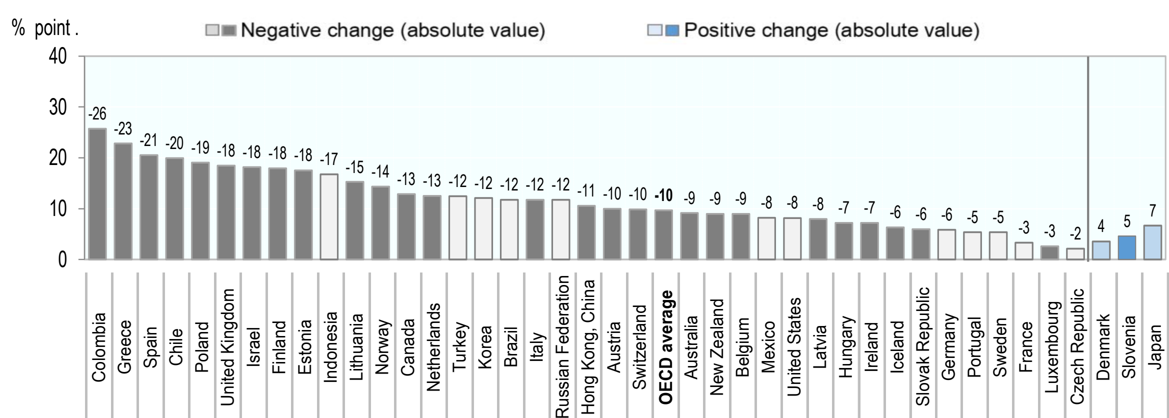
Innovation in OECD countries resulted in the reduced use of this practice. Between 2006 and 2015, the share of 15 year old students asked to draw conclusions from an experiment in all or most of their science lessons decreased by 10 percentage points on average. Together, negative and positive variations amounted to an absolute change of 11 percentage points, corresponding to a modest effect size of 0.22. The extent to which 15 year old students are regularly exposed to this science pedagogy varies considerably between OECD countries: from less than 14% of the students in Korea to 66% in Denmark in 2015.

### Countries where there has been the most change

Colombia, Greece and Spain recorded substantial contractions in this practice, above 20 percentage points in each case. Japan, Slovenia and Denmark registered the only three positive changes in the sample, albeit small ones.

**Figure 6.5. 15 year old students drawing conclusions from experiments in science**

Change in and share of students whose teachers ask them to draw conclusions from experiments they have concluded in all or most of the lessons, 2006-2015, students report




| % of students | | Colombia | Greece | Spain | Chile | Poland | United Kingdom | Israel | Finland | Estonia | Indonesia | Lithuania | Norway | Canada | Netherlands | Turkey | Korea | Brazil | Italy | Russian Federation | Hong Kong, China | Austria |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 37 | 31 | 27 | 35 | 40 | 49 | 39 | 37 | 30 | 39 | 47 | 35 | 53 | 39 | 40 | 14 | 32 | 24 | 52 | 40 | 28 |
| | 2006 | 62 | 53 | 48 | 55 | 59 | 67 | 57 | 55 | 47 | 56 | 62 | 49 | 66 | 51 | 53 | 26 | 44 | 36 | 63 | 50 | 38 |

| % of students | | Switzerland | **OECD average** | Australia | New Zealand | Belgium | Mexico | United States | Latvia | Hungary | Ireland | Iceland | Slovak Republic | Germany | Portugal | Sweden | France | Luxembourg | Czech Republic | Denmark | Slovenia | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 51 | **42** | 56 | 49 | 40 | 52 | 61 | 43 | 27 | 55 | 20 | 31 | 59 | 48 | 56 | 65 | 46 | 34 | 66 | 40 | 33 |
| | 2006 | 61 | **51** | 65 | 58 | 49 | 60 | 69 | 51 | 34 | 62 | 26 | 37 | 65 | 53 | 61 | 68 | 49 | 37 | 63 | 36 | 26 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933904486

## 30. Teacher explaining relevance of broad science topics in everyday life

### Why it matters

Students learn better science if they see the point of what they learn. Relating the scientific concepts learnt in class to the everyday life of children or, more generally, showing the relevance of what is taught to everyday life problems makes science more attractive – and its teaching and learning more effective. This good pedagogical practice should be as widespread as possible.

### Change at the OECD level: small

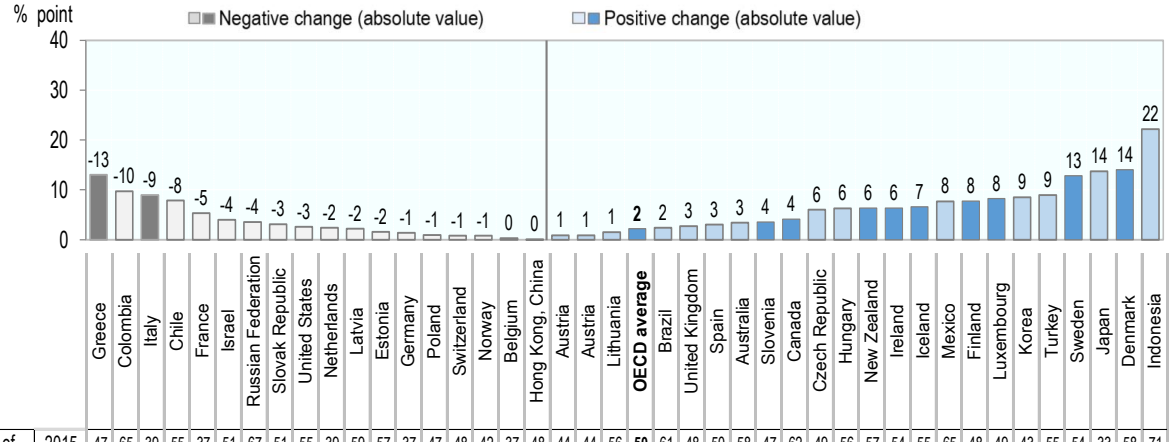
Between 2006 and 2015, the share of 15 year old students whose science teacher regularly explained the relevance of broad science topics in everyday life increased by 2 percentage point on average. Increases and reductions taken into account, the absolute change amounted to 5 percentage points, corresponding to a very small effect size of 0.1. In 2015, half of the students were exposed to this practice, which is particularly widespread in Mexico and Canada among OECD countries.

### Countries where there has been the most change

Students in Indonesia experienced an increase of 22 percentage points in this science practice. In Denmark, Sweden and Japan, it also expanded by around 14 percentage points. On the contrary, Colombia and Greece registered declines of over 10 percentage points.

**Figure 6.6. 15 year old students being explained the relevance of broad science topics**

Change in and share of students whose teachers explain them the relevance of broad science topics in everyday life in all or most of the lessons, 2006-2015, teachers report




*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933904505

## 31. Teacher explaining practical application of school science topics

### Why it matters

Some science topics cannot be easily related to students' daily life. To make the topics more relevant and interesting to them, teachers should at the very least explain what the practical applications of these science ideas are, what they allow doing or producing in real life, if not in everyday life.

### Change at the OECD level: small

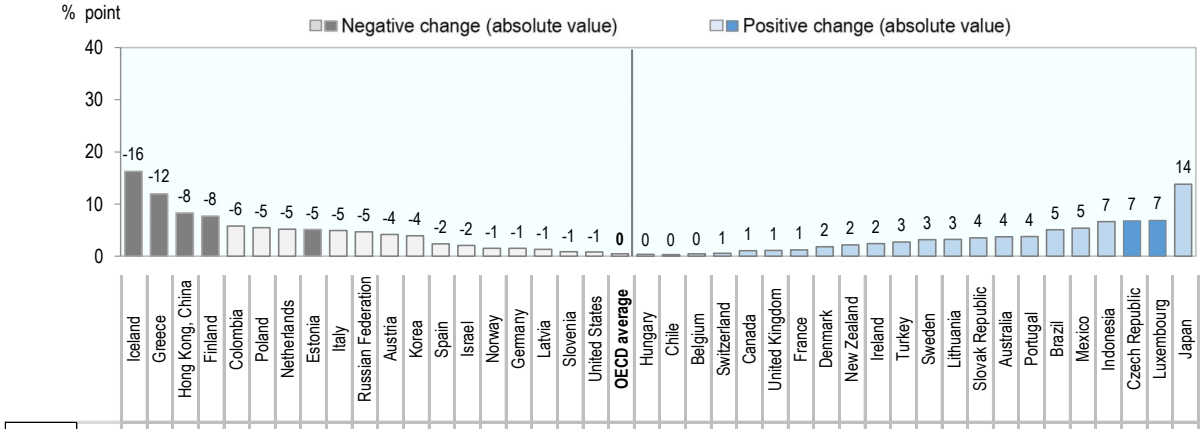
While positive and negative changes have cancelled each other across OECD countries, students experienced an absolute change in this practice of about 4 percentage points on average, corresponding to a small absolute effect size of 0.08. This practice is common across countries and concerned 59% of students in 2015, although significant differences can be observed across countries, touching 74% of students in Denmark compared to 40% in Japan.

### Countries where there has been the most change

Innovation was minor in this area and only manifested through small and modest increases and reductions in the use of this practice. Between 2007 and 2015, Japan experienced the largest diffusion of the practice (14 percentage points) whereas Iceland and Greece experienced the largest contraction (16 and 12 percentage points respectively).

**Figure 6.7. 15 year old students being explained practical applications of science topics**

Change in and share of students whose teachers explain practical applications of school science topics in all or most the lessons, 2006-2015, students report




| | | Iceland | Greece | Hong Kong, China | Finland | Colombia | Poland | Netherlands | Estonia | Italy | Russian Federation | Austria | Korea | Spain | Israel | Norway | Germany | Latvia | Slovenia | United States | **OECD average** | Hungary | Chile | Belgium | Switzerland | Canada | United Kingdom | France | Denmark | New Zealand | Ireland | Turkey | Sweden | Lithuania | Slovak Republic | Australia | Portugal | Brazil | Mexico | Indonesia | Czech Republic | Luxembourg | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 50 | 51 | 54 | 54 | 60 | 64 | 46 | 58 | 45 | 69 | 52 | 55 | 54 | 51 | 54 | 56 | 64 | 47 | 67 | **59** | 61 | 68 | 61 | 66 | 73 | 61 | 66 | 74 | 68 | 63 | 58 | 65 | 65 | 49 | 70 | 65 | 57 | 72 | 56 | 58 | 62 | 40 |
| | 2006 | 67 | 63 | 62 | 61 | 66 | 69 | 51 | 63 | 50 | 74 | 56 | 59 | 56 | 53 | 56 | 57 | 65 | 48 | 68 | **60** | 61 | 69 | 61 | 65 | 72 | 59 | 65 | 73 | 66 | 61 | 56 | 62 | 62 | 45 | 66 | 61 | 52 | 67 | 49 | 51 | 55 | 26 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases:

StatLink https://doi.org/10.1787/888933904524

## 32. Students comparing read text with their own experiences

### Why it matters

Connecting teaching and learning to students' everyday life and experiences drives their interest in learning. While reading need not be limited to what we have experienced, making connections between one's experiences and a read text helps to understand it, and also to learn to observe one's environment, be it internal (emotions and behaviour) or external (society). A good practice for text comprehension and social and behavioural skills.

### Change at the OECD level: moderate-low

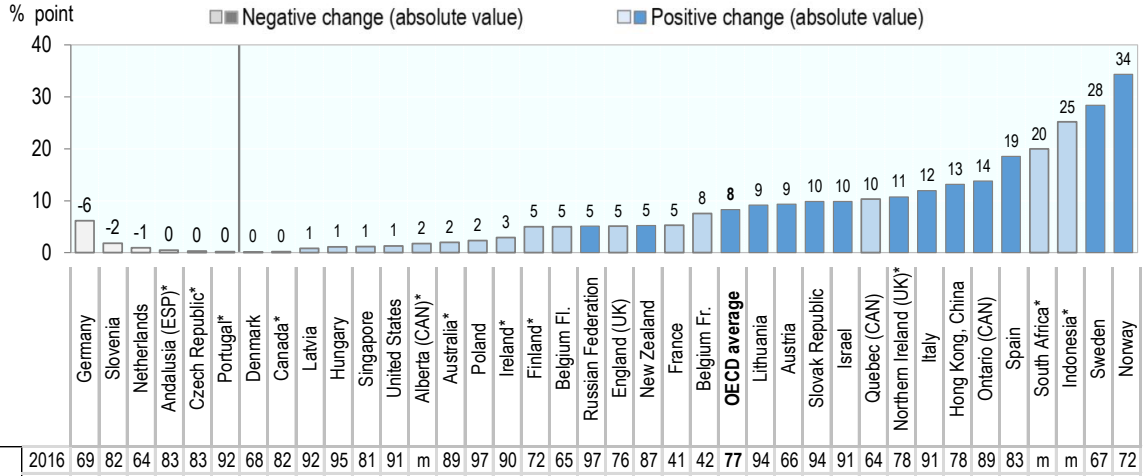
The share of primary students regularly comparing read text with their own experience rose by 8 percentage points on average between 2006 and 2016 in OECD systems. The practice spread in a majority of OECD countries. Looking at both negative and positive changes, the absolute change amounted to 9 percentage points, corresponding to a moderate-low effect size 0.22. Apart from Belgium (Fr.) and France where only around 40% of 4th grade students compared read text with their own experiences at least once a week in 2016, the practice is common in OECD countries touching at least two thirds of students, and 77% of students on average.

### Countries where there has been the most change

Norway and Sweden experienced the largest expansion of this practice, by 34 and 28 percentage points respectively. Reductions were few and not statistically significant.

**Figure 6.8. 4th grade students comparing read text with own experiences in reading lessons**

Change in and share of students whose teachers ask them to compare read text with their own experiences at least once a week, 2006-2015, teachers report




| % of students | Germany | Slovenia | Netherlands | Andalusia (ESP)* | Czech Republic* | Portugal* | Denmark | Canada* | Latvia | Hungary | Singapore | United States | Alberta (CAN)* | Australia* | Poland | Ireland* | Finland* | Belgium Fl. | Russian Federation | England (UK) | New Zealand | France | Belgium Fr. | **OECD average** | Lithuania | Austria | Slovak Republic | Israel | Quebec (CAN) | Northern Ireland (UK)* | Italy | Hong Kong, China | Ontario (CAN) | Spain | South Africa* | Indonesia* | Sweden | Norway |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 69 | 82 | 64 | 83 | 83 | 92 | 68 | 82 | 92 | 95 | 81 | 91 | m | 89 | 97 | 90 | 72 | 65 | 97 | 76 | 87 | 41 | 42 | **77** | 94 | 66 | 94 | 91 | 64 | 78 | 91 | 78 | 89 | 83 | m | m | 67 | 72 |
| 2011 | 74 | 88 | 77 | 83 | 83 | 92 | 65 | 82 | m | 95 | 89 | 95 | 85 | 87 | 96 | 87 | 67 | m | 92 | 78 | 89 | 39 | 29 | **75** | 99 | 64 | 92 | 90 | 52 | 67 | 88 | 81 | 94 | 84 | 86 | 81 | 56 | 65 |
| 2006 | 75 | 84 | 65 | m | m | m | 68 | m | 92 | 94 | 80 | 90 | 83 | m | 95 | m | m | 60 | 92 | 71 | 82 | 35 | 34 | **68** | 85 | 57 | 84 | 82 | 54 | m | 79 | 65 | 76 | 65 | 66 | 56 | 39 | 38 |

*Notes*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904543

## 33. Opportunities for students to explain their ideas

### Why it matters

Most education systems aim to develop children's critical thinking, creativity and communication skills. This requires that children are given enough room to express and explain their ideas, and that they are able to confront them with those of their peers. This "active" pedagogical practice should be part of the mix of learning activities, with teachers defining the right dosage for their teaching and learning context.

### Change at the OECD level: small

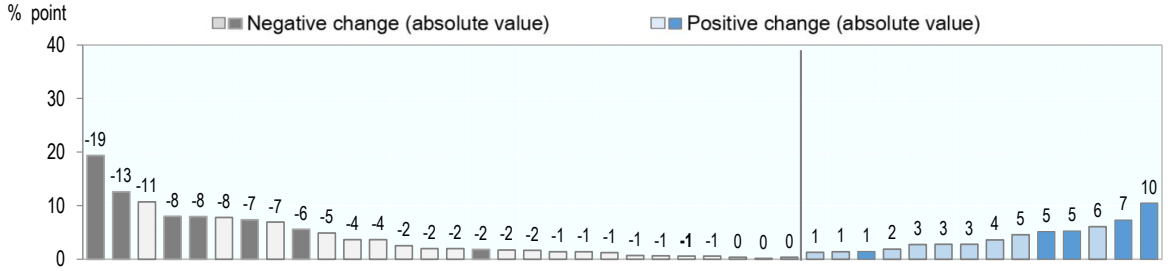
Most OECD countries saw little change in the use of this practice. Overall, negative changes slightly surpassed positive ones resulting in an average decline of 1 percentage point in the share of 15 year old students systematically given the opportunities to explain their ideas in science lessons. Accounting for increases and decreases, the mean absolute change amounted to 4 percentage points, corresponding to a small effect size of 0.1. In 2015, only 21% of secondary students were frequently given the opportunity to express their ideas in science lessons on average, with a span ranging from 8% in Poland to 68% in Denmark.

### Countries where there has been the most change

Innovation in this domains took the form of a strong meant a decrease in the use of this practice in Indonesia (-19 percentage points) and Israel (-13). On the other hand, Portugal and Denmark experienced increases by 10 and 7 percentage points respectively. In most places, there was no innovation in this domain.

**Figure 6.9. 15 year old students explaining their ideas in science lessons**

Change in and share of students who are given opportunities to explain their ideas in all or most of the lessons, 2006-2015, students report




| % of students | | Indonesia | Israel | Russian Federation | United Kingdom | Ireland | Turkey | Norway | United States | Greece | Chile | Hong Kong, China | Sweden | Italy | Colombia | Brazil | Estonia | Australia | Spain | Finland | Lithuania | New Zealand | Poland | Belgium | OECD average | Netherlands | Mexico | Germany | Canada | Switzerland | Korea | Iceland | Austria | Slovenia | Czech Republic | Hungary | Slovak Republic | Japan | Luxembourg | Latvia | France | Denmark | Portugal |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 10 | 21 | 33 | 19 | 27 | 21 | 16 | 39 | 15 | 20 | 33 | 24 | 15 | 14 | 11 | 9 | 24 | 7 | 21 | 20 | 22 | 8 | 12 | **21** | 29 | 35 | 22 | 29 | 25 | 10 | 8 | 18 | 27 | 11 | 12 | 15 | 15 | 24 | 13 | 29 | 68 | 24 |
| | 2006 | 30 | 34 | 43 | 27 | 35 | 28 | 24 | 45 | 20 | 25 | 37 | 28 | 17 | 16 | 13 | 11 | 25 | 8 | 22 | 22 | 23 | 8 | 12 | **21** | 30 | 35 | 22 | 28 | 23 | 9 | 7 | 16 | 24 | 9 | 9 | 12 | 10 | 19 | 8 | 23 | 61 | 13 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933904562

## 34. Making predictions about what will happen next in read text

### Why it matters

Imagining and envisioning are key sub-dimensions of higher order skills such as creativity and critical thinking. When the teacher is aware of this, making predictions about what will happen next in a read text can stimulate these skills. In any case it helps to learn to draw conclusions and thus to understand what is implied in a text. This teaching strategy for text comprehension can go beyond this mere objective.

### Change at the OECD level: moderate

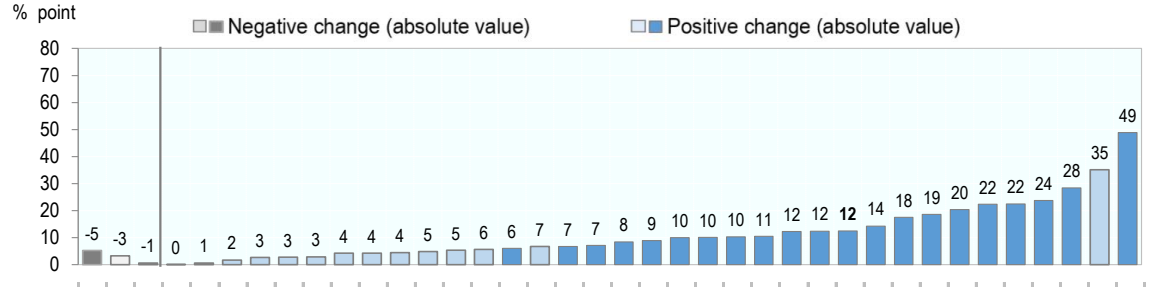
Most countries in the sample saw an expansion of the use of this practice, the OECD average rising by 12 percentage points between 2006 and 2016. Ignoring the direction of country-level changes, the average absolute change was a little over 13 percentage points which translated to a moderate effect size of 0.3. This practice was fairly common across OECD education systems in 2016, with 71% primary students concerned on average, the span going from 96% of students in Ireland to 38% in Austria.

### Countries where there has been the most change

This teaching and learning practice scaled up significantly in Sweden (49 percentage points), the Netherlands (28) and Hong Kong, China (24) between, 2006 and 2016, as well as in Indonesia (35 percentage points) between 2006 and 2011.

**Figure 6.10. 4th grade students making predictions in a read text in reading lessons**

Change in and share of students whose teachers ask them to make predictions about what will happen next in a read text at least once a week, 2006-2016, teachers report




| | | United States | Germany | Finland* | New Zealand | Canada* | Australia* | Poland | Portugal* | Alberta (CAN)* | Ireland* | South Africa* | Israel | Czech Republic* | Ontario (CAN) | France | Singapore | Andalusia (ESP)* | England (UK) | Austria | Northern Ireland (UK)* | Latvia | Belgium Fl. | Slovenia | Lithuania | Hungary | Russian Federation | Italy | **OECD average** | Norway | Denmark | Quebec (CAN) | Spain | Slovak Republic | Belgium Fr. | Hong Kong, China | Netherlands | Indonesia* | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 91 | 52 | 44 | 94 | 88 | 94 | 65 | 92 | m | 96 | m | 89 | 59 | 94 | 59 | 90 | 73 | 94 | 38 | 93 | 79 | 61 | 57 | 86 | 86 | 90 | 84 | **71** | 42 | 61 | 77 | 68 | 75 | 53 | 75 | 78 | m | 68 |
| | 2011 | 98 | 53 | 44 | 94 | 87 | 92 | 75 | 89 | 92 | 91 | 68 | 97 | 54 | 93 | 54 | 90 | 66 | 96 | 37 | 84 | m | m | 55 | 90 | 83 | 84 | 78 | **68** | 33 | 50 | 69 | 63 | 72 | 45 | 78 | 77 | 71 | 38 |
| | 2006 | 96 | 55 | m | 94 | m | m | 62 | m | 89 | m | 64 | 84 | m | 88 | 53 | 84 | m | 87 | 31 | m | 70 | 50 | 46 | 75 | 75 | 77 | 71 | **59** | 28 | 43 | 58 | 48 | 53 | 31 | 51 | 50 | 36 | 19 |

*Notes*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904581

## 35. Using digital devices for playing simulations at school

### Why it matters

One of the virtues of computers for learning lies in their power for simulations: they allow students to practice and to become experts in specific tasks without the real-life consequences of failure. Playing simulations (or learning in simulated environments) is thus one of the smart uses of computers for learning, and an interesting pedagogical practice to adopt, both in mathematics and other domains – although it will typically have to be supplemented by other non-simulated practices.

### Change at the OECD level: small

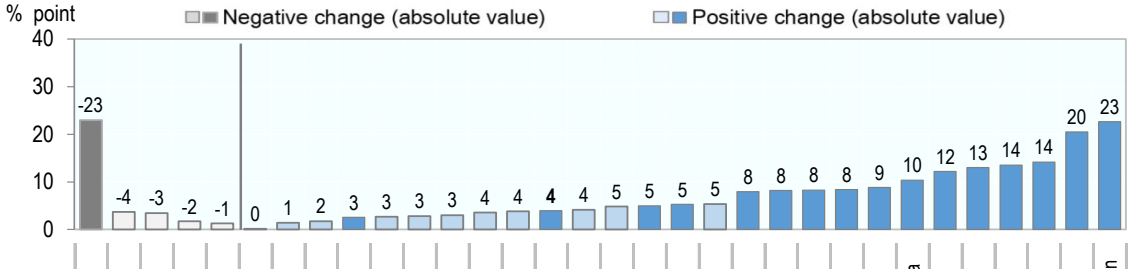
Across the OECD area, the use of this practice has more often increased than decreased. Overall, 4% more of the students reported to be doing these simulations at school at least once a month in 2015 than in 2009. The absolute change was around 6 percentage points, representing a small effect size of 0.15. The use of this IT-based practice is often low or moderate in OECD countries, with 26% of students concerned on average, with a span going from 41% in Italy to 10% in Japan.

### Countries where there has been the most change

Innovation occurred in both directions. Between 2009 and 2015 the Russian Federation saw the greatest increase in this practice (23 percentage points), while Germany experienced the most substantial decline (23 percentage points). An innovation in both places, but in opposite direction.

**Figure 6.11. 15 year old students using digital devices for playing simulations at school**

Change in and share of students who play simulations on computers at school, at least once a month, 2009-2015, students report.




| | | Germany | Ireland | Netherlands | Australia | Switzerland | Czech Republic | Belgium | Austria | Iceland | Finland | Japan | Denmark | Korea | Poland | **OECD average** | Chile | Greece | Slovenia | Portugal | Spain | Estonia | Hungary | Singapore | Israel | New Zealand | Hong Kong, China | Italy | Lithuania | Sweden | Slovak Republic | Latvia | Russian Federation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 14 | 14 | 25 | 31 | 22 | 30 | 19 | 23 | 18 | 27 | 10 | 33 | 11 | 22 | **26** | 23 | 36 | 35 | 29 | 24 | 23 | 31 | 28 | 34 | 29 | 30 | 41 | 36 | 32 | 35 | 36 | 40 |
| | 2009 | 37 | 17 | 28 | 32 | 23 | 30 | 17 | 22 | 15 | 25 | 7 | 30 | 7 | 18 | **22** | 19 | 31 | 30 | 24 | 19 | 15 | 22 | 19 | 25 | 20 | 20 | 29 | 23 | 19 | 21 | 16 | 17 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933904600

## 36. Allowing students to design their own experiments

### Why it matters

Designing their own experiments is one of the learning strategies for students to think as scientists and to get a deeper understanding of scientific phenomena. This pedagogical practice should be part of a mix of pedagogical practices in science and requires subtle guidance and feedback from teachers and peers. Allowing students to choose their own experiment also supports their student agency.

### Change at the OECD level: small

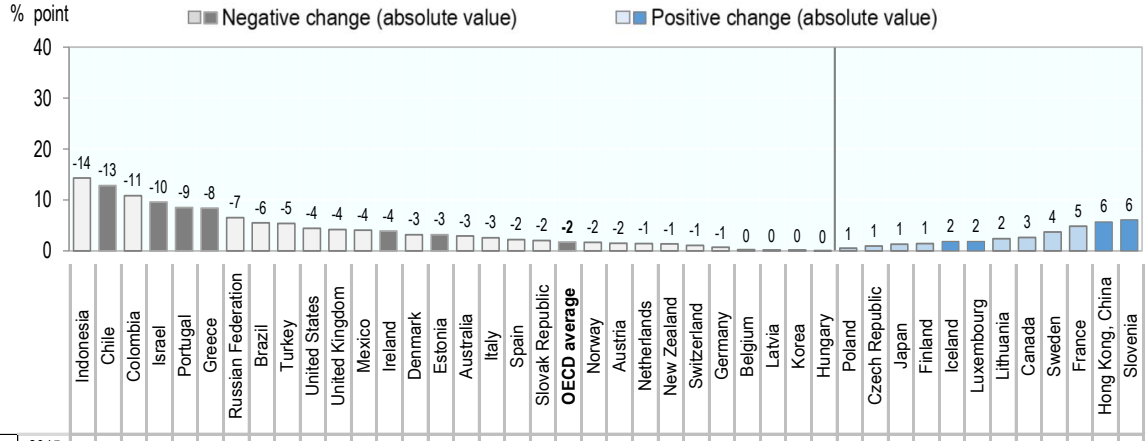
Between 2006 and 2015, negative changes slightly outweighed positive ones across OECD countries, leading to a net decrease of almost 2 percentage points in the share 15 year old students allowed to design their own experiments in most science lessons. The absolute change was 3 percentage points, with a small absolute effect size of 0.08. This practice is uncommon in OECD countries, with 16% students concerned on average in 2015, and a span going from 6% in Ireland and Finland to 36% in Turkey.

### Countries where there has been the most change

Negative changes trump positive ones in this practice. Slovenia and Hong Kong, China experienced a small increase (6 percentage points) between 2006 and 2015, but innovation mainly occurred in Chile, Colombia and Indonesia with contractions over 10 percentage points.

**Figure 6.12. 15 year old students designing their own experiments in science**

Change in and share of students who are allowed to design their own experiments in all or most of the lessons, 2006-2015, students report




| | | Indonesia | Chile | Colombia | Israel | Portugal | Greece | Russian Federation | Brazil | Turkey | United States | United Kingdom | Mexico | Ireland | Denmark | Estonia | Australia | Italy | Spain | Slovak Republic | **OECD average** | Norway | Austria | Netherlands | New Zealand | Switzerland | Germany | Belgium | Latvia | Korea | Hungary | Poland | Czech Republic | Japan | Finland | Iceland | Luxembourg | Lithuania | Canada | Sweden | France | Hong Kong, China | Slovenia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 23 | 16 | 22 | 22 | 20 | 15 | 30 | 26 | 36 | 25 | 9 | 30 | 6 | 10 | 12 | 13 | 13 | 11 | 16 | **16** | 11 | 11 | 11 | 13 | 17 | 13 | 11 | 15 | 12 | 12 | 16 | 14 | 10 | 6 | 11 | 18 | 15 | 21 | 23 | 22 | 20 | 28 |
| | 2006 | 38 | 29 | 33 | 31 | 28 | 23 | 37 | 31 | 42 | 30 | 14 | 34 | 10 | 13 | 15 | 16 | 16 | 13 | 18 | **17** | 13 | 12 | 13 | 14 | 18 | 14 | 12 | 15 | 13 | 12 | 16 | 13 | 9 | 5 | 9 | 16 | 13 | 18 | 19 | 17 | 14 | 21 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933904619

**Table 6.1. Effect sizes for changes in practices to develop creative and critical thinking skills in science and reading**

| | Observing and describing natural phenomena | | Students designing and planning science experiments | | Students drawing conclusions from an experiment | Teacher explaining relevance road science topics | Teacher explaining practical application of school science topics | Students comparing read text with their own experiences | Opportunities for students to explain their ideas | Making predictions about what will happen next in read text | Using digital devices for playing simulations at school | Scope for students to design their own experiments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4th grade | 8th grade | 4th grade | 8th grade | 8th grade | 8th grade | 8th grade | 4th grade | 8th grade | 4th grade | 8th grade | 8th grade |
| Australia | 0.83 | 0.83 | 0.71 | 0.55 | -0.19 | 0.07 | 0.08 | 0.06 | -0.04 | 0.07 | -0.04 | -0.08 |
| Austria | 0.26 | m | 0.05 | m | -0.21 | 0.02 | -0.08 | 0.19 | 0.05 | 0.15 | 0.04 | -0.05 |
| Belgium | m | m | m | m | -0.18 | -0.01 | 0.01 | m | -0.02 | m | 0.04 | -0.01 |
| Belgium (Fl.) | 0.21 | m | 0.30 | m | m | m | m | 0.10 | m | 0.20 | m | m |
| Belgium (Fr.) | m | m | m | m | m | m | m | 0.16 | m | 0.46 | m | m |
| Canada | m | m | m | m | -0.26 | 0.08 | 0.02 | 0.00 | 0.01 | 0.02 | m | 0.07 |
| Canada (Alberta) | 0.66 | m | 0.31 | m | m | m | m | 0.05 | m | 0.10 | m | m |
| Canada (Ontario) | 0.45 | 0.62 | 0.41 | 0.33 | m | m | m | 0.37 | m | 0.19 | m | m |
| Canada (Quebec) | 0.55 | 0.41 | 0.25 | -0.24 | m | m | m | 0.21 | m | 0.40 | m | m |
| Chile | 0.26 | 0.16 | 0.12 | 0.20 | -0.40 | -0.16 | -0.01 | m | -0.12 | m | 0.10 | -0.31 |
| Czech Republic | 0.85 | m | 0.55 | m | -0.05 | 0.12 | 0.14 | -0.01 | 0.09 | 0.10 | 0.00 | 0.03 |
| Denmark | 0.48 | m | 0.60 | m | 0.07 | 0.28 | 0.04 | 0.00 | 0.15 | 0.35 | 0.06 | -0.10 |
| Estonia | m | m | m | m | -0.36 | -0.03 | -0.10 | m | -0.06 | m | 0.20 | -0.09 |
| Finland | 0.40 | m | 0.20 | m | -0.36 | 0.16 | -0.16 | 0.11 | -0.03 | -0.01 | 0.06 | 0.06 |
| France | m | m | m | m | -0.07 | -0.11 | 0.03 | 0.11 | 0.14 | 0.11 | m | 0.12 |
| Germany | 0.91 | m | 0.50 | m | -0.12 | -0.03 | -0.03 | -0.14 | 0.00 | -0.07 | -0.54 | -0.02 |
| Greece | m | m | m | m | -0.47 | -0.26 | -0.24 | m | -0.15 | m | 0.10 | -0.21 |
| Hungary | 0.85 | 0.89 | 0.25 | 0.32 | -0.16 | 0.13 | -0.01 | 0.05 | 0.09 | 0.27 | 0.19 | 0.00 |
| Iceland | m | m | m | m | -0.15 | 0.13 | -0.33 | m | 0.05 | m | 0.07 | 0.06 |
| Ireland | 0.23 | m | 0.17 | m | -0.15 | 0.13 | 0.05 | 0.09 | -0.17 | 0.18 | -0.10 | -0.14 |
| Israel | m | 0.75 | m | 0.33 | -0.37 | -0.08 | -0.04 | 0.29 | -0.28 | 0.13 | 0.18 | -0.22 |
| Italy | 0.76 | 0.54 | 0.47 | 0.52 | -0.26 | -0.18 | -0.10 | 0.34 | -0.07 | 0.30 | 0.26 | -0.07 |
| Japan | 0.14 | 0.38 | 0.24 | 0.20 | 0.15 | 0.31 | 0.30 | m | 0.14 | m | 0.10 | 0.04 |
| Korea | 0.67 | 0.09 | 0.30 | 0.10 | -0.31 | 0.18 | -0.08 | m | 0.05 | m | 0.13 | 0.00 |
| Latvia | m | m | m | m | -0.16 | -0.05 | -0.03 | 0.03 | 0.17 | 0.21 | 0.48 | -0.01 |
| Lithuania | 0.39 | 0.60 | 0.52 | 0.37 | -0.31 | 0.03 | 0.07 | 0.30 | -0.03 | 0.26 | 0.29 | 0.07 |
| Luxembourg | m | m | m | m | -0.05 | 0.17 | 0.14 | m | 0.13 | m | m | 0.05 |
| Mexico | m | m | m | m | -0.17 | 0.16 | 0.12 | m | -0.01 | m | m | -0.09 |
| Netherlands | 0.71 | m | 0.33 | m | -0.25 | -0.05 | -0.10 | -0.02 | -0.01 | 0.60 | -0.08 | -0.04 |
| New Zealand | 0.69 | -0.06 | 0.44 | 0.16 | -0.18 | 0.13 | 0.05 | 0.15 | -0.03 | 0.00 | 0.21 | -0.04 |
| Norway | 0.43 | 0.57 | 0.60 | 0.25 | -0.29 | -0.02 | -0.03 | 0.70 | -0.18 | 0.30 | m | -0.05 |
| Poland | 0.91 | m | 0.70 | m | -0.38 | -0.02 | -0.12 | 0.12 | -0.02 | 0.06 | 0.10 | 0.01 |
| Portugal | 0.23 | m | 0.00 | m | -0.11 | 0.02 | 0.08 | -0.01 | 0.27 | 0.09 | 0.12 | -0.20 |
| Slovak Republic | 0.60 | m | 0.47 | m | -0.13 | -0.06 | 0.07 | 0.32 | 0.10 | 0.47 | 0.32 | -0.05 |
| Slovenia | 0.49 | 0.61 | 0.31 | 0.46 | 0.10 | 0.07 | -0.02 | -0.05 | 0.06 | 0.20 | 0.11 | 0.14 |
| Spain | 0.13 | m | 0.37 | m | -0.43 | 0.06 | -0.05 | 0.43 | -0.06 | 0.42 | 0.13 | -0.07 |
| Spain (Andalusia) | m | m | m | m | m | m | m | -0.01 | m | 0.15 | m | m |
| Sweden | 0.45 | 0.31 | 0.43 | 0.10 | -0.11 | 0.26 | 0.07 | 0.58 | -0.08 | 1.03 | 0.31 | 0.09 |
| Switzerland | m | m | m | m | -0.20 | -0.02 | 0.01 | m | 0.03 | m | -0.03 | -0.03 |
| Turkey | 0.58 | 0.66 | 0.19 | 0.29 | -0.25 | 0.18 | 0.05 | m | -0.18 | m | m | -0.11 |

| | Observing and describing natural phenomena | | Students designing and planning science experiments | | Students drawing conclusions from an experiment | Teacher explaining relevance of broad science topics | Teacher explaining practical application of school science topics | Students comparing read text with their own experiences | Opportunities for students to explain their ideas | Making predictions about what will happen next in read text | Using digital devices for playing simulations at school | Scope for students to design their own experiments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 8th Grade | 8th grade | 8th grade | 4th grade | 8th grade | 4th grade | 8th grade | 8th grade |
| United Kingdom | m | m | m | m | -0.38 | 0.05 | 0.02 | m | -0.19 | m | m | -0.13 |
| UK (England) | 0.39 | 0.81 | 0.28 | 0.54 | m | m | m | 0.12 | m | 0.23 | m | m |
| UK (Northern Ireland) | 0.18 | m | 0.10 | m | m | m | m | 0.24 | m | 0.27 | m | m |
| United States | 0.47 | 0.48 | 0.42 | 0.40 | -0.17 | -0.05 | -0.02 | 0.04 | -0.14 | -0.22 | m | -0.10 |
| US (Massachusetts) | m | 0.26 | m | 0.27 | m | m | m | m | m | m | m | m |
| US (Minnesota) | m | 0.64 | m | 0.74 | m | m | m | m | m | m | m | m |
| **OECD (average)** | **0.56** | **0.54** | **0.39** | **0.29** | **-0.19** | **0.04** | **-0.01** | **0.19** | **-0.01** | **0.26** | **0.09** | **-0.05** |
| **OECD (av. absolute)** | **0.59** | **0.57** | **0.43** | **0.33** | **0.22** | **0.11** | **0.08** | **0.22** | **0.10** | **0.30** | **0.15** | **0.08** |
| Brazil | m | m | m | m | -0.24 | 0.05 | 0.10 | m | -0.06 | m | m | -0.12 |
| Colombia | m | m | m | m | -0.52 | -0.21 | -0.12 | m | -0.06 | m | m | -0.24 |
| Hong Kong, China | 0.76 | 0.88 | 0.69 | 0.45 | -0.21 | 0.00 | -0.17 | 0.29 | -0.08 | 0.50 | 0.24 | 0.15 |
| Indonesia | m | 0.54 | m | 0.21 | -0.34 | 0.46 | 0.13 | 0.55 | -0.50 | 0.72 | m | -0.31 |
| Russian Federation | 0.18 | 0.50 | 0.55 | 0.25 | -0.24 | -0.08 | -0.10 | 0.23 | -0.22 | 0.34 | 0.51 | -0.14 |
| Singapore | 0.95 | 0.78 | 0.62 | 0.45 | m | m | m | 0.03 | m | 0.18 | 0.20 | m |
| South Africa | m | 0.41 | m | 0.34 | m | m | m | 0.48 | m | 0.09 | m | m |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015), PISA (2006, 2009 and 2015) and PIRLS (2006, 2011 and 2016).

StatLink https://doi.org/10.1787/888933904638

# Chapter 7.
# Innovation in personalised, collaborative and teacher-directed learning practices in reading

*This chapter presents the change in teaching and learning practices in reading that take different types of formats: personalised (for example, individualised instruction), collaborative (for example, students' peer discussion) or teacher-directed (for example, teacher reading to the whole class). The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 37. Making students read items of their choice

### Why it matters

Personalisation of learning does not necessarily imply student choice, but it is one component. The possibility to choose may reinforce interest, while mandated reading may trigger curiosity. Too often, students lack opportunity to read items of their choice just because it makes teachers' life easier. Are most teachers striking the right balance between texts chosen by students or by themselves? Not sure.

### Change at the OECD level: moderate

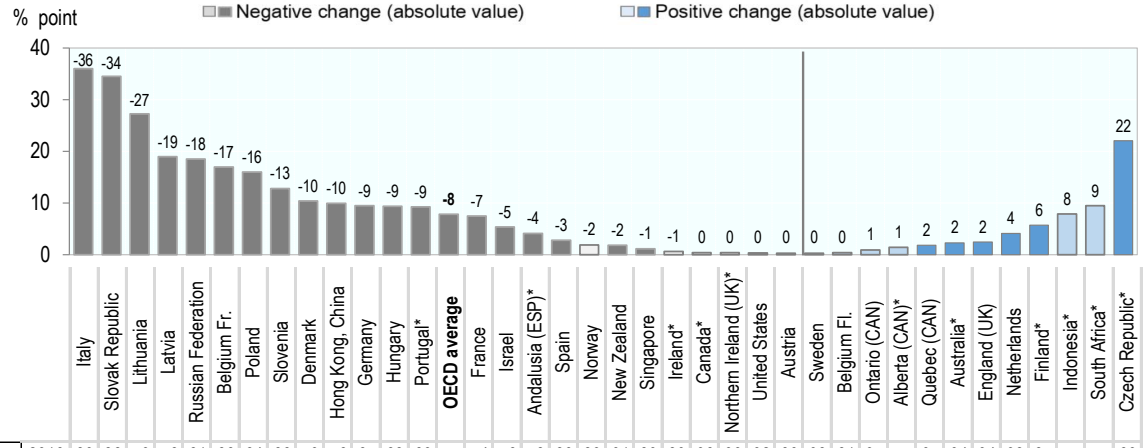
At the OECD level, the contraction of this practice strongly outweigh its spreading, leading to an average net decrease of 8 percentage points between 2006 and 2016. Accounting for changes in both directions, the absolute change was 9 percentage points on average, corresponding to a modest effect size of 0.2. This practice was widely used across OECD education systems in 2016, touching 77% of primary students, although large disparities prevail, with a span going from less than 40% in Italy and the Slovak Republic against 97% in Quebec (Canada).

### Countries where there has been the most change

Italy, the Slovak Republic and Lithuania experienced strong innovation in this area, with falls by 36, 34 and 27 percentage points respectively of the share of students concerned, followed by Lithuania with a decline of 27 percentage points between 2006 and 2016. Most negative changes were considerable in magnitude. The only substantial expansion occurred in the Czech Republic (22 percentage points) between 2011 and 2016.

**Figure 7.1. 4th grade students reading items of their own choice in reading lessons**

Change in and share of students who read items of their own choice during school lessons at least once a week, 2006-2016, students report




| | | Italy | Slovak Republic | Lithuania | Latvia | Russian Federation | Belgium Fr. | Poland | Slovenia | Denmark | Hong Kong, China | Germany | Hungary | Portugal* | **OECD average** | France | Israel | Andalusia (ESP)* | Spain | Norway | New Zealand | Singapore | Ireland* | Canada* | Northern Ireland (UK)* | United States | Austria | Sweden | Belgium Fl. | Ontario (CAN) | Alberta (CAN)* | Quebec (CAN) | Australia* | England (UK) | Netherlands | Finland* | Indonesia* | South Africa* | Czech Republic* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 39 | 38 | 59 | 56 | 61 | 66 | 64 | 66 | 79 | 76 | 67 | 63 | 69 | **77** | 74 | 76 | 78 | 80 | 89 | 91 | 89 | 89 | 96 | 90 | 92 | 80 | 93 | 81 | 95 | m | 97 | 94 | 94 | 93 | 87 | m | m | 60 |
| | 2011 | 70 | 59 | 76 | m | 71 | 79 | 70 | 76 | 91 | 83 | 63 | 65 | 78 | **82** | 78 | 82 | 82 | 82 | 89 | 93 | 87 | 90 | 96 | 90 | 92 | 80 | 94 | m | 96 | 97 | 95 | 92 | 93 | 91 | 82 | 88 | 87 | 38 |
| | 2006 | 75 | 73 | 86 | 75 | 79 | 83 | 79 | 79 | 89 | 86 | 77 | 72 | m | **85** | 82 | 81 | m | 82 | 91 | 93 | 90 | m | m | m | 93 | 80 | 93 | 81 | 94 | 95 | 95 | m | 91 | 89 | m | 80 | 78 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904657

## 38. Giving students time to read books of their own choice

### Why it matters

To incentivise students to read for pleasure, reading must me somewhat decoupled from teacher-assigned work, and one teaching strategy is to leave students some time to read a book of their choosing. While teachers should also assign some common reading to allow discussion between students or to ensure they read a diversity of texts, letting students time and choice supports their agency and autonomy in the learning process.

### Change at the OECD level: moderate

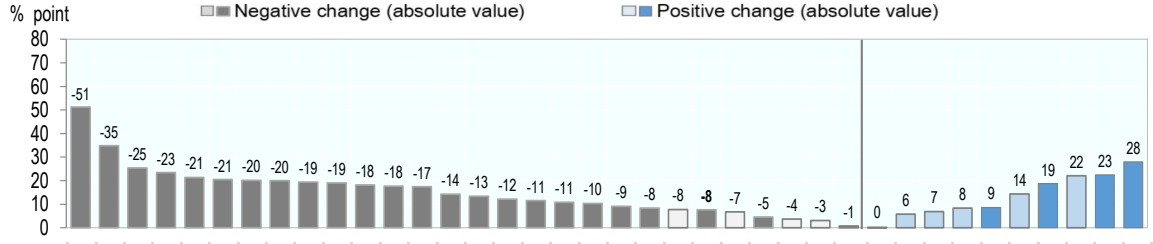
In OECD systems, 61% of 4th grade students were given time to read books of their own choice at least once a week on average in 2016, against 68% in 2006, a net decline by 7 percentage points. The average absolute change of 13 percentage points, including increases and reductions, corresponds to a moderate effect size of 0.34. While particularly widespread in the Netherlands, touching 92% of 4th grade students, this practice was used for 61% of primary students on average in 2016. With only 18% of students concerned, Poland makes the least use of it.

### Countries where there has been the most change

With an outstanding decline of 51 percentage points between 2011 and 2016, this was a strong domain of innovation in Finland. Between 2006 and 2016, Norway and Denmark also experienced significant contractions by over 25 percentage points of the practice. Almost all the downward changes in this practice were large in magnitude. Conversely, it expanded by 28 and 23 percentage points respectively in Lithuania and Italy.

**Figure 7.2. 4th grade students given time to read books of their own choice for reading lessons**

Change in and share of students whose teachers give them time to read books of their own choice at least once a week, 2006-2016, teachers report




| | | Finland* | Norway | Denmark | Hong Kong, China | Sweden | Singapore | Portugal* | Ireland* | Russian Federation | Belgium Fr. | England (UK) | France | Andalusia (ESP)* | Poland | Northern Ireland (UK)* | Ontario (CAN) | Australia* | New Zealand | Canada* | Belgium Fl. | United States | Spain | **OECD average** | Israel | Netherlands | Germany | Quebec (CAN) | Alberta (CAN)* | Slovenia | Latvia | Austria | Hungary | Czech Republic* | Indonesia* | Slovak Republic | South Africa* | Italy | Lithuania |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 38 | 58 | 56 | 39 | 77 | 63 | 52 | 73 | 40 | 51 | 76 | 53 | 55 | 18 | 80 | 87 | 84 | 86 | 87 | 56 | 87 | 56 | **61** | 58 | 92 | 33 | 88 | m | 38 | 32 | 58 | 40 | 40 | m | 45 | m | 54 | 60 |
| | 2011 | 90 | 95 | 91 | 74 | 99 | 88 | 72 | 93 | 67 | 58 | 98 | 65 | 72 | 21 | 94 | 98 | 95 | 98 | 98 | m | 96 | 67 | **72** | 88 | 99 | 47 | 95 | 99 | 32 | m | 68 | 39 | 32 | 49 | 38 | 73 | 46 | 43 |
| | 2006 | m | 93 | 81 | 62 | 98 | 84 | m | m | 60 | 70 | 94 | 70 | m | 33 | m | 99 | m | 97 | m | 65 | 96 | 63 | **68** | 65 | 97 | 37 | 91 | 100 | 38 | 26 | 51 | 31 | m | 35 | 26 | 51 | 31 | 32 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904676

## 39. Individualised instruction for reading

### Why it matters

Depending on their social backgrounds, special needs, interest or abilities, students learn to read at a different pace. Giving each student reading material that corresponds to their right learning level or focusing on their specific difficulties is the most effective instruction for reading. Easier said than done though. Teachers' attempts to individualise reading instruction are thus welcome and should be systematic.

### Change at the OECD level: moderate

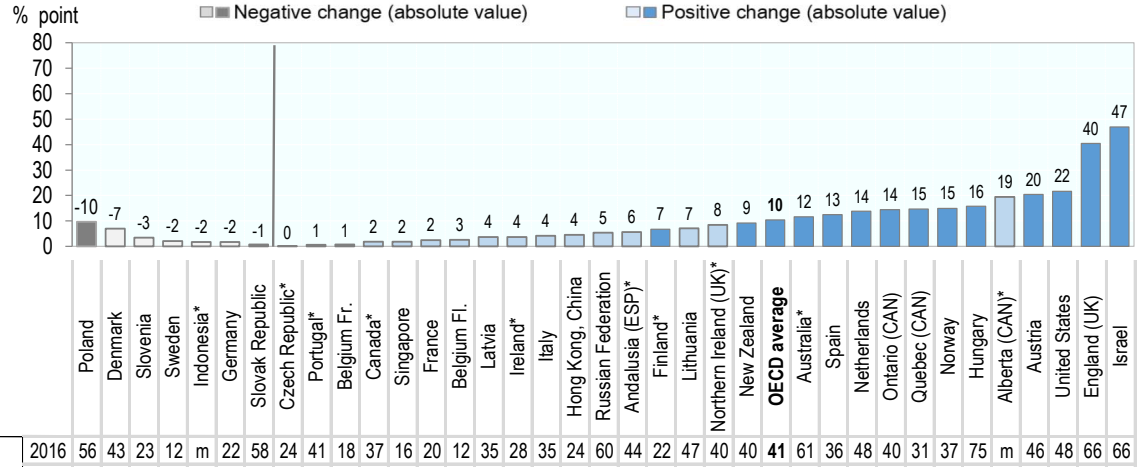
This practice has mostly spread across OECD systems. Between 2006 and 2016, the share of 4th grade students systematically receiving individualised reading instruction rose by 10 percentage points on average. The absolute change, regardless of direction, amounted to 12 percentage points and corresponds to a moderate effect size of 0.27. Among OECD education systems, this practice remains relatively uncommon, with only 41% of the 4th grade students on average concerned in OECD countries, the span going from 75% in Hungary to 12% in Sweden and Belgium (Fl.).

### Countries where there has been the most change

Students in Israel and England (United Kingdom) experienced large increases by 47 and 40 percentage points respectively between 2006 and 2016. Negative changes were less remarkable. Poland saw a fall of 10 percentage points (but remained above average).

**Figure 7.3. Individualised instruction in 4th grade reading lessons**

Change in and share of students whose teachers always or often use individualised instruction for reading, 2006-2016, teachers report




| % of students | Poland | Denmark | Slovenia | Sweden | Indonesia* | Germany | Slovak Republic | Czech Republic* | Portugal* | Belgium Fr. | Canada* | Singapore | France | Belgium Fl. | Latvia | Ireland* | Italy | Hong Kong, China | Russian Federation | Andalusia (ESP)* | Finland* | Lithuania | Northern Ireland (UK)* | New Zealand | **OECD average** | Australia* | Spain | Netherlands | Ontario (CAN) | Quebec (CAN) | Norway | Hungary | Alberta (CAN)* | Austria | United States | England (UK) | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 56 | 43 | 23 | 12 | m | 22 | 58 | 24 | 41 | 18 | 37 | 16 | 20 | 12 | 35 | 28 | 35 | 24 | 60 | 44 | 22 | 47 | 40 | 40 | **41** | 61 | 36 | 48 | 40 | 31 | 37 | 75 | m | 46 | 48 | 66 | 66 |
| 2011 | 45 | 54 | 19 | 18 | 72 | 25 | 65 | 24 | 40 | 18 | 35 | 22 | 17 | m | m | 25 | 45 | 26 | 62 | 38 | 15 | 37 | 32 | 33 | **40** | 50 | 36 | 55 | 42 | 23 | 48 | 72 | 40 | 35 | 46 | 43 | 65 |
| 2006 | 65 | 50 | 26 | 14 | 74 | 24 | 59 | m | m | 17 | m | 14 | 17 | 9 | 31 | m | 31 | 19 | 55 | m | m | 40 | m | 31 | **31** | m | 24 | 34 | 25 | 16 | 22 | 60 | 20 | 25 | 27 | 26 | 19 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904695

## 40. Frequency of teaching reading as a whole-class activity

### Why it matters

Teaching reading as a whole-class activity is extremely common given the organisation of the classroom and the teaching culture in most countries. It has its advantages as all students can in principle benefit from the guidance and attention of the teacher, unless they get bored and lose attention and interest. It has to be balanced with other types of teaching and learning strategies.

### Change at the OECD level: small

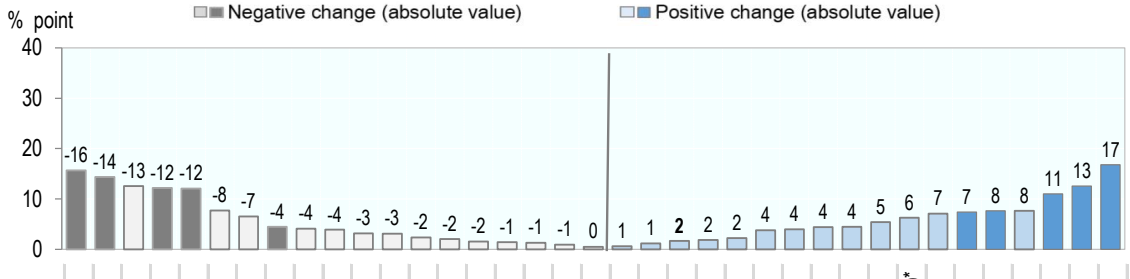
On average, this practice remained stable, with a slight expansion by 2 percentage points between 2006 and 2016. During this period, the mean absolute change was 7 percentage points, corresponding to a small effect size of 0.15. There is a substantial use of systematic whole-class teaching in 4th grade reading lessons, as it concerned 71% students on average in OECD educations systems in 2016. The practice is nearly universal in Portugal (94%). New Zealand is an exception to the rule, with only 13% of 4th grade students experiencing this teaching and learning strategy.

### Countries where there has been the most change

All in all, few countries experienced strong innovation in this domain. Sweden experienced the largest expansion (17 percentage points), and Poland, the largest contraction (-16 percentage points) between 2006 and 2016: an innovation for many students in both countries.

**Figure 7.4. Frequency of teaching reading as a whole-class activity in 4th grade**

Change in and share of students whose teachers always or often teach reading as a whole-class activity, 2006-2016, teachers report




| | Poland | Lithuania | Alberta (CAN)* | Belgium Fl. | Netherlands | Austria | Ontario (CAN) | Latvia | Finland* | Ireland* | France | Andalusia (ESP)* | Italy | Belgium Fr. | Russian Federation | Canada* | Spain | Indonesia* | Czech Republic* | Portugal* | United States | **OECD average** | England (UK) | Australia* | New Zealand | Singapore | Hungary | Denmark | Quebec (CAN) | Northern Ireland (UK)* | Hong Kong, China | Germany | Slovak Republic | Israel | Slovenia | Norway | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students 2016 | 63 | 62 | m | 44 | 44 | 52 | 69 | 93 | 77 | 74 | 83 | 95 | 96 | 82 | 98 | 73 | 92 | m | 80 | 94 | 76 | **71** | 51 | 55 | 13 | 85 | 84 | 64 | 91 | 46 | 87 | 74 | 85 | 81 | 71 | 74 | 73 |
| 2011 | 99 | 59 | 60 | m | 37 | 54 | 75 | m | 81 | 78 | 83 | 98 | 96 | 83 | 98 | 75 | 96 | 89 | 80 | 93 | 69 | **70** | 43 | 53 | 11 | 77 | 73 | 57 | 91 | 40 | 88 | 66 | 78 | 74 | 71 | 68 | 69 |
| 2006 | 79 | 76 | 73 | 56 | 56 | 59 | 75 | 97 | m | m | 86 | m | 99 | 84 | 99 | m | 94 | 90 | m | m | 75 | **69** | 49 | m | 10 | 81 | 79 | 59 | 86 | m | 80 | 67 | 77 | 73 | 60 | 61 | 56 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904714

## 41. Students working independently on an assigned plan or goal in reading

### Why it matters

Working independently on an assigned plan or goal in reading is one feature of individualised or personalised learning, allowing students to learn and progress based on their actual reading proficiency. Teachers may want to strike a balance between collaborative and individual learning, as working independently and collaboratively both have benefits for learning, including learning to read.

### Change at the OECD level: small

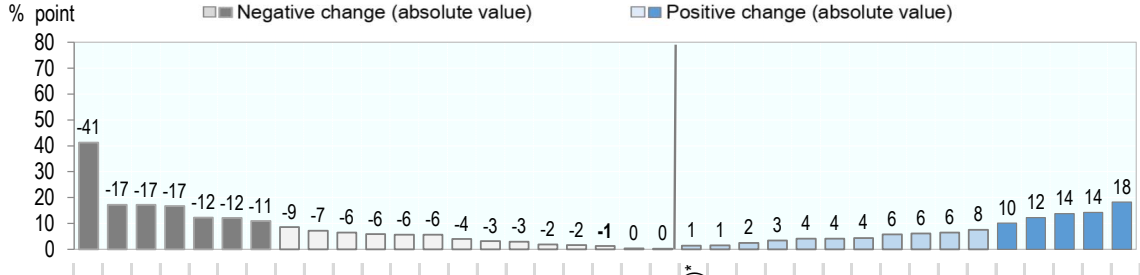
There has been little change on average in this practice, with positive and negative changes outweighing one another and leading to an average net decrease of just 1 percentage point in OECD countries between 2006 and 2016. The average absolute change was 8 percentage points, corresponding to a small effect size of 0.16. While this practice touches one in two students (56%) on average in OECD systems, it is widespread in the Slovak Republic (82%) but uncommon in the neighbouring Czech Republic (30%).

### Countries where there has been the most change

A few countries experienced a lot of innovation in this practice, which remained stable in most others. In the Czech Republic, the use of the practice fell by 41 percentage points between 2011 and 2016. Poland, Spain and Norway experienced a significant decrease between 2006 and 2016, and Denmark, an increase (all by 17-18 percentage points).

**Figure 7.5. 4th grade students working independently on an assigned plan in reading**

Change in and share of students who work independently always or often on an assigned plan or goal, 2006-2016, teachers report




| | | Czech Republic* | Poland | Spain | Norway | Andalusia (ESP)* | France | Belgium Fl. | Sweden | Lithuania | Finland* | Ireland* | Canada* | Italy | Hungary | Netherlands | Israel | Slovenia | Austria | **OECD average** | Hong Kong, China | Slovak Republic | Northern Ireland (UK)* | Quebec (CAN) | Latvia | Portugal* | Alberta (CAN)* | Germany | Russian Federation | Ontario (CAN) | Belgium Fr. | England (UK) | Indonesia* | New Zealand | Singapore | United States | Australia* | Denmark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 30 | 70 | 37 | 46 | 45 | 35 | 66 | 43 | 69 | 59 | 52 | 52 | 75 | 72 | 42 | 67 | 53 | 65 | **56** | 34 | 82 | 64 | 45 | 70 | 67 | m | 57 | 60 | 57 | 46 | 53 | m | 56 | 51 | 59 | 63 | 48 |
| | 2011 | 72 | 93 | 48 | 47 | 57 | 48 | m | 57 | 68 | 66 | 58 | 58 | 81 | 74 | 61 | 73 | 58 | 65 | **61** | 45 | 81 | 63 | 66 | m | 63 | 55 | 61 | 63 | 62 | 48 | 50 | 89 | 51 | 54 | 55 | 48 | 39 |
| | 2006 | m | 87 | 54 | 63 | m | 47 | 77 | 52 | 76 | m | m | m | 81 | 76 | 45 | 70 | 55 | 67 | **57** | 34 | 82 | m | 44 | 67 | m | 51 | 53 | 55 | 52 | 40 | 47 | 82 | 46 | 39 | 45 | m | 29 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904733

## 42. Frequency of teachers reading aloud to the class

### Why it matters

While reading aloud to the class may appear as a "traditional" or teacher-centred practice, some research shows that it is actually a good practice. It increases students' phonological awareness, may help students to concentrate and improve their understanding, and is also said to create a good class dynamics. Reading aloud does not need to be restricted to reading lessons and is more effective when done frequently, not just once a week.

### Change at the OECD level: small

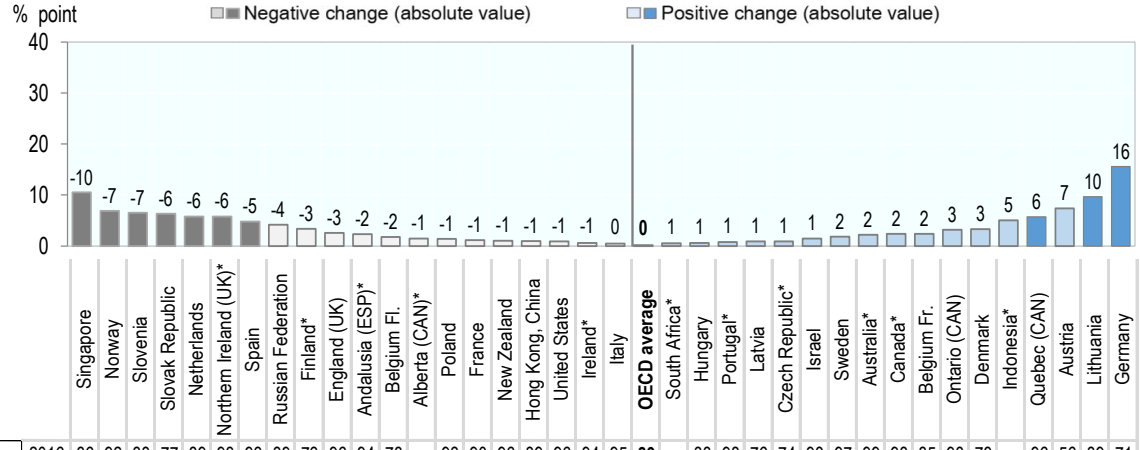
Positive changes and negative changes have balanced each other with an average zero net change between 2006 and 2016. The absolute change in this practice, positive and negative, was 4 percentage points on average, corresponding to a minor effect size of 0.14. Reading aloud to the class in primary reading lessons was a nearly universal practice in the OECD area in 2016, touching 89% of the 4th grade students on average. Austria is a bit of an exception with only 56% of students exposed to it.

### Countries where there has been the most change

Between 2006 and 2016, the practice spread by 16 and 10 percentage points respectively in Germany and Lithuania. In the same period, it contracted in Singapore (10 percentage points), Slovenia (7 percentage points) and Norway (7 percentage points). This was an innovation for students in all these countries.

**Figure 7.6. Frequency of teachers reading aloud to the class in 4th grade reading lessons**

Change in and share of students whose teachers read aloud to the class at least once a week, 2006-2016, teachers report




| % of students | Singapore | Norway | Slovenia | Slovak Republic | Netherlands | Northern Ireland (UK)* | Spain | Russian Federation | Finland* | England (UK) | Andalusia (ESP)* | Belgium Fl. | Alberta (CAN)* | Poland | France | New Zealand | Hong Kong, China | United States | Ireland* | Italy | **OECD average** | South Africa* | Hungary | Portugal* | Latvia | Czech Republic* | Israel | Sweden | Australia* | Canada* | Belgium Fr. | Ontario (CAN) | Denmark | Indonesia* | Quebec (CAN) | Austria | Lithuania | Germany |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2016 | 86 | 92 | 88 | 77 | 89 | 93 | 93 | 89 | 73 | 96 | 94 | 78 | m | 93 | 90 | 96 | 89 | 96 | 94 | 95 | **89** | m | 88 | 98 | 76 | 74 | 98 | 97 | 99 | 98 | 85 | 98 | 78 | m | 96 | 56 | 89 | 71 |
| 2011 | 92 | 95 | 94 | 77 | 95 | 99 | 95 | 90 | 76 | 95 | 96 | m | 98 | 97 | 89 | 95 | 94 | 94 | 95 | 94 | **88** | 94 | 85 | 98 | m | 73 | 98 | 97 | 97 | 95 | 85 | 99 | 69 | 95 | 91 | 51 | 86 | 59 |
| 2006 | 96 | 99 | 94 | 83 | 95 | m | 98 | 93 | m | 99 | m | 80 | 99 | 94 | 91 | 97 | 90 | 97 | m | 96 | **88** | 93 | 87 | m | 75 | m | 96 | 95 | m | m | 82 | 95 | 75 | 90 | 91 | 49 | 79 | 55 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904752

## 43. Students' peer discussion on read text

### Why it matters

Peer discussion on a text allows students to confront their views and deepen their understanding – not to mention the opportunity to develop their communication skills. While this can lead to more student engagement and learning, this may or may not work depending on the students and the text read, unless clear learning goals are set. Some evidence shows the format works for students with learning disabilities.

### Change at the OECD level: moderate

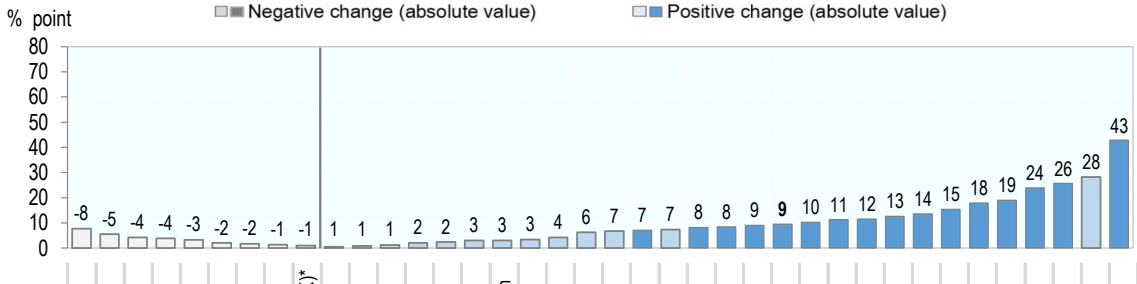
In the OECD area, the percentage of 4th grade students whose reading teachers regularly ask them to engage in peer discussion on read text rose by 9 percentage points on average between 2006 and 2016. The absolute change, regardless of direction, was 10 percentage points on average, corresponding to a modest effect size of 0.23. This is a widespread practice in most OECD education systems, covering around three fourths (74%) of 4th grade students in 2016.

### Countries where there has been the most change

This has been a domain of innovation in a few countries. Students in Norway experienced a spread by 43 percentage points of the practice between 2006 and 2016. It also diffused in Israel, Sweden and Indonesia, with increases above 20 percentage points. There were few contractions, all below 10 percentage points.

**Figure 7.7. 4th grade students discussing read text with peers in reading lessons**

Change in and share of students whose teachers ask them to discuss read text with peers at least once a week, 2006-2016, teachers report




| | Czech Republic* | Austria | Latvia | South Africa* | Lithuania | Germany | Portugal* | Quebec (CAN) | Northern Ireland (UK)* | France | Belgium Fr. | Alberta (CAN)* | Canada* | Slovenia | Netherlands | Russian Federation | Singapore | Belgium Fl. | Ontario (CAN) | Italy | Ireland* | Hungary | New Zealand | Australia* | United States | **OECD average** | Slovak Republic | Spain | England (UK) | Poland | Andalusia (ESP)* | Denmark | Hong Kong, China | Finland* | Israel | Sweden | Indonesia* | Norway |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students 2016 | 66 | 82 | 77 | m | 81 | 91 | 88 | 42 | 71 | 50 | 39 | m | 73 | 73 | 64 | 84 | 70 | 56 | 82 | 81 | 81 | 75 | 91 | 89 | 91 | **74** | 66 | 70 | 93 | 80 | 82 | 81 | 70 | 58 | 74 | 66 | m | 82 |
| 2011 | 74 | 89 | m | 71 | 85 | 93 | 90 | 41 | 72 | 41 | 29 | 76 | 71 | 84 | 59 | 79 | 66 | m | 85 | 69 | 73 | 86 | 89 | 81 | 91 | **70** | 64 | 68 | 83 | 83 | 68 | 75 | 71 | 39 | 73 | 51 | 97 | 58 |
| 2006 | m | 87 | 81 | 75 | 84 | 93 | m | 43 | m | 50 | 38 | 75 | m | 71 | 61 | 81 | 67 | 52 | 76 | 75 | m | 68 | 83 | m | 82 | **64** | 55 | 59 | 81 | 68 | m | 66 | 52 | m | 50 | 40 | 69 | 39 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904771

## 44. Use of school computers for group work and communication with other students

### Why it matters

While often criticised for their isolating power, computers can also facilitate group work, when students use them to carry out a group project or a common task. In some cases, mobile computer devices can be deliberately limited compared to the number of students to ensure collaboration and group work. Hopefully this develops collaborative and computer skills.

### Change at the OECD level: small

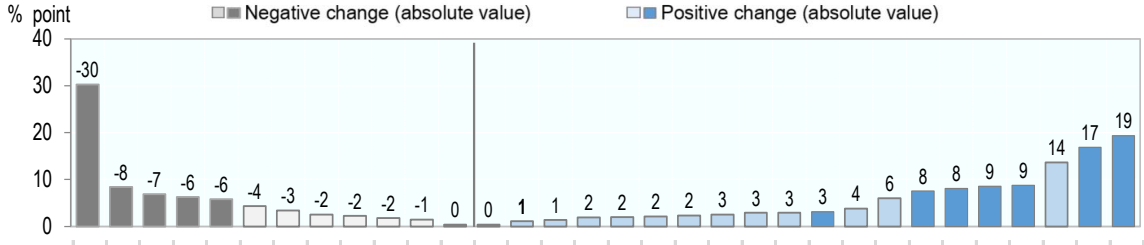
Positive changes compensated negatives ones across OECD countries. On average, the share of 15 year old students using school computers for group work and communication at least once a month increased by 1 percentage points between 2009 and 2015. The absolute change, including increases and reductions, reached 6 percentage points, corresponding to a small effect size of 0.13. The use of this computer-based practice at least once a month varied a lot across OECD countries in 2015, ranging from 70% of students concerned in Australia to only 9% in Japan.

### Countries where there has been the most change

Innovation in Denmark took the form of a large decline of 30 percentage points in the use of this practice between 2009 and 2015, with still an above-average use though. At the other end of the spectrum, Latvia and New Zealand recorded a notable innovation for their students with a diffusion of the practice by 19 and 17 percentage points respectively.

**Figure 7.8. 4th grade students using computers to work and communicate with peers**

Change in and share of students who use computers for group work or communication with other students at least once a month, 2009-2015, teachers report




| | | Denmark | Hungary | Hong Kong, China | Switzerland | Austria | Japan | Czech Republic | Germany | Slovenia | Slovak Republic | Portugal | Poland | Iceland | **OECD average** | Belgium | Finland | Spain | Singapore | Lithuania | Italy | Netherlands | Ireland | Estonia | Chile | Korea | Greece | Australia | Sweden | Israel | Russian Federation | New Zealand | Latvia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 56 | 44 | 45 | 46 | 46 | 9 | 58 | 43 | 48 | 50 | 59 | 33 | 62 | **49** | 47 | 57 | 55 | 56 | 45 | 45 | 66 | 42 | 40 | 63 | 20 | 55 | 70 | 62 | 43 | 51 | 65 | 49 |
| | 2009 | 87 | 53 | 52 | 52 | 52 | 13 | 61 | 46 | 50 | 52 | 61 | 34 | 62 | **48** | 45 | 55 | 53 | 54 | 42 | 43 | 63 | 39 | 37 | 59 | 14 | 47 | 62 | 53 | 34 | 37 | 48 | 29 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933904790

## 45. Same-ability class groups in reading lessons

### Why it matters

Breaking away from the whole-class format in reading lessons allows for more engagement and personalised learning. Same-ability groups have been traditionally favoured by teachers, but criticised for lowering the self-efficacy of poor readers and for widening the gap between strong and poor readers for only a modest gain in effectiveness for good readers. Poor readers may also receive poorer instruction than good readers in this format. The format works well for "gifted" students though.

### Change at the OECD level: moderate

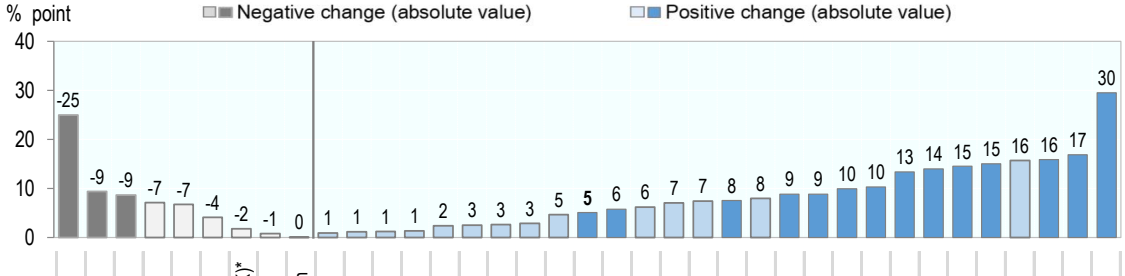
Increases in the use of this practice have prevailed over decreases across OECD countries. Between 2006 and 2016, there was an average net increase by 5 percentage points, while the mean absolute change, mirroring positive and negative changes, was 9 percentage points, corresponding to a modest effect size of 0.2. This practice is employed at very different intensities across OECD countries. In 2016, only 12% of primary students in Belgium (Fr.) had a teacher systematically creating same-ability groups, against 92% in Northern Ireland (United Kingdom) where the practice is nearly universal.

### Countries where there has been the most change

The Netherlands experienced strong innovation in this practice, with an expansion by 30 percentage points of students concerned. In Portugal, innovation took the form of a contraction by 25 percentage points between 2011 and 2016.

**Figure 7.9. Same-ability class grouping in 4th grade reading lessons**

Change in and share of students whose teachers always or often create same-ability class groups during reading instruction, 2006-2016, teachers report




| | | Portugal* | New Zealand | Poland | Norway | England (UK) | Belgium Fr. | Northern Ireland (UK)* | Hungary | Russian Federation | Sweden | Slovak Republic | Spain | Canada* | Finland* | Italy | Czech Republic* | Andalusia (ESP)* | Australia* | **OECD average** | Singapore | Indonesia* | Quebec (CAN) | Belgium Fl. | Hong Kong, China | France | Slovenia | Ireland* | Germany | Austria | Denmark | United States | Lithuania | Latvia | Alberta (CAN)* | Ontario (CAN) | Israel | Netherlands |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 19 | 83 | 18 | 21 | 69 | 12 | 92 | 39 | 51 | 22 | 28 | 15 | 45 | 21 | 15 | 21 | 17 | 81 | **37** | 22 | m | 25 | 33 | 10 | 34 | 27 | 38 | 30 | 34 | 37 | 61 | 40 | 39 | m | 57 | 48 | 63 |
| | 2011 | 43 | 96 | 29 | 33 | 81 | 16 | 94 | 36 | 53 | 17 | 30 | 11 | 44 | 18 | 8 | 19 | 14 | 77 | **36** | 30 | 45 | 24 | m | 10 | 20 | 17 | 30 | 25 | 34 | 29 | 55 | 36 | m | 52 | 55 | 53 | 53 |
| | 2006 | m | 92 | 26 | 28 | 76 | 16 | m | 40 | 51 | 21 | 27 | 14 | m | m | 13 | m | m | m | **32** | 17 | 38 | 18 | 26 | 3 | 26 | 18 | m | 20 | 24 | 24 | 47 | 26 | 24 | 36 | 41 | 31 | 33 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904809

## 46. Mixed-ability class groups in reading lessons

### Why it matters

Breaking away from the whole-class format in reading lessons allows for more engagement and personalised learning. Given the criticism against same ability groups that provide little gain on learning achievement but strong negative effects on equity, mixed-ability groups are now usually favoured even though teachers may still have the habit to create same-ability groups in some countries.

### Change at the OECD level: moderate

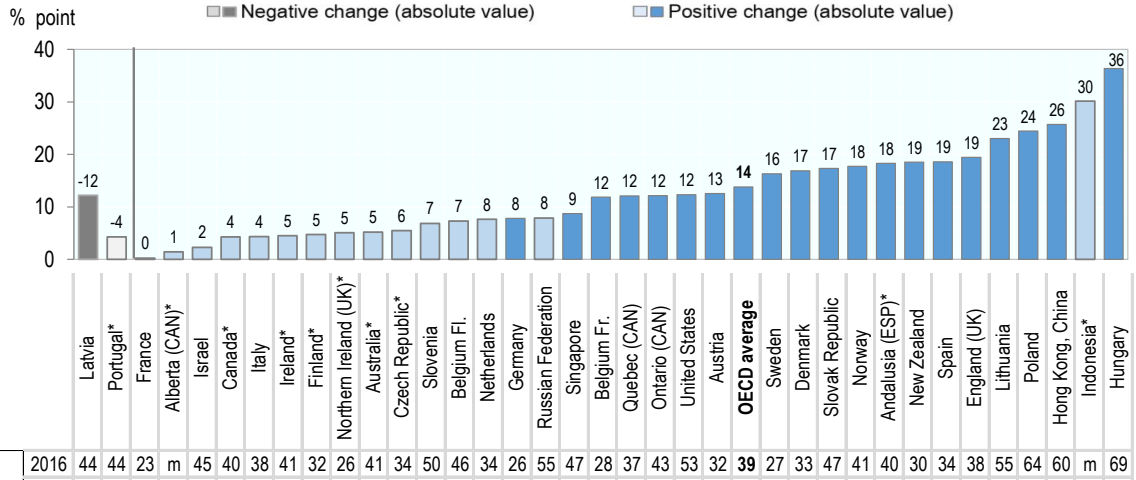
At the OECD level, the share of 4th grade students whose teachers systematically create mixed-ability groups increase by 14 percentage points on average between 2006 and 2016. The overall absolute change was the same, corresponding to a moderate absolute effect size of 0.3. This practice is used to a moderate extent in OECD systems, with around 39% of 4th grade students concerned in 2016 on average, with a span ranging from 23% in France to 69% in Hungary.

### Countries where there has been the most change

This has been a domain of innovation in many countries, usually through a diffusion of the practice. Hungary experienced the largest increase (36 percentage points), but the practice also gained significant ground in Indonesia, Hong Kong, China, Poland and Lithuania. Latvia (12 percentage points) recorded the only statistically significant negative change.

**Figure 7.10. Mixed-ability class grouping in 4th grade reading lessons**

Change in and share of students whose teachers always or often create mixed-ability class groups during reading instruction, 2006-2016, teachers report




| | | Latvia | Portugal* | France | Alberta (CAN)* | Israel | Canada* | Italy | Ireland* | Finland* | Northern Ireland (UK)* | Australia* | Czech Republic* | Slovenia | Belgium Fl. | Netherlands | Germany | Russian Federation | Singapore | Belgium Fr. | Quebec (CAN) | Ontario (CAN) | United States | Austria | **OECD average** | Sweden | Denmark | Slovak Republic | Norway | Andalusia (ESP)* | New Zealand | Spain | England (UK) | Lithuania | Poland | Hong Kong, China | Indonesia* | Hungary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 44 | 44 | 23 | m | 45 | 40 | 38 | 41 | 32 | 26 | 41 | 34 | 50 | 46 | 34 | 26 | 55 | 47 | 28 | 37 | 43 | 53 | 32 | **39** | 27 | 33 | 47 | 41 | 40 | 30 | 34 | 38 | 55 | 64 | 60 | m | 69 |
| | 2011 | m | 48 | 14 | 35 | 44 | 36 | 31 | 36 | 27 | 21 | 35 | 29 | 41 | m | 31 | 25 | 56 | 51 | 17 | 24 | 45 | 47 | 26 | **32** | 18 | 33 | 46 | 27 | 22 | 13 | 23 | 28 | 43 | 35 | 52 | 62 | 66 |
| | 2006 | 56 | m | 22 | 34 | 43 | m | 34 | m | m | m | m | m | 43 | 39 | 26 | 18 | 47 | 38 | 16 | 25 | 30 | 40 | 19 | **26** | 11 | 16 | 30 | 24 | m | 11 | 15 | 19 | 32 | 39 | 34 | 32 | 33 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933904828

**Table 7.1. Effect sizes for changes in personalised, collaborative and front-of-class teaching and learning practices in reading**

| | Making students read items of their choice | Giving students time to read books of their own choice | Individualised instruction for reading | Frequency of teaching reading as a whole-class activity | Students working independently on an assigned goal or plan | Frequency of reading aloud to the class | Students' peer discussion on read text | Use of school computers for group work and communication | Same class-ability groups in reading classes | Mixed-ability groups in reading classes |
|---|---|---|---|---|---|---|---|---|---|---|
| | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 8th grade | 4th grade | 4th grade |
| Australia | 0.09 | -0.40 | 0.23 | 0.04 | 0.29 | 0.15 | 0.24 | 0.17 | 0.12 | 0.11 |
| Austria | -0.01 | 0.14 | 0.43 | -0.16 | -0.03 | 0.15 | -0.15 | -0.12 | 0.23 | 0.29 |
| Belgium (Fl.) | 0.01 | -0.19 | 0.08 | -0.24 | -0.24 | -0.04 | 0.08 | m | 0.16 | 0.15 |
| Belgium (Fr.) | -0.39 | -0.39 | 0.02 | -0.05 | 0.12 | 0.06 | 0.02 | m | -0.12 | 0.29 |
| Canada | -0.02 | -0.42 | 0.04 | -0.03 | -0.11 | 0.13 | 0.05 | m | 0.03 | 0.09 |
| Canada (Alberta) | 0.07 | -0.09 | 0.43 | -0.27 | 0.08 | -0.12 | 0.03 | m | 0.32 | 0.03 |
| Canada (Ontario) | 0.04 | -0.55 | 0.31 | -0.15 | 0.12 | 0.18 | 0.15 | m | 0.32 | 0.25 |
| Canada (Quebec) | 0.09 | -0.10 | 0.35 | 0.17 | 0.03 | 0.24 | -0.03 | m | 0.17 | 0.26 |
| Czech Republic | 0.44 | 0.18 | 0.00 | -0.01 | -0.85 | 0.02 | -0.17 | -0.07 | 0.07 | 0.12 |
| Denmark | -0.29 | -0.56 | -0.14 | 0.09 | 0.38 | 0.08 | 0.35 | -0.69 | 0.29 | 0.40 |
| Estonia | m | m | m | m | m | m | m | 0.06 | m | m |
| Finland | 0.16 | -1.15 | 0.17 | -0.10 | -0.13 | -0.08 | 0.38 | 0.04 | 0.06 | 0.10 |
| France | -0.18 | -0.37 | 0.06 | -0.09 | -0.25 | -0.04 | 0.01 | m | 0.18 | 0.01 |
| Germany | -0.21 | -0.08 | -0.04 | 0.16 | 0.08 | 0.32 | -0.07 | -0.05 | 0.23 | 0.19 |
| Hungary | -0.20 | 0.17 | 0.34 | 0.11 | -0.09 | 0.02 | 0.16 | -0.17 | -0.02 | 0.74 |
| Iceland | m | m | m | m | m | m | m | 0.01 | m | m |
| Ireland | -0.02 | -0.56 | 0.08 | -0.09 | -0.12 | -0.03 | 0.17 | 0.06 | 0.19 | 0.09 |
| Israel | -0.13 | -0.14 | 1.00 | 0.18 | -0.06 | 0.09 | 0.50 | 0.18 | 0.35 | 0.05 |
| Italy | -0.75 | 0.46 | 0.09 | -0.16 | -0.14 | -0.02 | 0.16 | 0.05 | 0.07 | 0.09 |
| Japan | m | m | m | m | m | m | m | -0.14 | m | m |
| Korea | m | m | m | m | m | m | m | 0.16 | m | m |
| Latvia | -0.40 | 0.13 | 0.08 | -0.21 | 0.05 | 0.02 | -0.10 | 0.40 | 0.33 | -0.24 |
| Lithuania | -0.63 | 0.57 | 0.14 | -0.31 | -0.16 | 0.27 | -0.09 | 0.05 | 0.31 | 0.47 |
| Netherlands | 0.14 | -0.20 | 0.28 | -0.24 | -0.06 | -0.22 | 0.06 | 0.06 | 0.60 | 0.17 |
| New Zealand | -0.07 | -0.41 | 0.19 | 0.12 | 0.20 | -0.05 | 0.25 | 0.34 | -0.29 | 0.47 |
| Norway | -0.06 | -0.87 | 0.33 | 0.27 | -0.34 | -0.35 | 0.91 | m | -0.17 | 0.38 |
| Poland | -0.36 | -0.33 | -0.20 | -0.35 | -0.43 | -0.06 | 0.29 | -0.01 | -0.21 | 0.49 |
| Portugal | -0.21 | -0.42 | 0.01 | 0.02 | 0.07 | 0.06 | -0.06 | -0.03 | -0.55 | -0.09 |
| Slovak Republic | -0.71 | 0.40 | -0.01 | 0.20 | 0.00 | -0.16 | 0.21 | -0.04 | 0.03 | 0.36 |
| Slovenia | -0.29 | 0.00 | -0.08 | 0.23 | -0.04 | -0.23 | 0.05 | -0.05 | 0.21 | 0.14 |
| Spain | -0.07 | -0.16 | 0.27 | -0.05 | -0.35 | -0.23 | 0.24 | 0.04 | 0.04 | 0.44 |
| Spain (Andalusia) | -0.10 | -0.37 | 0.11 | -0.18 | -0.24 | -0.11 | 0.32 | m | 0.08 | 0.40 |
| Sweden | 0.01 | -0.75 | -0.06 | 0.35 | -0.17 | 0.09 | 0.52 | 0.17 | 0.02 | 0.42 |
| Switzerland | m | m | m | m | m | m | m | -0.13 | m | m |
| UK (England) | 0.09 | -0.54 | 0.84 | 0.04 | 0.13 | -0.17 | 0.35 | m | -0.15 | 0.44 |
| UK (Northern Ireland) | -0.01 | -0.41 | 0.18 | 0.13 | 0.00 | -0.34 | -0.02 | m | -0.07 | 0.12 |
| United States | -0.01 | -0.31 | 0.45 | 0.03 | 0.28 | -0.05 | 0.27 | m | 0.28 | 0.25 |
| **OECD (average)** | **-0.20** | **-0.16** | **0.22** | **0.04** | **-0.02** | **0.01** | **0.20** | **0.02** | **0.11** | **0.30** |
| **OECD (av. absolute)** | **0.20** | **0.35** | **0.27** | **0.16** | **0.16** | **0.14** | **0.24** | **0.13** | **0.20** | **0.31** |

| | Making students read items of their choice | Giving students time to read books of their own choice | Individualised instruction for reading | Frequency of teaching reading as a whole-class activity | Students working independently on an assigned goal or plan | Frequency of reading aloud to the class | Students' peer discussion on read text | Use of school computers for group work and communication | Same class-ability groups in reading classes | Mixed-ability groups in reading classes |
|---|---|---|---|---|---|---|---|---|---|---|
| | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 4th grade | 8th grade | 4th grade | 4th grade |
| Hong Kong, China | -0.25 | -0.47 | 0.11 | 0.19 | -0.01 | -0.03 | 0.37 | -0.14 | 0.32 | 0.52 |
| Indonesia | 0.22 | 0.29 | -0.04 | -0.03 | 0.22 | 0.20 | 0.84 | m | 0.13 | 0.61 |
| Russian Federation | -0.41 | -0.39 | 0.11 | -0.12 | 0.09 | -0.15 | 0.08 | 0.28 | 0.00 | 0.16 |
| Singapore | -0.04 | -0.47 | 0.05 | 0.11 | 0.25 | -0.38 | 0.07 | 0.04 | 0.15 | 0.18 |
| South Africa | 0.25 | 0.46 | m | m | m | 0.02 | -0.09 | m | m | m |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on PIRLS (2006, 2011 and 2016) and PISA (2006, 2009 and 2015).

StatLink https://doi.org/10.1787/888933904847

# Chapter 8.
# Innovation in homework practices

*This chapter presents the change in homework practices in mathematics and science. They include the frequency of homework, the form of its assessment as well as the monitoring and discussion of homework by the teacher. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 47. Frequency of homework

### Why it matters

Sometimes dreaded by students, and even by parents, homework contributes to better learning achievement in higher grades, though less in primary education. It may have a negative impact on the learning of low achievers. This practice should vary depending on the time already spent in school, and be balanced against the wellbeing of children. In (mainly Asian) countries where students commonly go to a cram school after formal schooling, school teachers may adapt to society by giving less homework to students.

## Mathematics

### Change at the OECD level: small

At the OECD level, the proportion of 8th grade students having mathematics homework twice a week or more decreased by 1 percentage point between 2007 and 2015. The mean absolute change amounted to 7 percentage points, corresponding to a small effect size of 0.17. Homework frequency in 8th grade mathematics varied markedly across OECD systems: while on average 55% students get maths homework at least twice a week, the span goes from 94% in Lithuania to 8% in Sweden.

### Countries where there has been the most change

Moderate changes were observed in both directions. The share of 8th grade students given mathematics homework twice a week or more increased by 13 percentage points in Quebec (Canada) and Slovenia while it declined by 15 percentage points in Ontario (Canada).

## Science

### Change at the OECD level: small

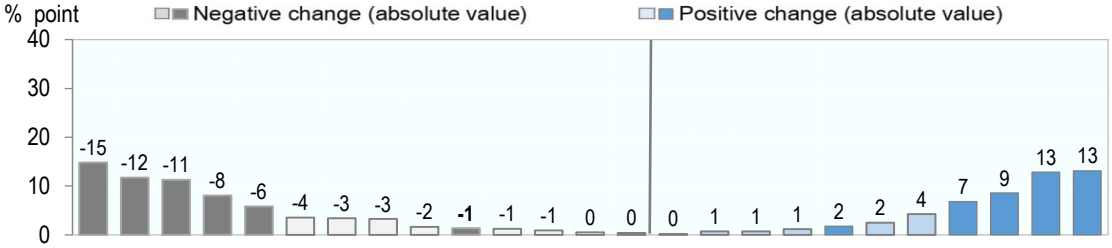
While positive and negative changes have nullified each other, the mean absolute change in this practice at the OECD level was 7 percentage points. This change translates into a small effect size of 0.18. In 2015, on average 23% of students got science homework at least twice a week, with a span ranging from 45% in Turkey to 5% in Korea (where students may go to a cram school after class).

### Countries where there has been the most change

Few countries registered significant changes in the frequency of science homework. On the one hand, Quebec (Canada) and Turkey witnessed considerable increases in the share of 8th grade students given science homework very frequently between 2007 and 2015 (+17 and 13 percentage points respectively). On the other hand, Minnesota (United States) and the United States experienced a decline of about 10 percentage points between 2007 and 2011. Positive and negative changes recorded were generally below 10 percentage points.

## Figure 8.1. Frequency of homework in 8th grade maths

Change in and share of students whose teachers give them homework at least twice a week, 2007-2015, teachers report



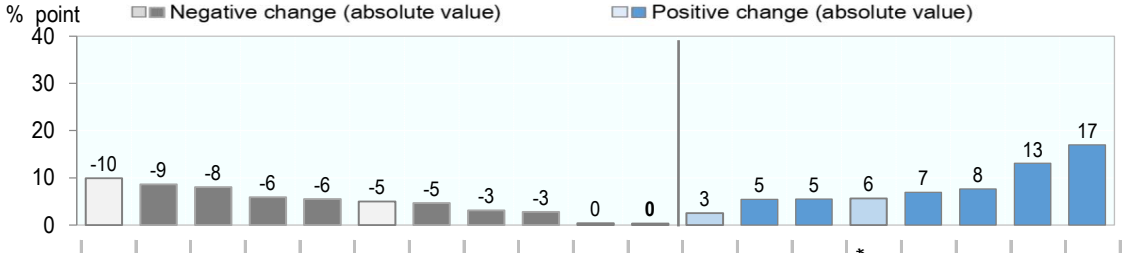

| | | Ontario (CAN) | Norway | United States | Korea | Italy | Australia | New Zealand* | Indonesia* | Massachusetts (USA)* | **OECD average** | Israel | Hungary | Sweden | Lithuania | England (UK) | Hong Kong, China | Chile* | Minnesota (USA)* | Russian Federation | Singapore | Japan | South Africa* | Turkey | Slovenia | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 70 | 38 | 75 | 18 | 79 | 46 | 35 | m | m | **55** | 80 | 92 | 8 | 94 | 14 | 73 | 32 | m | 98 | 73 | 29 | 92 | 48 | 94 | 82 |
| | 2011 | 70 | 41 | 81 | 25 | 86 | 49 | 39 | 56 | 91 | **56** | 81 | 93 | 10 | 92 | 12 | 72 | 31 | 92 | 97 | 72 | 24 | 85 | 40 | 92 | 76 |
| | 2007 | 85 | 50 | 86 | 26 | 85 | 49 | m | 59 | 93 | **56** | 81 | 93 | 8 | 95 | 14 | 72 | m | 91 | 96 | 71 | 25 | m | 39 | 81 | 69 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904866

## Figure 8.2. Frequency of homework in 8th grade science

Change in and share of students whose teachers give them homework at least twice a week, 2007-2015, teachers report




| | | Minnesota (USA)* | United States | Norway | Israel | Italy | Ontario (CAN) | Korea | Australia | Chile* | England (UK) | **OECD average** | New Zealand* | Hong Kong, China | Singapore | Massachusetts (USA)* | South Africa* | Japan | Turkey | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 33 | 19 | 37 | 21 | 20 | 5 | 22 | 21 | 14 | **23** | 24 | 29 | 44 | m | 64 | 12 | 45 | 26 |
| | 2011 | 34 | 34 | 20 | 41 | 19 | 17 | 6 | 18 | 24 | 13 | **21** | 21 | 17 | 36 | 65 | 57 | 7 | 44 | 11 |
| | 2007 | 44 | 42 | 27 | 43 | 26 | 25 | 10 | 25 | m | 14 | **23** | m | 23 | 39 | 60 | m | 4 | 32 | 9 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904885

## 48. Monitoring homework completion

### Why it matters

Why do teachers give homework if they do not monitor their completion? This may reduce students' incentives to actually complete them. On the other hand, as students and parents know, it gives students some slack if, for some reason, they could not make it. However, one would expect teachers who give homework to monitor whether they students do them as homework should also be part of their teaching and learning strategy. One should just expect the good practice of systematically monitoring completion to spread within systems.

## Mathematics

### Change at the OECD level: moderate

OECD systems experienced both expansions and contractions of this practice, albeit the average net change was slightly negative (about 1 percentage point). The overall absolute change, regardless of change direction, was 10 percentage points, corresponding to a modest effect size of 0.23. On average, about 3 in 4 students had a teacher who monitors systematically the completion of their maths homework in OECD systems in 2015, with a span ranging from 95% of students in Slovenia to 55% in Quebec (Canada).

### Countries where there has been the most change

The spread of this practice by 23 percentage points was an innovation for Turkish students between 2007 and 2015, and this was also the case in Norway (14 percentage points) and Slovenia (12). By contrast, the share of students exposed to this good practice declined by over 15 percentage points in Sweden and Ontario (Canada).

## Science

### Change at the OECD level: small

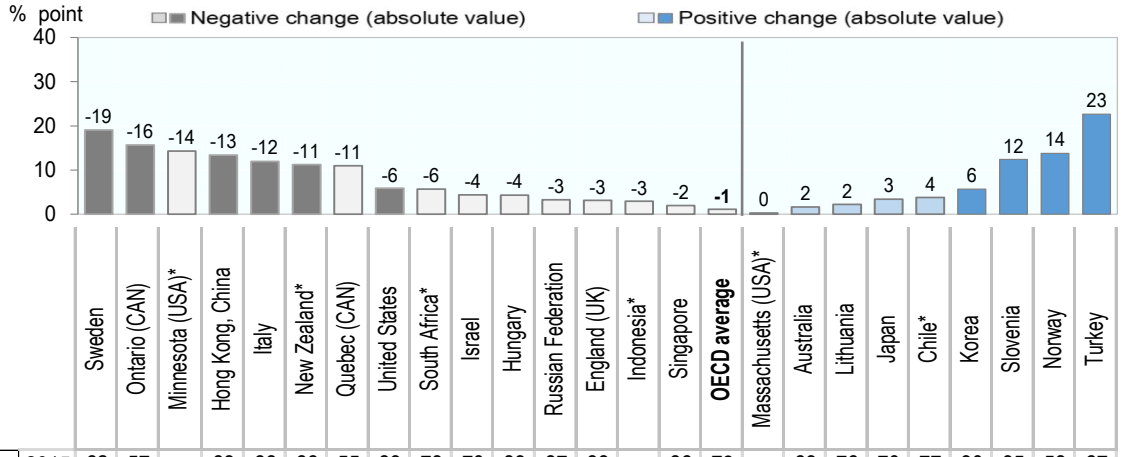
The share of students whose science teachers constantly monitor the completion of their homework decreased by 3 percentage points on average in OECD systems. Combining positive and negative variations, the absolute change was 8 percentage points, corresponding to a small effect size of 0.18. In 2015, 70% of 8th grade students got the completion of their homework constantly monitored by their teacher on average, although it was still only the case for half of the students in Norway.

### Countries where there has been the most change

Innovation has been modest in this area and only a small number of countries registered substantial changes. Particularly, between 2007 and 2015, the share of 8th grade students with science teachers who constantly monitor homework completion increased by 16 percentage points in Turkey. This share reduced by 16 and 14 percentage points in Italy and Ontario (Canada), respectively. All other positive and negative changes were below 10 percentage points.

**Figure 8.3. 8th grade students being monitored for homework completion in maths**

Change in and share of students whose teachers monitor homework completion always or almost always, 2007-2015, teachers report



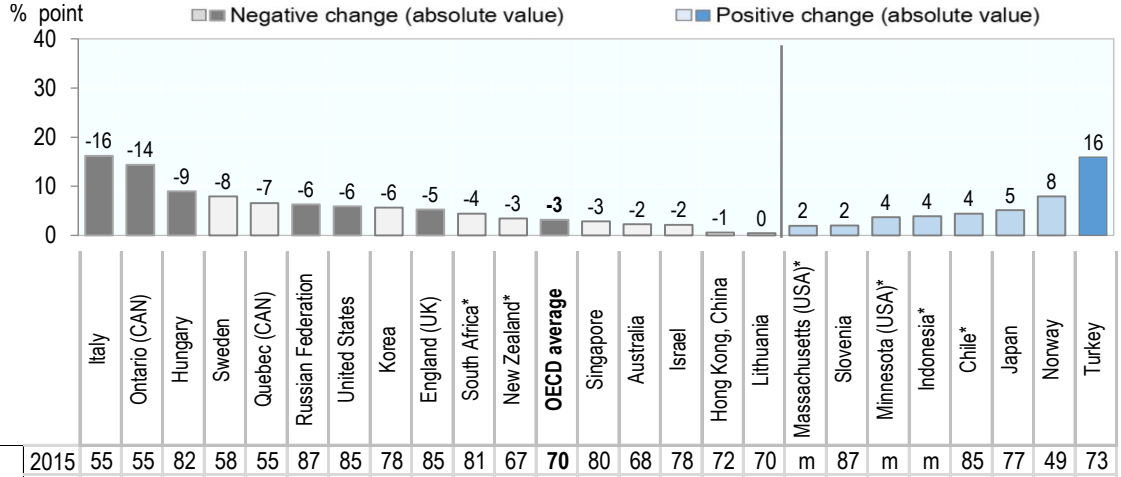

| | | Sweden | Ontario (CAN) | Minnesota (USA)* | Hong Kong, China | Italy | New Zealand* | Quebec (CAN) | United States | South Africa* | Israel | Hungary | Russian Federation | England (UK) | Indonesia* | Singapore | **OECD average** | Massachusetts (USA)* | Australia | Lithuania | Japan | Chile* | Korea | Slovenia | Norway | Turkey |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 62 | 57 | m | 69 | 66 | 66 | 55 | 89 | 79 | 70 | 89 | 87 | 88 | m | 86 | **73** | m | 69 | 76 | 70 | 77 | 90 | 95 | 58 | 67 |
| | 2011 | 74 | 61 | 85 | 74 | 71 | 77 | 46 | 92 | 85 | 76 | 85 | 87 | 91 | 87 | 83 | **73** | 97 | 68 | 75 | 60 | 73 | 82 | 90 | 54 | 67 |
| | 2007 | 81 | 73 | 100 | 82 | 78 | m | 66 | 95 | m | 75 | 93 | 90 | 91 | 90 | 88 | **74** | 96 | 67 | 73 | 66 | m | 85 | 83 | 45 | 45 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904904

**Figure 8.4. 8th grade students being monitored for homework completion in science**

Change in and share of students whose teachers monitor homework completion always or almost always, 2007-2015, teachers report




| | | Italy | Ontario (CAN) | Hungary | Sweden | Quebec (CAN) | Russian Federation | United States | Korea | England (UK) | South Africa* | New Zealand* | **OECD average** | Singapore | Australia | Israel | Hong Kong, China | Lithuania | Massachusetts (USA)* | Slovenia | Minnesota (USA)* | Indonesia* | Chile* | Japan | Norway | Turkey |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 55 | 55 | 82 | 58 | 55 | 87 | 85 | 78 | 85 | 81 | 67 | **70** | 80 | 68 | 78 | 72 | 70 | m | 87 | m | m | 85 | 77 | 49 | 73 |
| | 2011 | 67 | 64 | 87 | 54 | 59 | 89 | 92 | 79 | 87 | 85 | 70 | **73** | 83 | 76 | 87 | 72 | 66 | 93 | 84 | 83 | 95 | 81 | 66 | 47 | 67 |
| | 2007 | 71 | 70 | 91 | 65 | 61 | 93 | 91 | 84 | 90 | m | m | **74** | 83 | 70 | 80 | 73 | 71 | 91 | 85 | 79 | 92 | m | 71 | 41 | 57 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904923

## 49. Students correcting their own homework

### Why it matters

While homework should always be corrected, there is no need for teachers to always correct it themselves. Depending on time available and on the nature of the homework, teachers can either correct the homework in a whole-class setting or just provide some form of correction and let students correct their own homework. Teachers should however assess formatively the school- (and sometimes) home- work of their students to help them progress.

## Mathematics

### Change at the OECD level: moderate

The share of students systematically correcting their maths homework themselves increased by about 5 percentage points on average in OECD systems. Increases and reductions combined, the average absolute change was 12 percentage points, corresponding to a moderate effect size of 0.25. While on average 44% students were asked to do so in 2015, large differences can be highlighted with for example 69% of students concerned in Japan but only 16% in Lithuania.

### Countries where there has been the most change

Between 2007 and 2015, teachers in Japan innovated by strongly increasing the use of this practice: the proportion of students regularly exposed to it rose by 22 percentage points. This was the same in Sweden and England, where the practice increased by 20 percentage points. In contrast, this practice lost considerable ground in Indonesia, with a decline by 17 percentage points between 2007 and 2011, as well as in Italy where it contracted by 16 percentage points between 2007 and 2015.

## Science

### Change at the OECD level: moderate-low

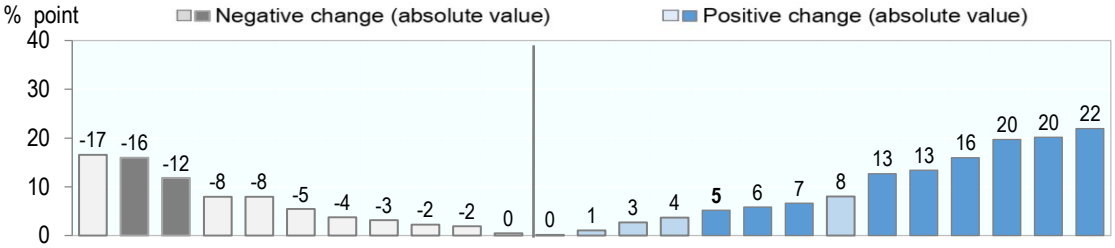
At the OECD level, this practice has more often expanded than retracted, leading to an average net increase of 3 percentage points in the share of 8th grade students regularly exposed to it in science. Combining variations in both directions, the absolute change reached 10 percentage points on average, representing a moderate-low effect size of 0.23. Across the OECD area on average, 28% of the 8th grade students were constantly asked by their science teachers to correct their own homework in 2015 – much less than in mathematics.

### Countries where there has been the most change

Like in maths, Japan innovated greatly by increasing by 34 percentage points the share of 8th grade students always or almost always asked to correct their homework. Notable positive changes were also witnessed in Slovenia and England. The decreases of 20 and 12 percentage points in Israel and both Ontario (Canada) and Italy represent also an innovation in those systems.

**Figure 8.5. 8th grade students correcting their own homework in maths**

Change in and share of students whose teachers ask them to correct their own homework always or almost always, 2007-2015, teachers report



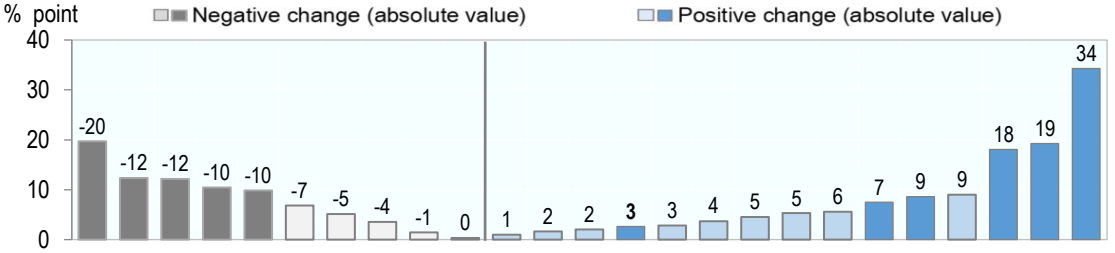

| | | Indonesia* | Italy | Israel | Hungary | Ontario (CAN) | Massachusetts (USA)* | New Zealand* | Lithuania | Chile* | Russian Federation | United States | South Africa* | Hong Kong, China | Turkey | Norway | **OECD average** | Singapore | Slovenia | Minnesota (USA)* | Korea | Quebec (CAN) | Australia | England (UK) | Sweden | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 42 | 17 | 64 | 48 | m | 43 | 16 | 55 | 17 | 56 | 37 | 19 | 28 | 17 | **44** | 34 | 59 | m | 51 | 61 | 46 | 33 | 30 | 69 |
| | 2011 | 31 | 48 | 22 | 62 | 45 | 53 | 47 | 14 | 57 | 16 | 58 | 36 | 20 | 42 | 22 | **40** | 34 | 45 | 72 | 51 | 41 | 44 | 13 | 13 | 57 |
| | 2007 | 48 | 58 | 29 | 72 | 56 | 58 | m | 19 | m | 19 | 56 | m | 18 | 25 | 14 | **39** | 28 | 53 | 64 | 38 | 48 | 30 | 13 | 10 | 47 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904942

**Figure 8.6. 8th grade students correcting their own homework in science**

Change in and share of students whose teachers ask them to correct their own homework always or almost always, 2007-2015, teachers report




| | | Israel | Ontario (CAN) | Italy | Russian Federation | Lithuania | Chile* | Hungary | Australia | Minnesota (USA)* | United States | Quebec (CAN) | Sweden | Indonesia* | **OECD average** | Norway | Turkey | Hong Kong, China | South Africa* | Massachusetts (USA)* | Singapore | New Zealand* | Korea | England (UK) | Slovenia | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 23 | 21 | 28 | 17 | 7 | 47 | 46 | 15 | m | 23 | 33 | 4 | m | **28** | 9 | 26 | 24 | 32 | m | 38 | 22 | 35 | 25 | 45 | 63 |
| | 2011 | 18 | 25 | 32 | 20 | 7 | 54 | 46 | 22 | 13 | 21 | 21 | 5 | 23 | **25** | 5 | 32 | 18 | 27 | 33 | 45 | 14 | 36 | 5 | 29 | 48 |
| | 2007 | 43 | 33 | 40 | 27 | 17 | m | 51 | 19 | 15 | 24 | 32 | 2 | 21 | **26** | 6 | 23 | 20 | m | 28 | 31 | m | 26 | 7 | 26 | 28 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904961

## 50. Discussion of homework in class

### Why it matters

Discussing homework in class is one straightforward way for teachers to correct it in whole-class groups. In some cases, it also allows engaging students to go beyond their homework, to deepen their understanding of the maths and science concepts they have learnt, and also identify what they may have not understood. This is thus a good practice that one would expect to be almost systematic. The flipped classroom even makes of homework discussion and correction the key aspect of class instruction.

## Mathematics

### Change at the OECD level: large

Between 2007 and 2015, this practice almost unanimously spread in OECD systems. On average, OECD systems recorded a net increase as well as an absolute change of 36 percentage points in the share of 8th grade students frequently discussing their maths homework in class. This corresponds to a very large effect size of 0.83. On average, 58% of students discussed their homework in class in OECD countries. While nearly universal in Hungary and Italy, this practice is far less common in other OECD countries. In Japan for instance, only 4% of the students systematically discussed their homework in maths class.

### Countries where there has been the most change

The strong innovation in this domain took the form of a large expansion in the use of this method. Outstanding diffusion of the practice characterised Hungary (89 percentage points), Lithuania (70 percentage points) and Quebec (Canada) (61 percentage points). Slovenia and the Russian Federation exhibited also expansions above 50 percentage points.

## Science

### Change at the OECD level: large

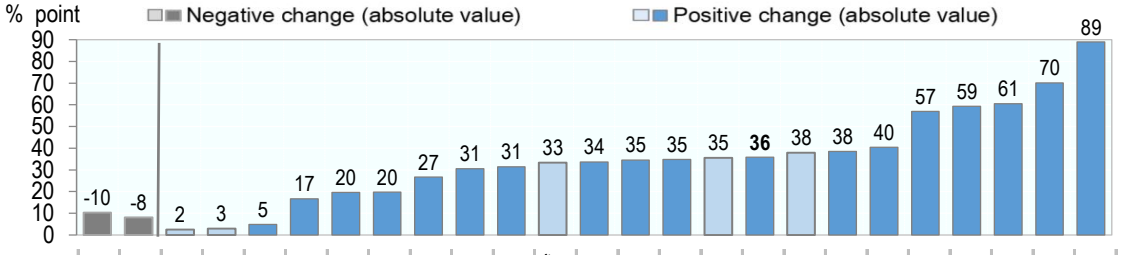
The use of systematic homework discussion in science class has increased in most OECD countries. On average, the proportion of 8th grade science students exposed to this practice went up from 25% in 2007 to 55% in 2015. The 30 percentage-point absolute change in this practice corresponds to a large effect size of 0.66. Japan registered the lowest use of homework discussion in science class, with less than 4% of students concerned in 2015, whereas Hungary recorded the most substantial use (86% of students concerned). The OECD country average was at 55%.

### Countries where there has been the most change

Innovation was substantial in this practice and occurred through a significant diffusion of its use. Hungary stands out with an increase by 74 percentage points of students concerned between 2007 and 2015, followed by the Russian Federation and Lithuania, both recording 57-percentage point increases. Most other countries also registered significant increases.

**Figure 8.7. 8th grade students discussing homework in maths**

Change in and share of students whose teachers discuss the homework in class always or almost always, 2007-2015, teachers report



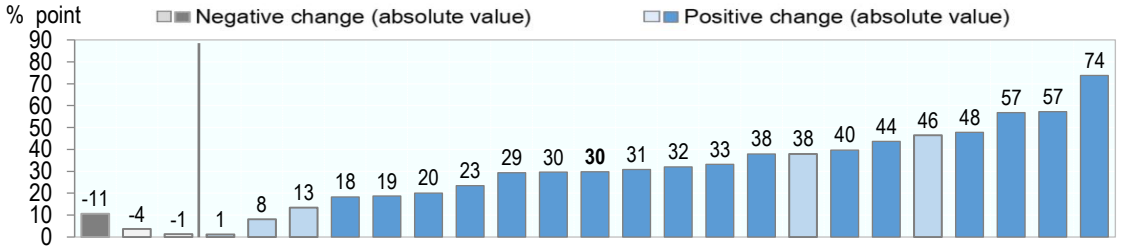

| | | Chile* | New Zealand* | South Africa* | Hong Kong, China | Japan | Turkey | Sweden | Korea | United States | England (UK) | Australia | Massachusetts (USA)* | Italy | Norway | Ontario (CAN) | Indonesia* | **OECD average** | Minnesota (USA)* | Singapore | Israel | Russian Federation | Slovenia | Quebec (CAN) | Lithuania | Hungary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 72 | 26 | 89 | 27 | 10 | 28 | 38 | 25 | 80 | 44 | 47 | m | 85 | 44 | 82 | m | **58** | m | 68 | 72 | 64 | 78 | 79 | 80 | 97 |
| | 2011 | 83 | 34 | 86 | 34 | 8 | 31 | 22 | 24 | 81 | 40 | 48 | 83 | 83 | 30 | 77 | 58 | **56** | 84 | 59 | 78 | 67 | 86 | 80 | 71 | 96 |
| | 2007 | m | m | m | 24 | 5 | 11 | 18 | 6 | 54 | 13 | 15 | 50 | 51 | 9 | 47 | 23 | **22** | 46 | 30 | 32 | 7 | 19 | 19 | 10 | 8 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904980

**Figure 8.8. 8th grade students discussing homework in science**

Change in and share of students whose teachers discuss the homework in class always or almost always, 2007-2015, teachers report




| | | Chile* | South Africa* | Japan | New Zealand* | Italy | Minnesota (USA)* | Korea | Ontario (CAN) | United States | Turkey | Norway | Hong Kong, China | **OECD average** | Australia | Sweden | England (UK) | Singapore | Massachusetts (USA)* | Quebec (CAN) | Israel | Indonesia* | Slovenia | Lithuania | Russian Federation | Hungary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 76 | 82 | 4 | 45 | 64 | m | 25 | 70 | 58 | 40 | 52 | 44 | **55** | 48 | 58 | 46 | 73 | m | 64 | 78 | m | 79 | 68 | 72 | 86 |
| | 2011 | 87 | 85 | 11 | 44 | 80 | 57 | 19 | 75 | 67 | 33 | 50 | 37 | **58** | 61 | 53 | 37 | 77 | 72 | 66 | 77 | 67 | 82 | 69 | 74 | 93 |
| | 2007 | m | m | 5 | m | 56 | 43 | 6 | 52 | 38 | 17 | 22 | 15 | **25** | 17 | 26 | 13 | 35 | 34 | 24 | 34 | 21 | 32 | 11 | 14 | 12 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933904999

**Table 8.1. Effect sizes for changes in homework practices**

| | Frequency of homework | | Monitoring homework completion | | Students correcting their own homework | | Discussion of homework in class | |
|---|---|---|---|---|---|---|---|---|
| | 8th Grade Math | 8th Grade Science | 8th Grade Math | 8th Grade Science | 8th Grade Math | 8th Grade Science | 8th Grade Math | 8th Grade Science |
| Australia | -0.07 | -0.07 | 0.04 | -0.05 | 0.33 | -0.09 | 0.70 | 0.68 |
| Canada (Ontario) | -0.36 | -0.12 | -0.33 | -0.30 | -0.16 | -0.28 | 0.75 | 0.39 |
| Canada (Quebec) | 0.31 | 0.46 | -0.23 | -0.13 | 0.27 | 0.02 | 1.30 | 0.82 |
| Chile | 0.02 | -0.07 | 0.09 | 0.12 | -0.04 | -0.14 | -0.25 | -0.28 |
| Hungary | -0.03 | m | -0.15 | -0.27 | -0.17 | -0.10 | 2.22 | 1.66 |
| Israel | -0.03 | -0.12 | -0.10 | -0.05 | -0.28 | -0.42 | 0.83 | 0.91 |
| Italy | -0.15 | -0.13 | -0.27 | -0.34 | -0.32 | -0.26 | 0.75 | 0.17 |
| Japan | 0.10 | 0.29 | 0.07 | 0.12 | 0.45 | 0.70 | 0.18 | -0.06 |
| Korea | -0.20 | -0.18 | 0.17 | -0.14 | 0.26 | 0.20 | 0.58 | 0.53 |
| Lithuania | -0.02 | m | 0.05 | -0.01 | -0.08 | -0.31 | 1.57 | 1.26 |
| New Zealand | -0.07 | 0.06 | -0.25 | -0.07 | -0.08 | 0.23 | -0.18 | 0.02 |
| Norway | -0.24 | -0.19 | 0.28 | 0.16 | 0.10 | 0.11 | 0.83 | 0.62 |
| Slovenia | 0.40 | m | 0.41 | 0.06 | 0.13 | 0.40 | 1.27 | 1.01 |
| Sweden | -0.02 | m | -0.43 | -0.16 | 0.52 | 0.09 | 0.44 | 0.66 |
| Turkey | 0.17 | 0.27 | 0.46 | 0.34 | 0.06 | 0.09 | 0.43 | 0.53 |
| UK (England) | 0.00 | -0.01 | -0.10 | -0.16 | 0.48 | 0.51 | 0.70 | 0.76 |
| United States | -0.29 | -0.18 | -0.22 | -0.18 | -0.01 | -0.01 | 0.58 | 0.40 |
| US (Massachusetts) | -0.06 | 0.12 | 0.01 | 0.07 | -0.11 | 0.12 | 0.73 | 0.78 |
| US (Minnesota) | 0.04 | -0.20 | -0.65 | 0.09 | 0.17 | -0.04 | 0.82 | 0.27 |
| **OECD (average)** | **-0.03** | **-0.01** | **-0.03** | **-0.07** | **0.11** | **0.06** | **0.75** | **0.62** |
| **OECD (av. absolute)** | **0.17** | **0.18** | **0.23** | **0.18** | **0.25** | **0.24** | **0.83** | **0.66** |
| Hong Kong, China | 0.02 | 0.12 | -0.31 | -0.01 | 0.03 | 0.11 | 0.07 | 0.67 |
| Indonesia | -0.07 | m | -0.09 | 0.16 | -0.34 | 0.05 | 0.74 | 0.97 |
| Russian Federation | 0.11 | m | -0.10 | -0.21 | -0.05 | -0.25 | 1.31 | 1.24 |
| Singapore | 0.05 | 0.11 | -0.06 | -0.07 | 0.13 | 0.16 | 0.79 | 0.78 |
| South Africa | 0.22 | 0.14 | -0.15 | -0.12 | 0.00 | 0.12 | 0.08 | -0.10 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015).

StatLink https://doi.org/10.1787/888933905018

# Chapter 9.
# Innovation in assessment practices

*This chapter presents the change in assessment practices in teaching and learning practices in reading, maths and science, including the emphasis given to different types of assessments (classroom, regional or national assessments). The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 51. Frequency of correction of assignment and feedback

### Why it matters

Formative assessment is a key pedagogical practice, structured around feedback, continuous monitoring of students' work, and appropriate new assignments to make them overcome their difficulties or move to the next level. Always correcting assignments and giving feedback to students is a professional and moral imperative for teachers, and one would expect the practice to be close to universal within all systems.

## Mathematics

### Change at the OECD level: moderate

OECD countries experienced changes in both directions, although the average net change was slightly positive (2 percentage points). The overall absolute change, counting both positives and negatives variations, was 15 percentage points on average, corresponding to a moderate effect size of 0.33. Surprisingly, this practice varies a lot within OECD countries. In 2015, 79 % of 8th grade students had their assignments systematically corrected in Chile, compared to only 2% in Slovenia – the OECD average being 44%.

### Countries where there has been the most change

Innovation took the form of both increases and reductions in this good practice. Large increases in the share of secondary students concerned were recorded in Korea (40 percentage points), Italy (21 percentage points) and Turkey (19 percentage points) whereas the practice lost considerable ground in Sweden and Australia (22 percentage point reduction in each case).

## Science

### Change at the OECD level: moderate-low

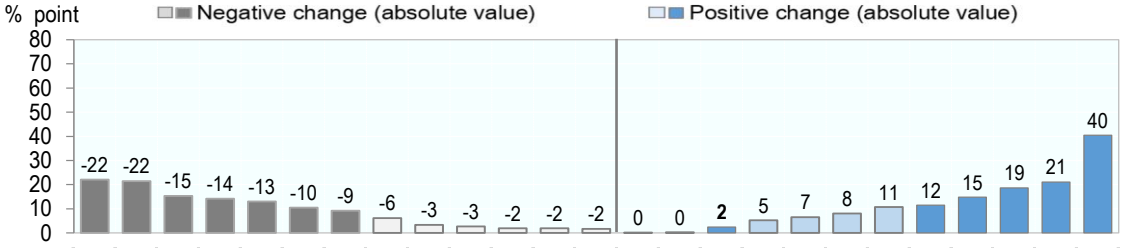
In science, the share of 8th grade students receiving a systematic correction of assignments decreased by 2 percentage points on average. Combining variations in both directions, the absolute change reached 11 percentage points, corresponding to a modest effect size of 0.23. Systematic correction and feedback is as common in science as in maths and concerns 45% of secondary students on average in OECD countries, with a span ranging from 83% in Chile to roughly 7% in Norway in 2015.

### Countries where there has been the most change

The spread of this practice was a significant innovation in Japan, where the share of students concerned has expanded by 30 percentage points, but also in Turkey (17 percentage points). Innovation has taken the form of a reduction of the practice in a few countries: it has decreased by 17 percentage points in Slovenia, and around 13 percentage points in the Russian Federation, Ontario (Canada), Australia, Hungary and Singapore.

**Figure 9.1. Correction of assignments and feedback in 8th grade maths**

Change in and share of students whose teachers correct assignments and give feedback always or almost always, 2007-2015, teachers report



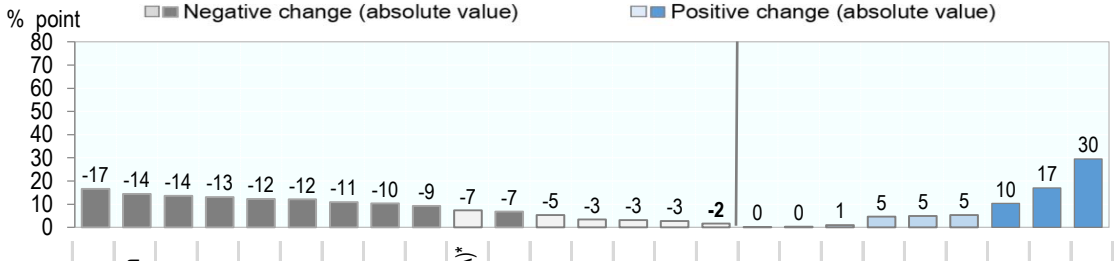

| | | Sweden | Australia | England (UK) | Hungary | Hong Kong, China | Slovenia | Lithuania | Chile* | Indonesia* | Russian Federation | Singapore | Ontario (CAN) | South Africa* | New Zealand* | United States | **OECD average** | Norway | Minnesota (USA)* | Quebec (CAN) | Massachusetts (USA)* | Israel | Japan | Turkey | Italy | Korea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 35 | 41 | 57 | 22 | 64 | 2 | 19 | 79 | m | 55 | 81 | 48 | 84 | 31 | 45 | **44** | 13 | m | 78 | m | 52 | 42 | 58 | 73 | 53 |
| | 2011 | 52 | 42 | 70 | 20 | 71 | 21 | 23 | 85 | 81 | 57 | 74 | 51 | 86 | 31 | 46 | **48** | 12 | 53 | 86 | 36 | 60 | 47 | 42 | 79 | 47 |
| | 2007 | 58 | 63 | 72 | 36 | 77 | 12 | 28 | m | 84 | 57 | 83 | 50 | m | m | 45 | **42** | 8 | 46 | 70 | 25 | 40 | 27 | 40 | 52 | 13 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905037

**Figure 9.2. Correction of assignments and feedback in 8th grade science**

Change in and share of students whose teachers correct assignments and give feedback always or almost always, 2007-2015, teachers report




| | | Slovenia | Russian Federation | Ontario (CAN) | Australia | Hungary | Singapore | England (UK) | Lithuania | United States | Massachusetts (USA)* | Norway | Indonesia* | Minnesota (USA)* | New Zealand* | Sweden | **OECD average** | Chile* | South Africa* | Italy | Israel | Quebec (CAN) | Korea | Hong Kong, China | Turkey | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 13 | 56 | 46 | 57 | 33 | 60 | 56 | 41 | 52 | m | 7 | m | m | 36 | 40 | **45** | 83 | 79 | 52 | 59 | 69 | 32 | 67 | 66 | 55 |
| | 2011 | 37 | 64 | 62 | 58 | 37 | 64 | 59 | 42 | 61 | 43 | 11 | 87 | 53 | 39 | 40 | **50** | 82 | 79 | 63 | 59 | 81 | 28 | 70 | 60 | 46 |
| | 2007 | 29 | 70 | 59 | 70 | 45 | 72 | 67 | 51 | 61 | 50 | 14 | 92 | 57 | m | 42 | **47** | m | m | 51 | 55 | 64 | 27 | 57 | 49 | 26 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905056

## 52. Emphasis on classroom tests

### Why it matters

Classroom tests are a widespread practice to assess how students are doing, whether they have understood the content and procedural knowledge that they were supposed to acquire. They are most useful when used formatively to monitor students' progress, and help them acquire the knowledge they have missed. They can be counterproductive when used for mere summative and selective purposes to put students in different study tracks rather than support them. This is thus an ambivalent pedagogical practice.

## Mathematics

### Change at the OECD level: moderate

In 8th grade mathematics lessons, the use of classroom tests has increased in most countries. In OECD countries, the share of students widely subjected to classroom tests has registered an average net increase of 7 percentage points. The absolute change, combining positives and negatives, was 12 percentage points, corresponding to a moderate effect size of 0.29. In 2015, maths teachers putting an emphasis on classroom tests taught 77% of 8th grade students in the OECD area.

### Countries where there has been the most change

Between 2007 and 2015, England registered a noticeable expansion by 28 percentage points of the share of 8th grade students extensively assessed through classroom tests, followed closely by Japan (27 percentage points). Very few countries recorded contractions in this practice. The practice decreased by 18 and 10 percentage points in Hungary and Italy, but to remain at high levels of use.

## Science

### Change at the OECD level: moderate-high

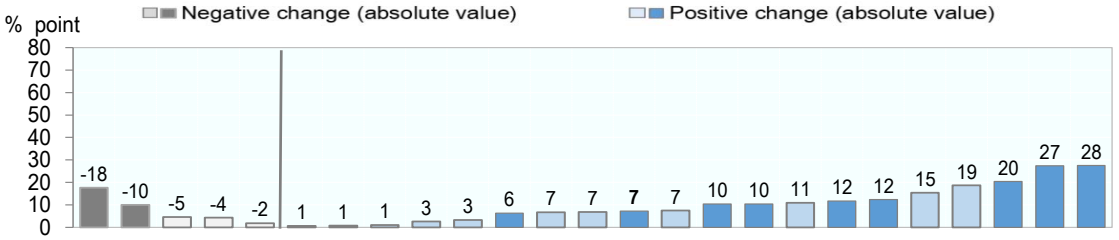
A large majority of countries saw the use of classroom tests in 8th grade science gain ground. At the OECD level, on average 72% of 8th grade students were extensively assessed through classroom tests in science lessons in 2015, compared to 60% in 2007. The absolute change in this practice was 16 percentage points on average, corresponding to a moderate-high effect size of 0.36. This practice is common in most OECD systems, touching three in four students on average (73%), with a span ranging from 94% in Japan to 57% in Ontario (Canada).

### Countries where there has been the most change

Innovation took the form of a significant diffusion of this practice. Japan is by far the country which experienced the most innovation in this area, with an expansion by 44 percentage points between 2007 and 2015, followed by Quebec (Canada) (28 percentage points). Indonesia and Minnesota (United States) saw also the practice gain significant ground between 2007 and 2011. On the other hand, Hungary experienced a significant contraction, with a decrease by 16 percentage points in the share of students concerned.

**Figure 9.3. 8th grade students assessed through classroom tests in maths**

Change in and share of students whose teachers put major emphasis on classroom tests to monitor students' progress, 2007-2015, teachers report



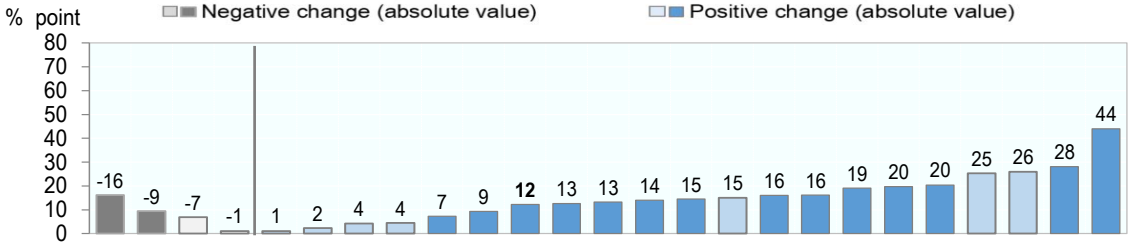

| | | Hungary | Italy | Australia | Chile* | South Africa* | Norway | New Zealand* | Hong Kong, China | Russian Federation | Ontario (CAN) | United States | Sweden | Lithuania | **OECD average** | Korea | Israel | Singapore | Massachusetts (USA)* | Turkey | Quebec (CAN) | Indonesia* | Minnesota (USA)* | Slovenia | Japan | England (UK) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 72 | 69 | 74 | 75 | 78 | 83 | 72 | 82 | 94 | 64 | 83 | 65 | 61 | **77** | 62 | 89 | 88 | m | 80 | 88 | m | m | 80 | 99 | 69 |
| | 2011 | 69 | 77 | 80 | 79 | 79 | 86 | 72 | 82 | 90 | 69 | 82 | 67 | 50 | **77** | 64 | 89 | 89 | 82 | 82 | 86 | 82 | 90 | 77 | 97 | 51 |
| | 2007 | 89 | 79 | 78 | m | m | 82 | m | 81 | 92 | 61 | 77 | 58 | 54 | **70** | 55 | 79 | 77 | 71 | 69 | 76 | 67 | 72 | 60 | 71 | 42 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905075

**Figure 9.4. 8th grade students assessed through classroom tests in science**

Change in and share of students whose teachers put major emphasis on classroom tests to monitor students' progress, 2007-2015, teachers report




| | | Hungary | South Africa* | Italy | Australia | Chile* | Russian Federation | Ontario (CAN) | New Zealand* | Singapore | Korea | **OECD average** | Norway | Israel | Sweden | United States | Massachusetts (USA)* | England (UK) | Hong Kong, China | Lithuania | Turkey | Slovenia | Minnesota (USA)* | Indonesia* | Quebec (CAN) | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 67 | 63 | 61 | 62 | 86 | 86 | 57 | 74 | 84 | 67 | **73** | 86 | 86 | 58 | 66 | m | 81 | 70 | 68 | 81 | 68 | m | m | 83 | 94 |
| | 2011 | 64 | 73 | 62 | 70 | 85 | 90 | 53 | 69 | 87 | 66 | **70** | 81 | 89 | 60 | 63 | 67 | 61 | 72 | 50 | 77 | 63 | 71 | 78 | 75 | 95 |
| | 2007 | 83 | m | 68 | 63 | m | 83 | 53 | m | 77 | 57 | **60** | 73 | 73 | 44 | 52 | 52 | 64 | 54 | 49 | 61 | 48 | 45 | 52 | 55 | 51 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink h https://doi.org/10.1787/888933905094

## 53. Emphasis on national or regional achievement tests

### Why it matters

National or regional achievement tests give teachers and schools a benchmark on how their students are doing compared to their peers, help policy makers, administrators, but also potentially school principals and teachers to make better informed decisions. Too much emphasis on those tests in the classroom may have counterproductive effects if they become so important that teachers "teach to the test". By their very nature, from an educational standpoint no test can be worth teaching to. Putting an emphasis on preparing for testing may have good or bad effects, depending on how it is done.

## Mathematics

### Change at the OECD level: moderate

The average net change in this domain was a slight expansion of the practice by 2 percentage points between 2007 and 2015 in OECD systems. Combining positive and negative changes, the absolute change in the use of this practice was 15 percentage points on average, corresponding to a moderate effect size of 0.34. While the importance of regional or national tests was relatively low across OECD education systems, with an average of 25% students concerned in 2015, there was a big variation going from only 2% of students experiencing an emphasis on national or regional tests in Ontario (Canada) compared to 70% in England.

### Countries where there has been the most change

In the Russian Federation, the share of 8th grade students widely exposed to this form of assessment increased by 41 percentage points between 2007 and 2015. Similarly, Israel and England (U.K.) recorded increases of 31 and 25 percentage points respectively. Decreases in this practice were quite insignificant, with the stark exception of Slovenia where the share of students exposed to this practice fell very significantly, by 68 percentage points.

## Science

### Change at the OECD level: moderate

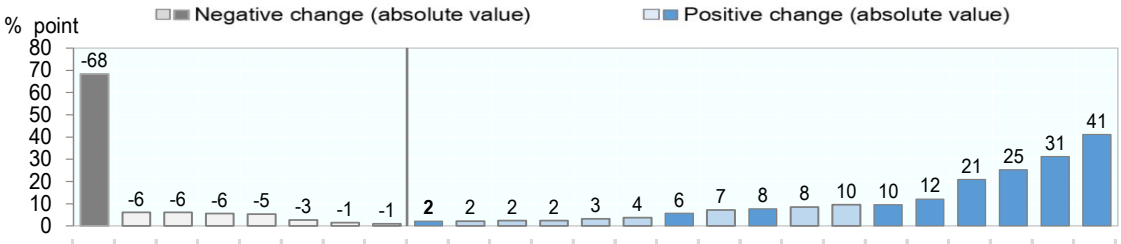
In OECD systems, the practice diffused slightly more than it receded, resulting in an average net increase of 2 percentage points. The average absolute change amounted to 12 percentage points, corresponding to modest effect size of 0.28. The use of this assessment method remains low on average (22% of students concerned) but differs quite a lot among OECD systems, with 8th grade science teachers in Turkey strongly relying on national or regional tests to assess students' progress while teachers in Ontario (Canada) barely doing so.

### Countries where there has been the most change

Innovation mainly took the shape of increases in the use of this practice. Between 2007 and 2015, Israel (32 parentage points), the Russian Federation (24 percentage points) and Turkey (21 percentage points) recorded substantial increases in the share of 8th grade students with a teacher emphasising national or regional achievement tests. During the same time period, the only substantial contraction of this practice was seen in Slovenia where the share of touched students decreased by 55 percentage points.

**Figure 9.5. 8th grade students assessed through regional or national tests in maths**

Change in and share of students whose teachers put major emphasis on regional or national tests to monitor students' progress, 2007-2015, teachers report



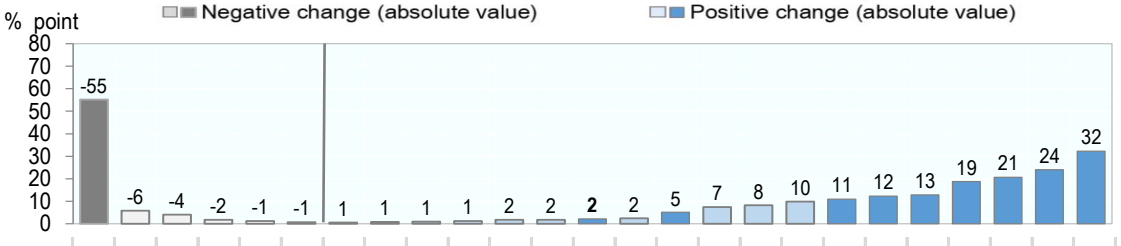

| | | Slovenia | South Africa* | Massachusetts (USA)* | Chile* | Norway | Korea | Ontario (CAN) | Sweden* | **OECD average** | Quebec (CAN) | Hong Kong, China | Australia | Italy | New Zealand* | Japan | Hungary | United States | Minnesota (USA)* | Indonesia* | Lithuania | Singapore | Turkey | England (UK) | Israel | Russian Federation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 14 | 58 | m | 29 | 9 | 14 | 2 | 44 | **25** | 28 | 8 | 5 | 12 | 22 | 11 | 24 | 28 | m | m | 28 | 49 | 66 | 70 | 41 | 91 |
| | 2011 | 10 | 64 | 11 | 35 | 10 | 21 | 1 | 45 | **21** | 5 | 8 | 7 | 15 | 18 | 10 | 14 | 29 | 15 | 55 | 7 | 45 | 58 | 38 | 50 | 83 |
| | 2007 | 83 | m | 17 | m | 15 | 17 | 3 | m | **23** | 26 | 6 | 3 | 9 | m | 5 | 17 | 21 | 7 | 45 | 18 | 37 | 45 | 44 | 10 | 49 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905113

**Figure 9.6. 8th grade students assessed through regional or national tests in science**

Change in and share of students whose teachers put major emphasis on regional or national tests to monitor students' progress, 2007-2015, teachers report




| | | Slovenia | South Africa* | Korea | Ontario (CAN) | Chile* | Norway | Hong Kong, China | Hungary | Australia | Japan | Lithuania | Massachusetts (USA)* | **OECD average** | Italy | New Zealand* | Indonesia* | Quebec (CAN) | Minnesota (USA)* | England (UK) | Sweden* | United States | Singapore | Turkey | Russian Federation | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 16 | 48 | 12 | 1 | 33 | 3 | 7 | 22 | 6 | 6 | 26 | m | **22** | 10 | 11 | m | 23 | m | 60 | 38 | 26 | 51 | 62 | 83 | 41 |
| | 2011 | 9 | 54 | 17 | m | 34 | 1 | 10 | 16 | 4 | 4 | 10 | 10 | **18** | 12 | 6 | 52 | 5 | 17 | 32 | 26 | 24 | 44 | 57 | 81 | 52 |
| | 2007 | 71 | m | 16 | 3 | m | 4 | 6 | 21 | 5 | 5 | 25 | 8 | **20** | 7 | m | 45 | 15 | 8 | 49 | m | 13 | 32 | 41 | 59 | 9 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905132

## 54. Written test in reading

### Why it matters

Frequent written tests in reading allow teachers to assess how their students are doing, whether they are acquiring the expected reading, writing and understanding skills. Tests are most useful when used formatively to monitor students' progress and help teachers provide the support to their students to make progress. Frequent testing can be counterproductive when used for mere summative or selective purposes.

### Change at the OECD level: large

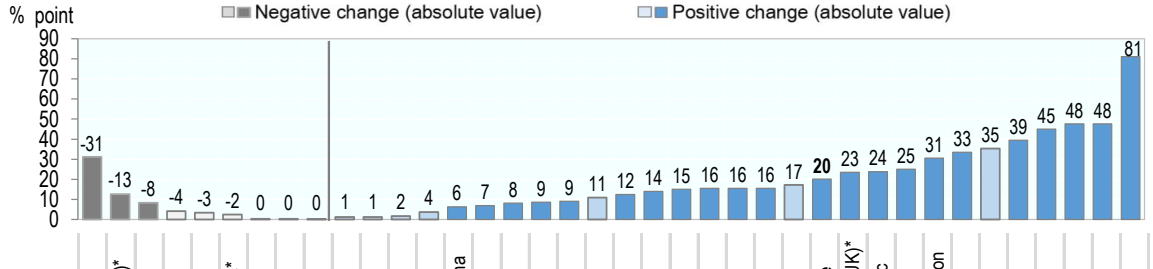
At the OECD level, the share of 4th grade students who were given a written test in reading at least once a week went from an average of 21% in 2006 to 41% in 2016. The average absolute change, reflecting the positive and negative variation, amounted to 21 percentage points, corresponding to a large effect size of 0.53. While this practice affects on average less than half of primary students in OECD countries, its prevalence varies strongly across OECD systems, with 95% of students touched in Hungary as opposed to only 8% in Denmark in 2016.

### Countries where there has been the most change

Hungary registered an outstanding increase in the share of 4th grade students regularly exposed to written tests in reading (81 percentage points). Increases above 40 percentage points occurred in Belgium (Fr.), Austria and Germany. Among the few systems experiencing a contraction of the practice, Belgium (Fl.) stood out with a 31-percentage points decrease of students given regular written tests.

**Figure 9.7. 4th grade students taking written tests in reading**

Change in and share of students whose teachers give them a written test in reading at least once a week, 2006-2016, teachers report




| | | Belgium Fl. | Andalusia (ESP)* | Israel | Poland | United States | Czech Republic* | Finland* | Spain | Canada* | Latvia | Australia* | Italy | Ontario (CAN) | Hong Kong, China | Denmark | France | Lithuania | Sweden | Alberta (CAN)* | Portugal* | New Zealand | Ireland* | Netherlands | Norway | Singapore | South Africa* | **OECD average** | Northern Ireland (UK)* | Slovak Republic | England (UK) | Russian Federation | Quebec (CAN) | Indonesia* | Slovenia | Germany | Austria | Belgium Fr. | Hungary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | -31 | -13 | -8 | -4 | -3 | -2 | 0 | 0 | 0 | 1 | 1 | 2 | 4 | 6 | 7 | 8 | 9 | 9 | 11 | 12 | 14 | 15 | 16 | 16 | 16 | 17 | **20** | 23 | 24 | 25 | 31 | 33 | 35 | 39 | 45 | 48 | 48 | 81 |
| % of students | 2016 | 13 | 22 | 13 | 42 | 64 | 20 | 10 | 25 | 28 | 22 | 31 | 56 | 14 | 13 | 8 | 27 | 20 | 17 | m | 82 | 17 | 42 | 39 | 24 | 33 | m | **41** | 53 | 38 | 32 | 47 | 68 | m | 65 | 47 | 61 | 73 | 95 |
| | 2011 | m | 35 | 16 | 55 | 74 | 22 | 10 | 31 | 29 | m | 29 | 53 | 17 | 17 | 8 | 31 | 8 | 17 | 26 | 69 | 8 | 27 | 49 | 20 | 33 | 54 | **39** | 30 | 21 | 14 | 41 | 67 | 75 | 56 | 5 | 72 | 78 | 97 |
| | 2006 | 44 | m | 21 | 46 | 67 | m | m | 25 | m | 21 | m | 54 | 10 | 6 | 1 | 19 | 11 | 8 | 15 | m | 3 | m | 24 | 8 | 18 | 37 | **21** | m | 14 | 7 | 16 | 35 | 40 | 26 | 3 | 13 | 26 | 14 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905151

## 55. Emphasis on classroom tests in reading

### Why it matters

Classroom tests are a widespread practice to assess how students are doing, whether they are gaining the vocabulary, phonological awareness and text comprehension expected from them. Tests are most useful when used formatively to monitor students' progress, to help identify and remedy their knowledge gaps. They can be counterproductive when used for mere summative and selective purposes to put students in tracks or ability groups rather than support them. This is thus an ambivalent pedagogical practice.

### Change at the OECD level: moderate

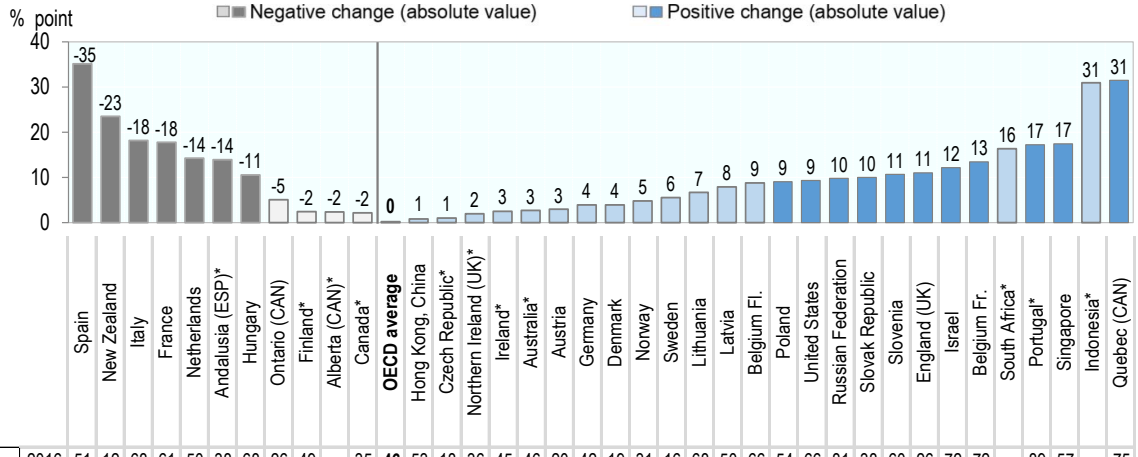
While expansions and contractions have cancelled each other across OECD countries, the overall absolute change in the share of 4th grade students significantly assessed through classroom tests in reading amounted to 13 percentage points on average. This corresponds to a moderate absolute effect size of 0.28. In 2016, the use of this practice concerned about one student in two in the OECD systems covered, with a span ranging from 89% of in Portugal to 12% in New Zealand.

### Countries where there has been the most change

Innovation took the form of both increases and reductions in the use of classroom tests. Quebec (Canada) recorded a substantial increase of 31 percentage points in the share of students using classroom tests in reading, whereas Spain experienced a decrease of 35 percentage points.

**Figure 9.8. 4th grade students assessed for reading through classroom tests**

Change in and share of students whose teachers put major emphasis on classroom tests to monitor students' progress, 2006-2016, teachers report




| | | Spain | New Zealand | Italy | France | Netherlands | Andalusia (ESP)* | Hungary | Ontario (CAN) | Finland* | Alberta (CAN)* | Canada* | **OECD average** | Hong Kong, China | Czech Republic* | Northern Ireland (UK)* | Ireland* | Australia* | Austria | Germany | Denmark | Norway | Sweden | Lithuania | Latvia | Belgium Fl. | Poland | United States | Russian Federation | Slovak Republic | Slovenia | England (UK) | Israel | Belgium Fr. | South Africa* | Portugal* | Singapore | Indonesia* | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 51 | 12 | 68 | 61 | 50 | 38 | 68 | 26 | 49 | m | 35 | **46** | 53 | 18 | 36 | 45 | 46 | 20 | 42 | 19 | 31 | 16 | 68 | 50 | 66 | 54 | 66 | 81 | 38 | 60 | 26 | 72 | 72 | m | 89 | 57 | m | 75 |
| | 2011 | 63 | 22 | 64 | 79 | 70 | 52 | 65 | 29 | 52 | 30 | 37 | **49** | 60 | 17 | 34 | 42 | 43 | 14 | 41 | 18 | 53 | 30 | 56 | m | m | 48 | 60 | 76 | 23 | 55 | 21 | 83 | 77 | 73 | 72 | 66 | 78 | 66 |
| | 2006 | 86 | 35 | 86 | 79 | 64 | m | 79 | 31 | m | 33 | m | **46** | 53 | m | m | m | m | 17 | 38 | 15 | 26 | 11 | 61 | 42 | 57 | 45 | 57 | 71 | 28 | 50 | 15 | 60 | 58 | 57 | m | 40 | 47 | 44 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905170

## 56. Emphasis on national or regional tests in reading

### Why it matters

National or regional achievement tests give teachers and schools a benchmark on how their students are doing compared to their peers, help policy makers, administrators, but also potentially school principals and teachers to make informed decisions. Too much emphasis on national or regional tests in the classroom may have counterproductive effects if they become so important that teachers "teach to the test". By their very nature, from an educational standpoint no test can be worth teaching to. Putting an emphasis on preparing testing may thus have good or bad effects, depending on how it is done.

### Change at the OECD level: small

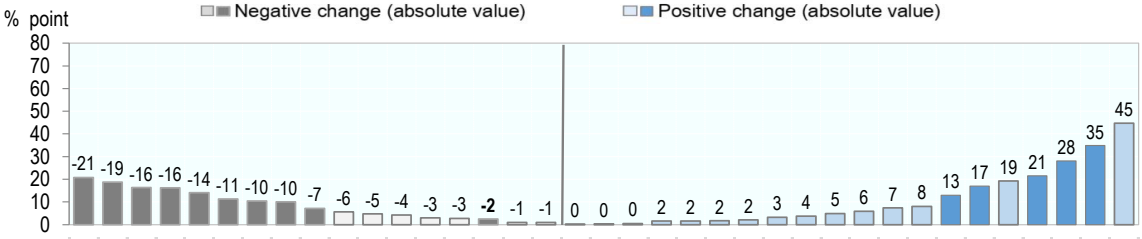
Between 2006 and 2016, OECD systems presented both positive and negative changes in the use of this practice, leading to a slightly negative average net change (-2 percentage points). The mean absolute change, accounting for changes in both directions, was 9 percentage points, corresponding to a modest effect size of 0.22. Across OECD countries, on average 23% of the 4th grade students had teachers emphasising regional or national tests in reading in 2016, with a span ranging from 62% in Israel to 4% in Germany.

### Countries where there has been the most change

Indonesia stood out with a spread of this practice by 45 percentage points between 2006 and 2011. Between 2006 and 2016, Israel, the Russian Federation and Portugal experienced substantial increases above 20 percentage points. Conversely, this practice receded in Belgium (Fl.) and France (21 and 19 percentage points respectively). In all these countries this has been a domain of significant innovation.

**Figure 9.9. 4th grade students assessed for reading through regional or national tests**

Change in and share of students whose teachers put major emphasis on regional or national tests to monitor students' progress, 2006-2016, teachers report




| | | Belgium Fl. | France | Netherlands | Spain | Hungary | Poland | Sweden | England (UK) | Germany | Norway | Alberta (CAN)* | Singapore* | Italy | Finland* | **OECD average** | Slovak Republic | Hong Kong, China | Slovenia | Denmark | Czech Republic* | Ontario (CAN) | Austria | Canada* | Ireland* | Australia* | Belgium Fr. | Latvia | Andalusia (ESP)* | Quebec (CAN) | Northern Ireland (UK)* | Lithuania | United States | South Africa* | Portugal* | Russian Federation | Israel | Indonesia* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 22 | 18 | 47 | 13 | 22 | 11 | 34 | 23 | 4 | 27 | m | 42 | 12 | 8 | **23** | 13 | 15 | 11 | 15 | 4 | 7 | 7 | 9 | 43 | 18 | 49 | 26 | 18 | 19 | 44 | 35 | 41 | m | 41 | 77 | 62 | m |
| | 2011 | m | 22 | 74 | 10 | 28 | 6 | 54 | 29 | 5 | 35 | 3 | 46 | 10 | 11 | **26** | 12 | 22 | 13 | 15 | 4 | 9 | 11 | 7 | 41 | 15 | 50 | m | 12 | 8 | 36 | 12 | 38 | 32 | 19 | 67 | 70 | 76 |
| | 2006 | 43 | 36 | 64 | 30 | 36 | 22 | 44 | 33 | 11 | 32 | 8 | m | 15 | m | **25** | 14 | 16 | 11 | 14 | m | 5 | 6 | m | m | m | 45 | 21 | m | 11 | m | 22 | 24 | 12 | m | 49 | 27 | 31 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905189

**Table 9.1. Effect sizes for changes in assessment practices**

| | Frequency of correction of assignment and feedback | | Emphasis on classroom tests | | Emphasis on national or regional achievement tests | | Written tests on reading | Emphasis on classroom test in reading | Emphasis on national or regional tests in reading |
|---|---|---|---|---|---|---|---|---|---|
| | 8th grade Maths | 8th grade Science | 8th grade Maths | 8th grade Science | 8th grade Maths | 8th grade Science | 4th grade | 4th grade | 4th grade |
| Australia | -0.43 | -0.27 | -0.11 | -0.02 | 0.12 | 0.04 | 0.03 | 0.05 | 0.09 |
| Austria | m | m | m | m | m | m | 1.04 | 0.08 | 0.06 |
| Belgium (Fl.) | m | m | m | m | m | m | -0.72 | 0.18 | -0.45 |
| Belgium (Fr.) | m | m | m | m | m | m | 0.99 | 0.28 | 0.08 |
| Canada | m | m | m | m | m | m | 0.00 | -0.05 | 0.06 |
| Canada (Alberta) | m | m | m | m | m | m | 0.27 | -0.05 | -0.22 |
| Canada (Ontario) | -0.04 | -0.27 | 0.07 | 0.08 | -0.09 | -0.14 | 0.12 | -0.11 | 0.07 |
| Canada (Quebec) | 0.18 | 0.10 | 0.32 | 0.62 | 0.05 | 0.21 | 0.68 | 0.65 | 0.21 |
| Chile | -0.16 | 0.00 | -0.10 | 0.03 | -0.12 | -0.03 | m | m | m |
| Czech Republic | m | m | m | m | m | m | -0.06 | 0.03 | 0.02 |
| Denmark | m | m | m | m | m | m | 0.37 | 0.11 | 0.01 |
| Finland | m | m | m | m | m | m | -0.01 | -0.05 | -0.09 |
| France | m | m | m | m | m | m | 0.19 | -0.39 | -0.43 |
| Germany | m | m | m | m | m | m | 1.20 | 0.08 | -0.28 |
| Hungary | -0.31 | -0.25 | -0.46 | -0.38 | 0.18 | 0.02 | 1.93 | -0.24 | -0.31 |
| Ireland | m | m | m | m | m | m | 0.32 | 0.05 | 0.04 |
| Israel | 0.23 | 0.09 | 0.28 | 0.33 | 0.75 | 0.79 | -0.22 | 0.26 | 0.72 |
| Italy | 0.44 | 0.02 | -0.23 | -0.14 | 0.11 | 0.09 | 0.03 | -0.44 | -0.09 |
| Japan | 0.31 | 0.61 | 0.92 | 1.08 | 0.21 | 0.06 | m | m | m |
| Korea | 0.90 | 0.12 | 0.15 | 0.19 | -0.07 | -0.12 | m | m | m |
| Latvia | m | m | m | m | m | m | 0.03 | 0.16 | 0.12 |
| Lithuania | -0.22 | -0.21 | 0.14 | 0.39 | 0.23 | 0.04 | 0.24 | 0.14 | 0.29 |
| Netherlands | m | m | m | m | m | m | 0.34 | -0.29 | -0.33 |
| New Zealand | 0.00 | -0.07 | 0.02 | 0.10 | 0.10 | 0.18 | 0.52 | -0.57 | m |
| Norway | 0.17 | -0.23 | 0.01 | 0.32 | -0.16 | -0.04 | 0.44 | 0.11 | -0.12 |
| Poland | m | m | m | m | m | m | -0.09 | 0.18 | -0.31 |
| Portugal | m | m | m | m | m | m | 0.29 | 0.45 | 0.48 |
| Slovak Republic | m | m | m | m | m | m | 0.56 | 0.21 | -0.03 |
| Slovenia | -0.45 | -0.42 | 0.45 | 0.42 | -1.51 | -1.19 | 0.81 | 0.22 | 0.00 |
| Spain | m | m | m | m | m | m | -0.01 | -0.79 | -0.40 |
| Spain (Andalusia) | m | m | m | m | m | m | -0.28 | -0.28 | 0.17 |
| Sweden | -0.45 | -0.05 | 0.14 | 0.28 | -0.02 | 0.27 | 0.28 | 0.16 | -0.21 |
| Switzerland | m | m | m | m | m | m | m | m | m |
| Turkey | 0.37 | 0.35 | 0.27 | 0.44 | 0.43 | 0.42 | m | m | m |
| UK (England) | -0.32 | -0.23 | 0.56 | 0.36 | 0.52 | 0.22 | 0.67 | 0.28 | -0.22 |
| UK (Northern Ireland) | m | m | m | m | m | m | 0.48 | 0.04 | 0.16 |

| | Frequency of correction of assignment and feedback | | Emphasis on classroom tests | | Emphasis on national or regional achievement tests | | Written tests on reading | Emphasis on classroom test in reading | Emphasis on national or regional tests in reading |
|---|---|---|---|---|---|---|---|---|---|
| | 8th grade Maths | 8th grade Science | 8th grade Maths | 8th grade Science | 8th grade Maths | 8th grade Science | 4th grade | 4th grade | 4th grade |
| United States | 0.00 | -0.19 | 0.16 | 0.30 | 0.18 | 0.33 | -0.07 | 0.19 | 0.36 |
| US (Massachusetts) | 0.23 | -0.15 | 0.26 | 0.31 | -0.17 | 0.06 | m | m | m |
| US.(Minnesota) | 0.13 | -0.07 | 0.49 | 0.52 | 0.27 | 0.30 | m | m | m |
| **OECD (average)** | **0.05** | **-0.03** | **0.16** | **0.26** | **0.05** | **0.05** | **0.44** | **0.00** | **-0.06** |
| **OECD (av. absolute)** | **0.33** | **0.23** | **0.29** | **0.36** | **0.34** | **0.28** | **0.53** | **0.28** | **0.22** |
| Hong Kong, China | -0.29 | 0.21 | 0.03 | 0.33 | 0.09 | 0.02 | 0.22 | 0.02 | -0.03 |
| Indonesia | -0.09 | -0.17 | 0.36 | 0.55 | 0.19 | 0.15 | 0.73 | 0.65 | 0.93 |
| Russian Federation | -0.05 | -0.30 | 0.10 | 0.06 | 0.96 | 0.54 | 0.68 | 0.23 | 0.59 |
| Singapore | -0.05 | -0.26 | 0.28 | 0.18 | 0.25 | 0.38 | 0.36 | 0.35 | -0.08 |
| South Africa | -0.05 | 0.01 | -0.04 | -0.20 | -0.13 | -0.12 | 0.35 | 0.35 | 0.47 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PIRLS (2006, 2011 and 2016).

StatLink https://doi.org/10.1787/888933905208

# Chapter 10.
# Innovation in learning scaffolding practices in reading

*This chapter presents the change in teaching and learning practices aimed at supporting students having difficulties in reading. They go from waiting for maturation to having a teaching aid or asking parents to help. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 57. Availability of teacher aide or an adult volunteer to work with students who have difficulty with reading

### Why it matters

Having to teach whole classes, teachers may find it difficult to provide students with reading difficulties the individualised instruction that works best for them. A possible strategy is to support teachers with teacher aides, adult or parent volunteers having the competence to help students. If teacher aides are not properly trained, this support may not add much to the learning gains to the beneficiary students, although it may have other benefits.

### Change at the OECD level: small

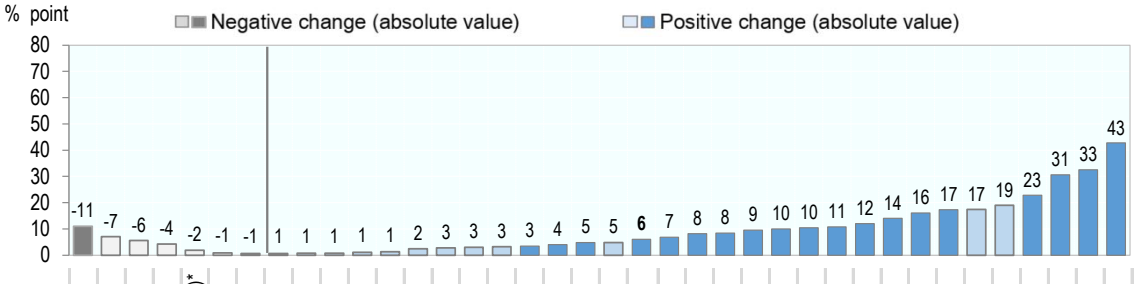
In OECD systems, on average 13% of 4th grade students with reading difficulties had a teacher aide or an adult volunteer supporting them academically in 2016, compared to 7% in 2006. When both increases and decreases are accounted for, the absolute change amounted to 7 percentage points on average, corresponding to a small absolute effect size of 0.24. In 2016, England stood out with 62% of 4th grade reading students having this type of scaffolding available. But overall, this practice is not common in OECD systems.

### Countries where there has been the most change

England innovated the most with an increase of 43 percentage points in the share of students exposed to the practice. With increases exceeding 30 percentage points, Belgium (Fl.) and Singapore display the same pattern. Decreases in this practice were rather small.

**Figure 10.1. Availability of an aide for 4th grade students who have reading difficulty**

Change in and share of students who have always teacher aide or adult volunteer available to work with those who have reading difficulty, 2006-2016, teachers report




| | | Ireland* | Alberta (CAN)* | Ontario (CAN) | United States | Northern Ireland (UK)* | Hungary | Andalusia (ESP)* | Norway | Quebec (CAN) | France | Canada* | Slovenia | Denmark | Israel | Sweden | Finland* | Poland | Germany | Belgium Fr. | Australia* | **OECD average** | New Zealand | Portugal* | Austria | Czech Republic* | Spain | Netherlands | Russian Federation | Italy | Latvia | Slovak Republic | Lithuania | South Africa* | Indonesia* | Hong Kong, China | Singapore | Belgium Fl. | England (UK) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 10 | m | 8 | 11 | 32 | 12 | 7 | 9 | 5 | 1 | 11 | 3 | 5 | 12 | 9 | 13 | 7 | 4 | 9 | 30 | **13** | 28 | 15 | 10 | 13 | 11 | 15 | 15 | 21 | 16 | 17 | 19 | m | m | 25 | 32 | 38 | 62 |
| | 2011 | 21 | 13 | 13 | 16 | 34 | 10 | 8 | 13 | 3 | 1 | 10 | 10 | 3 | 22 | 10 | 9 | 9 | 5 | 5 | 25 | **12** | 29 | 6 | 4 | 4 | 13 | 10 | 28 | 12 | m | 12 | 20 | 24 | 24 | 20 | 24 | m | 44 |
| | 2006 | m | 20 | 13 | 16 | m | 13 | m | 9 | 4 | 1 | m | 1 | 2 | 9 | 6 | m | 4 | 0 | 4 | m | **7** | 21 | m | 2 | m | 1 | 4 | 4 | 9 | 2 | 1 | 2 | 7 | 5 | 2 | 1 | 5 | 19 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905227

## 58. Waiting for maturation to improve performance if a student begins to fall behind in reading

### Why it matters

Maturation does improve reading performance, both for cognitive and biological reasons (e.g. eye maturation and visual span). Waiting for maturation to improve performance if students begin to fall behind in reading is better than, say, make students repeat a grade. In some cases this may be too passive a teaching strategy, unless the origin of the reading difficulty cannot be tackled. While not harmful, one would not want this practice to be systematic.

### Change at the OECD level: moderate

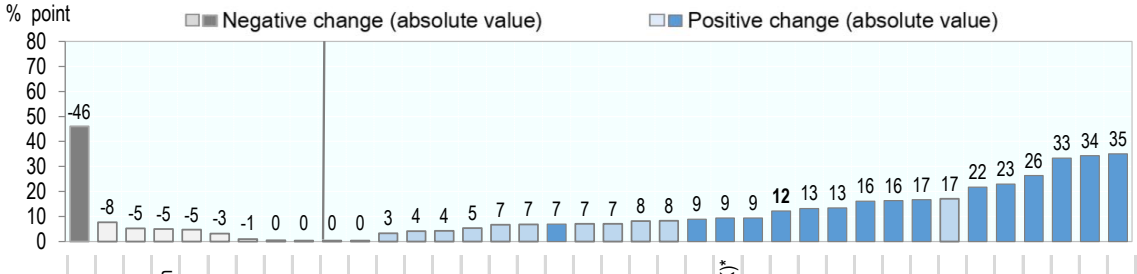
In 4th grade reading lessons, across OECD systems, this approach generally spread and the share of students exposed to it increased by 12 percentage points on average. As a result of negative and positive changes, the absolute change was 14 percentage points, corresponding to a moderate absolute effect size of 0.3. Within OECD countries, the use of this practice is modest. In 2016, 42% of 4th grade students were instructed by teachers employing this "waiting" method with students beginning to fall behind in reading.

### Countries where there has been the most change

Between 2006 and 2016, this practice scaled up significantly in Hungary, Spain and the Slovak Republic, all three recording increases above 30 percentage points. In contrast, decreases in this domain were of a small order, with the exception of Latvia where the practice contracted by 46 percentage points.

**Figure 10.2. Waiting for maturation to improve performance in 4th grade reading**

Change in and share of students whose teachers wait for maturation to improve performance if a student begins to fall behind, 2006-2016, teachers report




| | | Latvia | England (UK) | Sweden | Russian Federation | Belgium Fl. | Lithuania | Quebec (CAN) | Italy | Austria | Australia* | Finland* | Belgium Fr. | Hong Kong, China | France | Germany | Ireland* | Czech Republic* | Canada* | Alberta (CAN)* | Andalusia (ESP)* | United States | South Africa* | Norway | Northern Ireland (UK)* | Slovenia | **OECD average** | Netherlands | Singapore | New Zealand | Denmark | Portugal* | Indonesia* | Israel | Ontario (CAN) | Poland | Slovak Republic | Spain | Hungary |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 44 | 27 | 25 | 60 | 38 | 46 | 43 | 48 | 44 | 26 | 57 | 56 | 97 | 46 | 31 | 43 | 41 | 46 | m | 59 | 41 | m | 33 | 32 | 21 | **42** | 31 | 66 | 35 | 49 | 51 | m | 40 | 46 | 41 | 58 | 60 | 68 |
| | 2011 | m | 23 | 22 | 57 | m | 30 | 44 | 55 | 46 | 25 | 56 | 56 | 96 | 38 | 31 | 37 | 34 | 39 | 38 | 52 | 37 | 59 | 24 | 22 | 26 | **36** | 18 | 55 | 33 | 33 | 35 | 61 | 42 | 40 | 13 | 27 | 59 | 61 |
| | 2006 | 91 | 34 | 30 | 65 | 43 | 49 | 44 | 48 | 45 | m | m | 53 | 93 | 41 | 25 | m | m | m | 31 | m | 32 | 51 | 24 | m | 11 | **30** | 18 | 52 | 19 | 32 | m | 43 | 19 | 23 | 14 | 24 | 25 | 33 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905246

## 59. Spending more time on reading individually with students beginning to fall behind in reading

### Why it matters

One on one instruction seems to be the most effective teaching strategy for students falling behind in reading (and elsewhere). It is thus good practice for teachers to spend more time on reading individually with students who begin to fall behind in reading. Part of the issue may be emotional and related to anxiety, so the earlier the teacher intervention the better.

### Change at the OECD level: moderate-low

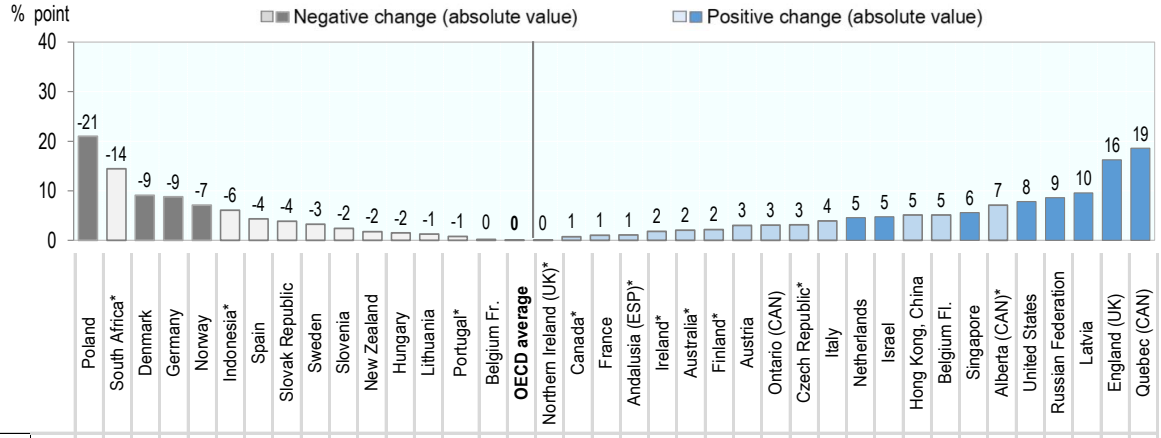
Contractions have fully balanced expansions of the practice across OECD systems, but on average there has been an absolute change of 6 percentage points in the use of this practice, corresponding to a moderate-low absolute effect size of 0.22. This scaffolding technique in reading is widely used, with on average 89% of students instructed by teachers that work individually with those falling behind in reading in an OECD system in 2016 – and always at least 70% of students taught by such teachers.

### Countries where there has been the most change

Innovation has taken the shape of both diffusion and recession of the practice. While the practice spread in Quebec (Canada) and England by over 15 percentage points between 2006 and 2016, it contracted by 21 percentage points in Poland. South Africa registered a contraction of this practice by 14 percentage points between 2006 and 2011.

**Figure 10.3. Spending more time on 4th grade students beginning to fall behind in reading**

Change in and share of students whose teachers spend more time working individually with those who begin to fall behind, 2006-2016, teachers report.




| % of students | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 78 | m | 74 | 72 | 89 | m | 83 | 92 | 87 | 94 | 92 | 96 | 96 | 99 | 73 | **89** | 95 | 94 | 83 | 85 | 91 | 96 | 85 | 89 | 97 | 85 | 96 | 99 | 96 | 87 | 92 | 84 | m | 96 | 98 | 93 | 94 | 88 |
| | 2011 | 98 | 75 | 83 | 78 | 95 | 77 | 78 | 92 | 95 | 95 | 96 | 99 | 97 | 100 | 72 | **91** | 95 | 93 | 87 | 84 | 89 | 94 | 82 | 91 | 99 | 82 | 91 | 99 | 96 | 93 | m | 82 | 98 | 94 | 97 | m | 90 | 86 |
| | 2006 | 99 | 90 | 84 | 80 | 96 | 84 | 87 | 95 | 90 | 97 | 94 | 98 | 98 | m | 73 | **89** | m | m | 82 | m | m | m | m | 86 | 94 | m | 92 | 94 | 91 | 82 | 87 | 78 | 90 | 89 | 89 | 83 | 78 | 70 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905265

## 60. Parental help if a student begins to fall behind in reading

### Why it matters

Parents play a fundamental role in the education of their children, including their school education. Parental engagement is one of the strongest predictors of good learning outcomes. This is even more important when student start having difficulties in reading (or elsewhere) and need extra support. Parental interventions are particularly effective in early grades, for example when they teach literacy skills to their children.

### Change at the OECD level: small

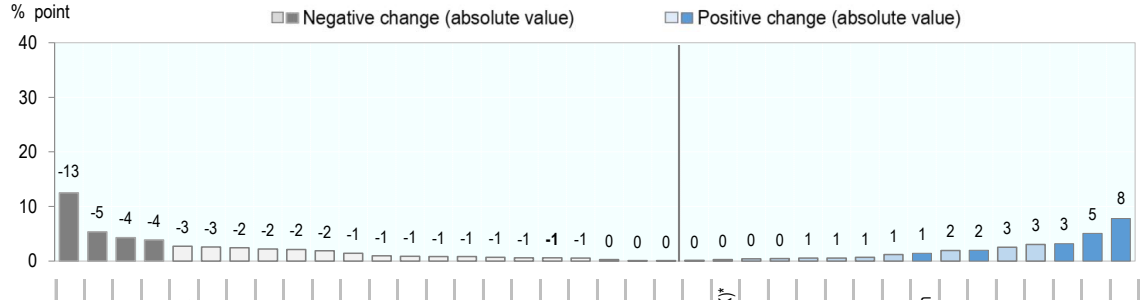
Between 2006 and 2016, the use of this practice has both increased and decreased across OECD countries, resulting in a net decline of 1 percentage point in the share of 4th grade students instructed by teachers who ask parental help for students falling behind in reading. The mean absolute change in this practice was only 3 percentage points, corresponding to a small absolute effect size of 0.13. All OECD education systems covered show near universal use of this practice, concerning on average 96% of students.

### Countries where there has been the most change

Israel experienced the largest positive change in the use of this practice, with an increase of 8 percentage points in the share of students with a teacher asking their parents to help when they fall behind. In contrast, Quebec (Canada) recorded the largest decrease (13 percentage points). However these changes remain modest and innovation in this domain was minor in the past decade.

**Figure 10.4. Parental help for 4th grade students beginning to fall behind in reading**

Change in and share of students whose teachers ask parents to help those students who begin to fall behind, 2006-2016, teachers report




| % of students | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 84 | 92 | 95 | 95 | 80 | 91 | 91 | 97 | m | 97 | m | 81 | 91 | 97 | 99 | 94 | 98 | **96** | 98 | 98 | 99 | 99 | 91 | 97 | 99 | m | 99 | 98 | 100 | 96 | 100 | 86 | 100 | 97 | 97 | 100 | 98 | 98 |
| | 2011 | 86 | 95 | 100 | 99 | 86 | 93 | 92 | 99 | 96 | m | 96 | 86 | m | 96 | 99 | 94 | 98 | **96** | 98 | 97 | 99 | 98 | 91 | 96 | 98 | 96 | 100 | 100 | 99 | 95 | 100 | 88 | 98 | 94 | 97 | 96 | 98 | 97 |
| | 2006 | 97 | 97 | m | 99 | 83 | 93 | 93 | 99 | 98 | 99 | 97 | 82 | 91 | 97 | 100 | m | 99 | **96** | 98 | 98 | m | 99 | m | m | 99 | 95 | 98 | 98 | 99 | m | 99 | 84 | 98 | m | 94 | m | 93 | 91 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905284

**Table 10.1. Effect sizes for changes in scaffolding practices in reading**

| | Availability of teacher aide or adult volunteer to work with students who have difficulty in reading | Waiting for maturation to see if performance improve to work to work with students who have difficulty in reading | Reading individually with students | Parental help |
|---|---|---|---|---|
| | 4th grade | 4th grade | 4th grade | 4th grade |
| Australia | 0.11 | 0.01 | 0.09 | 0.00 |
| Austria | 0.38 | -0.01 | 0.09 | 0.04 |
| Belgium (Fl.) | 0.86 | -0.10 | 0.17 | -0.03 |
| Belgium (Fr.) | 0.20 | 0.06 | 0.00 | -0.10 |
| Canada | 0.03 | 0.14 | 0.03 | -0.03 |
| Canada (Alberta) | -0.19 | 0.15 | 0.32 | -0.12 |
| Canada (Ontario) | -0.18 | 0.49 | 0.16 | 0.15 |
| Canada (Quebec) | 0.04 | -0.02 | 0.47 | -0.45 |
| Czech Republic | 0.35 | 0.14 | 0.09 | 0.26 |
| Denmark | 0.14 | 0.33 | -0.22 | -0.09 |
| Finland | 0.10 | 0.01 | 0.06 | 0.12 |
| France | 0.07 | 0.08 | 0.03 | 0.05 |
| Germany | 0.33 | 0.12 | -0.21 | 0.04 |
| Hungary | -0.03 | 0.72 | -0.09 | -0.05 |
| Ireland | -0.31 | 0.14 | 0.06 | 0.05 |
| Israel | 0.09 | 0.48 | 0.20 | 0.37 |
| Italy | 0.34 | -0.01 | 0.16 | 0.26 |
| Latvia | 0.54 | -1.06 | 0.30 | -0.15 |
| Lithuania | 0.64 | -0.06 | -0.07 | 0.20 |
| Netherlands | 0.37 | 0.31 | 0.27 | -0.04 |
| New Zealand | 0.16 | 0.37 | -0.07 | -0.09 |
| Norway | 0.02 | 0.20 | -0.28 | -0.17 |
| Poland | 0.15 | 0.61 | -0.79 | 0.00 |
| Portugal | 0.27 | 0.34 | -0.18 | -0.01 |
| Slovak Republic | 0.63 | 0.69 | -0.16 | -0.02 |
| Slovenia | 0.09 | 0.26 | -0.12 | 0.11 |
| Spain | 0.45 | 0.71 | -0.12 | 0.05 |
| Spain (Andalusia) | -0.02 | 0.14 | 0.03 | -0.31 |
| Sweden | 0.12 | -0.12 | -0.10 | -0.26 |
| UK (England) | 0.91 | -0.17 | 0.49 | -0.05 |
| UK (Northern Ireland) | -0.04 | 0.21 | 0.00 | 0.02 |
| United States | -0.12 | 0.17 | 0.31 | -0.24 |
| **OECD (average)** | **0.20** | **0.26** | **0.00** | **-0.03** |
| **OECD (av. absolute)** | **0.24** | **0.30** | **0.22** | **0.13** |
| Hong Kong, China | 0.75 | 0.20 | 0.14 | -0.07 |
| Indonesia | 0.57 | 0.34 | -0.15 | 0.02 |
| Russian Federation | 0.38 | -0.10 | 0.39 | 0.24 |
| Singapore | 0.98 | 0.27 | 0.14 | -0.02 |
| South Africa | 0.50 | 0.17 | -0.39 | -0.08 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on PIRLS (2006, 2011 and 2016)

StatLink https://doi.org/10.1787/888933905303

# Chapter 11.
# Innovation in access and use of learning resources

*This chapter presents the change in the availability of learning resources for students in school or in their classroom. The learning resources include school libraries, reading corners and computers. The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 61. Availability of science laboratory for students

### Why it matters

Hands-on science education requires some form of science laboratory where students can experiment. Those exist in almost all secondary schools, but only in some primary schools. While useful, school laboratories may be replaced by outdoor experiments in some instances or by remote or virtual laboratories. Their very existence incentivises teachers to use them for science education though, which makes them very convenient in spite of the availability of other learning solutions to teach well in science.

## Primary education

### Change at the OECD level: small

Across the OECD area, negative changes slightly outweigh positive ones and the share of 4th grade students having access to a science laboratory at school decreased by 1 percentage point on average. Between 2007 and 2015, the average absolute change in the availability of this resource was 8 percentage points, corresponding to a small effect size of 0.2. In 2015, there were big differences across OECD countries in this domain: while primary schools in Korea and Japan have a science laboratory available for almost all 4th grade students, practically no school in Northern Ireland reported to have any.

### Countries where there has been the most change

Poland experienced the largest increase in this domain (59 percentage points), followed by the Russian Federation and Portugal (over 20 percentage points). By contrast, access to science laboratories significantly dropped in several countries, with declines by 24 percentage points in Denmark and by 22 percentage points in Turkey, Hungary and Ontario (Canada). (Some of these changes were measured between 2011 and 2015 instead of between 2007 and 2015.)

## Secondary education

### Change at the OECD level: small

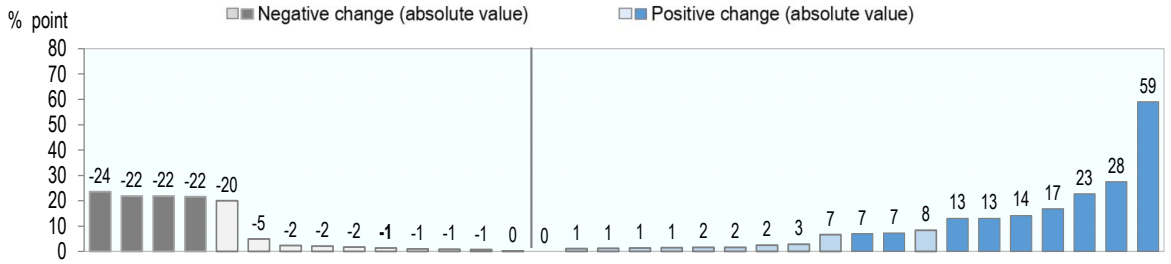
Between 2007 and 2015, the share of 8th grade students with access to a science laboratory at school decreased by 2 percentage points on average in OECD systems. Only a small number of countries innovated in this domain and the absolute change in the access to this resource amounted to 3 percentage points, corresponding to a small absolute effect size of 0.12. At the OECD level, on average 81% of secondary students had access to a science laboratory at school in 2015.

### Countries where there has been the most change

Between 2007 and 2011, Minnesota (United States) recorded a 16-percentage point increase in the share of 8th grade students with access to a science laboratory at school. In the same way, the Russian Federation saw an increase of 13 percentage points between 2007 and 2015. Reductions in the availability of this resource were generally small. Only students in Hungary experienced a decrease by over 10 percentage points.

**Figure 11.1. 4th grade students with access to a science laboratory at school**

Change in and share of students who have access to a science laboratory at school, 2007-2015, school principals report



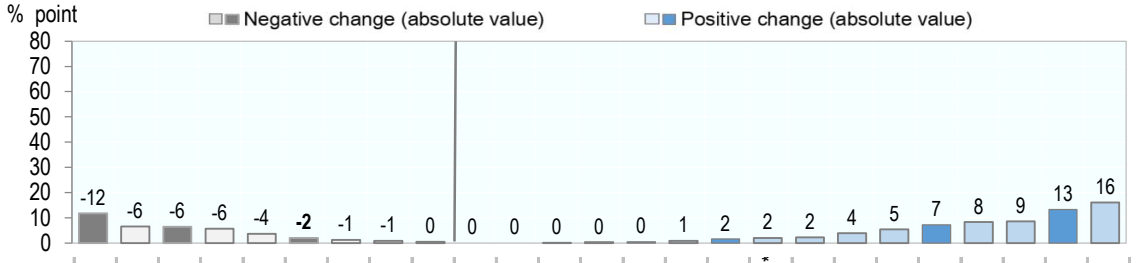

| | | Denmark | Turkey* | Hungary | Ontario (CAN) | Alberta (CAN)* | Slovak Republic | Spain* | Sweden | New Zealand | **OECD average** | Lithuania | Japan | Korea* | Singapore | Northern Ireland (UK)* | Quebec (CAN) | Ireland* | Australia | Netherlands* | England (UK) | Belgium (Fl.)* | Italy | Czech Republic | Austria* | United States | Germany | Finland* | Norway | Hong Kong, China | Slovenia | Chile* | Portugal* | Russian Federation | Poland* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 51 | 44 | 12 | 7 | m | 27 | 32 | 31 | 6 | **26** | 2 | 97 | 99 | 98 | 0 | 12 | 1 | 13 | 1 | 8 | 2 | 31 | 40 | m | 29 | 15 | 25 | 31 | 38 | 23 | 61 | 41 | 34 | 68 |
| | 2011 | 56 | 66 | 13 | 8 | 14 | 21 | 34 | 24 | 5 | **25** | m | 99 | 100 | 100 | 0 | 14 | 0 | 13 | 3 | 9 | 1 | 43 | 36 | 8 | 25 | 13 | 16 | 17 | 37 | 19 | 45 | 18 | 23 | 9 |
| | 2007 | 75 | m | 34 | 28 | 34 | 32 | m | 33 | 8 | **27** | 3 | 98 | m | 98 | m | 11 | m | 12 | m | 7 | m | 29 | 37 | 1 | 22 | 7 | m | 18 | 25 | 9 | m | m | 6 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905322

**Figure 11.2. 8th grade students with access to a science laboratory at school**

Change in and share of students who have access to a science laboratory at school, 2007-2015, school principals report




| | | Hungary | United States | Turkey | Slovenia | Ontario (CAN) | **OECD average** | Australia | Korea | New Zealand* | Singapore | England (UK) | Japan | Israel | Quebec (CAN) | Hong Kong, China | Sweden | Massachusetts (USA)* | Italy | Norway | South Africa* | Lithuania | Chile* | Indonesia* | Russian Federation | Minnesota (USA)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 30 | 74 | 78 | 50 | 54 | **81** | 99 | 99 | 99 | 100 | 100 | 99 | 88 | 100 | 100 | 100 | m | 71 | 93 | 49 | 11 | 68 | m | 84 | m |
| | 2011 | 36 | 81 | 83 | 48 | 52 | **82** | 100 | 100 | 100 | 100 | 100 | 100 | 86 | 99 | 99 | 99 | 83 | 74 | 90 | 44 | 13 | 59 | 71 | 86 | 98 |
| | 2007 | 42 | 80 | 84 | 56 | 57 | **83** | 100 | 100 | m | 100 | 100 | 99 | 88 | 100 | 99 | 98 | 81 | 69 | 90 | m | 4 | m | 62 | 71 | 82 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905341

## 62. Availability of a school library

### Why it matters

A school library is an important learning and school resource, notably if librarians can support teachers in curating their teaching materials and support students in learning to access information. The quality of the available resources within the library and its use certainly make more difference to student learning and socialising, but ideally one would still want to see such a resource in schools, especially for students who have less access to culture and information at home.

### Change at the OECD level: moderate-low

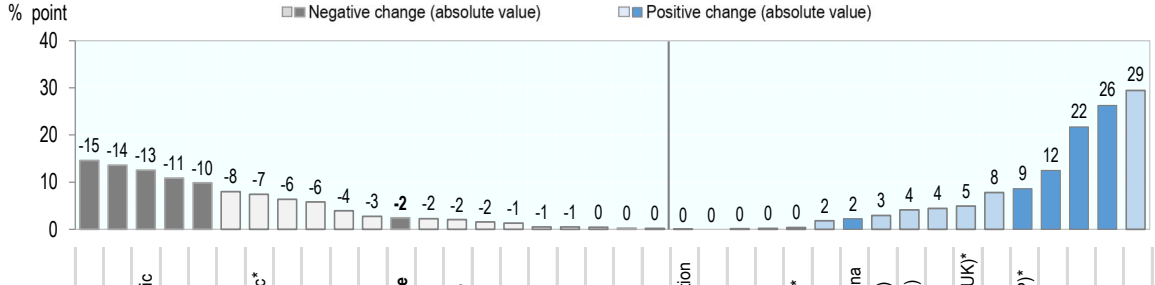
OECD systems have experienced differing trends, although on average the net availability of school libraries in primary education has slightly decreased by 2 percentage points between 2006 and 2016. All country-level variations lead to an average absolute change of 6 percentage points, corresponding to a moderate-low effect size of 0.22. At the OECD level, on average 88% of 4th grade students have access to a library at school, ranging from 64% in Ireland to 100% in Slovenia in 2016.

### Countries where there has been the most change

Between 2006 and 2016, widened access to school libraries in primary has been an innovation in Austria, where the share of students concerned expanded by 26 percentage points. Students in South Africa experienced an even more prominent increase of 29 percentage points between 2006 and 2011. On the contrary, decreased access exceeded 10 percentage points in France, Hungary, the Slovak Republic and Italy.

**Figure 11.3. 4th grade students with access to a school library**

Change in and share of students who have access to a library at school, 2006-2016, school principals report




| | | France | Hungary | Slovak Republic | Italy | Finland* | Belgium Fr. | Czech Republic* | Germany | Israel | England (UK) | Denmark | **OECD average** | Norway | United States | Spain | Netherlands | Canada* | Latvia | New Zealand | Slovenia | Poland | Russian Federation | Singapore | Australia* | Lithuania | Alberta (CAN)* | Indonesia* | Hong Kong, China | Ontario (CAN) | Quebec (CAN) | Sweden | Northern Ireland (UK)* | Belgium Fl. | Andalusia (ESP)* | Ireland* | Portugal* | Austria | South Africa* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 75 | 85 | 86 | 83 | 70 | 64 | 76 | 72 | 83 | 92 | 94 | **88** | 96 | 97 | 96 | 75 | 99 | 99 | 99 | 100 | 96 | 100 | 100 | 99 | 99 | m | m | 100 | 100 | 96 | 95 | 74 | 51 | 99 | 64 | 98 | 79 | m |
| | 2011 | 73 | 96 | 89 | 88 | 79 | 72 | 83 | 74 | 83 | 93 | 96 | **89** | 96 | 99 | 95 | 83 | 99 | m | 100 | 99 | 99 | 99 | 100 | 99 | 97 | 100 | 79 | 100 | 99 | 98 | 83 | 69 | m | 90 | 52 | 76 | 73 | 70 |
| | 2006 | 90 | 98 | 99 | 94 | m | 72 | m | 79 | 89 | 96 | 97 | **91** | 98 | 99 | 98 | 76 | m | 100 | 99 | 100 | 97 | 100 | 100 | m | 99 | 100 | 77 | 98 | 97 | 91 | 90 | m | 43 | m | m | m | 53 | 40 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905360

## 63. Availability of a library or a reading corner in the classroom

### Why it matters

Classrooms with a library or reading corner makes it easier to introduce small group work, to let students read books of their choice, to work on an assignment as other students are (still) engaged in another activity, or just to read for entertainment. This may also create a cosy atmosphere in the classroom and make reading and learning resources more easily available and pleasurable for the students.

### Change at the OECD level: moderate-low

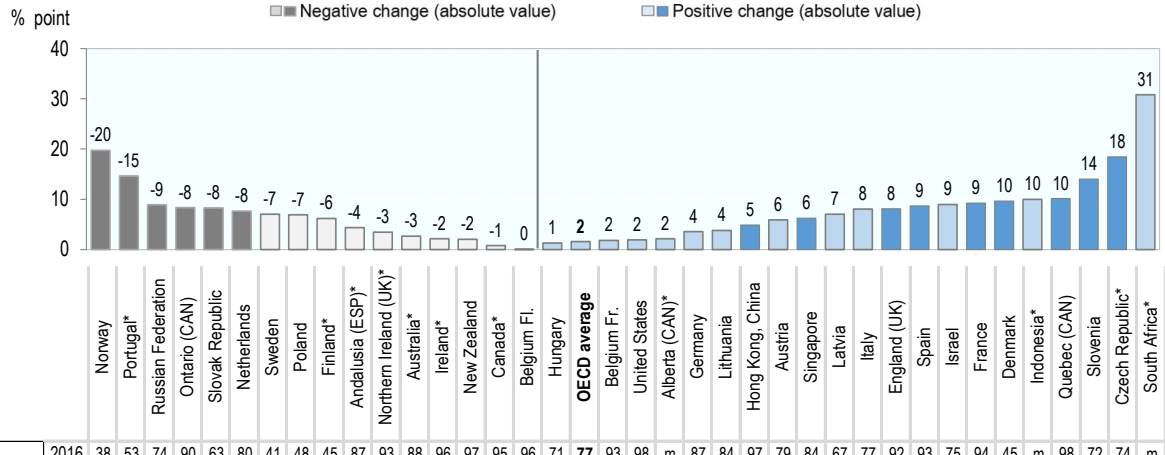
OECD countries experienced both increases and reductions in the share of 4th grade students with access to a library or reading corner in the classroom, while overall the net OECD average rose by 2 percentage points. Positive and negative changes combined resulted in a modest average absolute change of 8 percentage points, corresponding to an effect size of 0.21. On average, in 2016, three in four primary (77%) students had access to a library or reading corner in the classroom in OECD systems.

### Countries where there has been the most change

The practice gained significant ground in South Africa and Czech Republic, with prominent increases of 31 and 18 percentage points in the availability of this resource, between 2006-2011 and 2011-2016 respectively. Conversely, students in Norway experienced a notable decrease by 20 percentage points between 2006 and 2016.

**Figure 11.4. 4th grade students with access to a library or reading corner in the classroom**

Change in and share of students who have access to a library or a reading corner in the classroom, 2006-2016, teachers report




| | | Norway | Portugal* | Russian Federation | Ontario (CAN) | Slovak Republic | Netherlands | Sweden | Poland | Finland* | Andalusia (ESP)* | Northern Ireland (UK)* | Australia* | Ireland* | New Zealand | Canada* | Belgium Fl. | Hungary | **OECD average** | Belgium Fr. | United States | Alberta (CAN)* | Germany | Lithuania | Hong Kong, China | Austria | Singapore | Latvia | Italy | England (UK) | Spain | Israel | France | Denmark | Indonesia* | Quebec (CAN) | Slovenia | Czech Republic* | South Africa* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 38 | 53 | 74 | 90 | 63 | 80 | 41 | 48 | 45 | 87 | 93 | 88 | 96 | 97 | 95 | 96 | 71 | **77** | 93 | 98 | m | 87 | 84 | 97 | 79 | 84 | 67 | 77 | 92 | 93 | 75 | 94 | 45 | m | 98 | 72 | 74 | m |
| | 2011 | 60 | 67 | 77 | 94 | 69 | 86 | 52 | 65 | 51 | 92 | 97 | 91 | 98 | 99 | 95 | m | 80 | **79** | 89 | 99 | 98 | 82 | 87 | 95 | 78 | 92 | m | 73 | 87 | 91 | 89 | 87 | 38 | 58 | 99 | 59 | 55 | 71 |
| | 2006 | 58 | m | 83 | 98 | 71 | 88 | 48 | 55 | m | m | m | m | m | 99 | m | 96 | 70 | **75** | 91 | 96 | 95 | 84 | 80 | 92 | 73 | 78 | 60 | 69 | 84 | 85 | 66 | 85 | 35 | 48 | 88 | 58 | m | 40 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905379

## 64. Allowing students to borrow books from the classroom library

### Why it matters

Allowing students to borrow books from the classroom library signals that the classroom library has enough materials to allow students to borrow them. It may also give students responsibilities, and signal to them that they are trustworthy persons that can take care of books. Students themselves could even be in charge of the classroom library. One could in principle only applaud that students can borrow books from their classroom library.

### Change at the OECD level: moderate-low

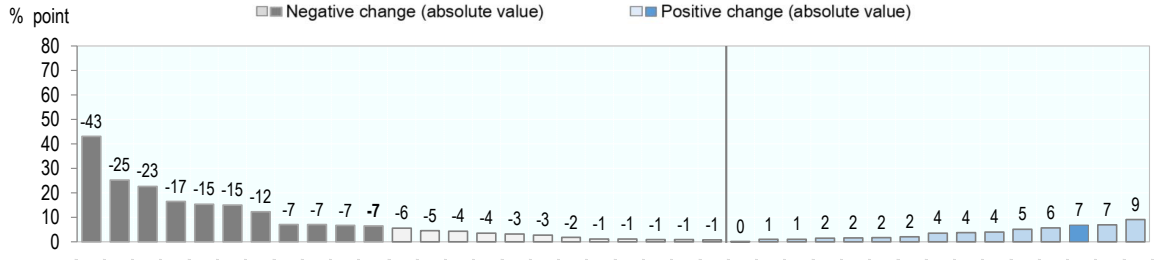
This practice has become a bit less common in OECD systems, with the average share of primary students allowed to borrow books from the classroom library going down from 79% to 72% between 2006 and 2016. Regardless of change direction, the absolute change was 8 percentage points, corresponding to a modest effect size of 0.21. Across OECD systems, in 2016, the extent to which 4th grade students could borrow books from the classroom library ranged from 22% in the Netherlands to 95% in Northern Ireland and Italy.

### Countries where there has been the most change

Innovation took the form of large decreases in the use of this practice. Poland experienced a significant reduction of 43 percentage points in the share of students given this possibility, followed by Honk Kong, China and Denmark with declines by over 20 percentage points both. No country in the sample registered an increase exceeding 10 percentage points, showing little innovation in that direction.

**Figure 11.5. 4th grade students borrowing books from the classroom library**

Change in and share of students who are allowed to borrow books from the classroom library or reading corner to take home, 2006-2016, teachers report




| | | Poland | Hong Kong, China | Denmark | Germany | France | Sweden | Latvia | Russian Federation | Spain | Austria | **OECD average** | Belgium Fr. | Ontario (CAN) | Quebec (CAN) | New Zealand | Alberta (CAN)* | Czech Republic* | Italy | Slovenia | Hungary | Singapore | Belgium Fl. | Indonesia* | Ireland* | Israel | Slovak Republic | Australia* | Finland* | Netherlands | United States | Lithuania | England (UK) | Northern Ireland (UK)* | Portugal* | Andalusia (ESP)* | Canada* | South Africa* | Norway |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 45 | 48 | 62 | 71 | 68 | 65 | 77 | 92 | 85 | 85 | **72** | 65 | 82 | 78 | 62 | m | 75 | 95 | 62 | 76 | 75 | 62 | m | 89 | 76 | 83 | 61 | 51 | 22 | 89 | 97 | 88 | 95 | 88 | 94 | 80 | m | 86 |
| | 2011 | 77 | 64 | 68 | 86 | 72 | 85 | m | 98 | 88 | 89 | **75** | 65 | 79 | 64 | 63 | 78 | 78 | 97 | 69 | 70 | 80 | m | 86 | 89 | 85 | 80 | 60 | 49 | 17 | 89 | 95 | 84 | 91 | 83 | 88 | 73 | 71 | 67 |
| | 2006 | 88 | 74 | 84 | 88 | 83 | 80 | 90 | 99 | 92 | 92 | **79** | 70 | 86 | 82 | 65 | 81 | m | 97 | 63 | 77 | 76 | 63 | 86 | m | 75 | 82 | m | m | 20 | 87 | 94 | 84 | m | m | m | m | 64 | 77 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905398

## 65. Frequency of use of computers or tablets in elementary schools

### Why it matters

The first wave of school digitalisation focused too much on computer availability rather than on their pedagogical use. While technology is just a medium for instruction, it sometimes allows teachers to do things that would not be possible without it, for example individualised real time feedback. As the relatively low frequency of computer and tablet use in primary schools remains stable, one can wonder whether this is a missed opportunity or not.

### Change at the OECD level: moderate

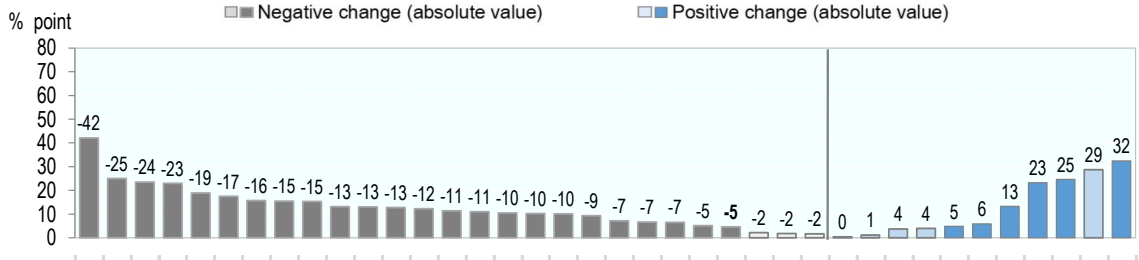
Between 2006 and 2016, the share of primary students using computers at least once a week has decreased in a majority of countries. In the OECD education systems covered, it has decreased by 5 percentage points on average. Negative and positive variations resulted in an average absolute change of 14 percentage points, corresponding to a moderate effect size of 0.31. In 2016, on average 41% of 4th grade students used computers at school at least once a week in OECD countries.

### Countries where there has been the most change

The share of primary students using regularly computers in Italy decreased by 42 percentage points between 2006 and 2016, followed by England where it declined by 25 percentage points. Conversely, Denmark registered a remarkable increase of 32 percentage points, as well as South Africa, New Zealand and Sweden, with increases above 23 percentage points.

**Figure 11.6. 4th grade students using computers at school**

Change in and share of students who use computers at school at least once a week, 2006-2016, students report




| | | Italy | England (UK) | Czech Republic* | Ireland* | France | Northern Ireland (UK)* | Hong Kong, China | Portugal* | Israel | Canada* | United States | Ontario (CAN) | Spain | Austria | Australia* | Quebec (CAN) | Germany | Singapore | Lithuania | Poland | Andalusia (ESP)* | Netherlands | Belgium Fr. | **OECD average** | Alberta (CAN)* | Latvia | Slovenia | Hungary | Belgium Fl. | Finland* | Indonesia* | Slovak Republic | Russian Federation | Norway | Sweden | New Zealand | South Africa* | Denmark |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 21 | 60 | 23 | 23 | 22 | 59 | 42 | 25 | 52 | 54 | 61 | 56 | 28 | 16 | 74 | 41 | 14 | 25 | 12 | 26 | 19 | 59 | 16 | **41** | m | 22 | 23 | 34 | 29 | 37 | m | 43 | 26 | 54 | 54 | 77 | m | 71 |
| | 2011 | 43 | 84 | 47 | 46 | 39 | 76 | 57 | 41 | 71 | 67 | 76 | 66 | 45 | 25 | 85 | 57 | 28 | 28 | 20 | 42 | 25 | 71 | 21 | **51** | 73 | m | 25 | 67 | m | 33 | 28 | 44 | 30 | 58 | 38 | 73 | 70 | 44 |
| | 2006 | 63 | 85 | m | m | 41 | m | 58 | m | 68 | m | 74 | 69 | 41 | 27 | m | 52 | 24 | 35 | 21 | 33 | m | 65 | 21 | **46** | 76 | 24 | 24 | 34 | 28 | m | 25 | 38 | 20 | 41 | 31 | 53 | 41 | 39 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905417

## 66. Students visiting a library other than their classroom library

### Why it matters

By nature, classrooms libraries have a limited amount of resources. It would thus be welcome that all students could visit another library: either their school library (if any) or any other library that could provide them with a socialising and learning space. This is a practice one would want to see universal, although online libraries may gradually give access to similar learning and reading resources.

### Change at the OECD level: moderate-high

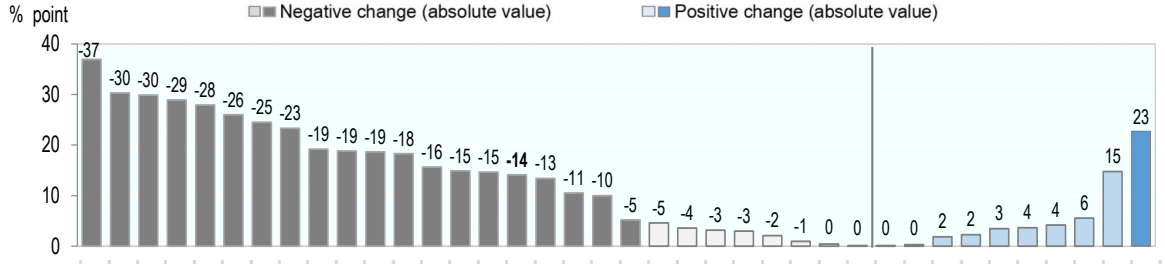
This activity has been reduced in most OECD countries, with 14% less of 4th grade students visiting at least once a month another library than their classroom library in 2016 compared to 2006. Combining the few positive changes to the numerous decreases, we reach an average absolute change of less than 15 percentage points corresponding to an absolute effect size of 0.38. Despite its decline, this practice remains common across OECD systems and concerns 70% of primary students on average. It is universal in the United States where 94% of students did so in 2016.

### Countries where there has been the most change

Innovation mainly took the form of a contraction of this activity. Between 2006 and 2016, the share of 4th grade students visiting external libraries on a regular basis decreased over 30 percentage points in the Slovak Republic, Israel and Singapore. Andalusia (Spain) and South Africa experienced the only two notable increases in this domain (23 and 15 percentage points respectively), in a shorter time period.

**Figure 11.7. 4th grade students visiting a library other than the classroom library**

Change in and share of students who visit a library other than a classroom library at least once a month, 2006-2016, teachers report




| | | Slovak Republic | Israel | Singapore | Hungary | France | Poland | Belgium Fr. | Latvia | Sweden | Slovenia | Lithuania | Germany | Italy | Russian Federation | Belgium Fl. | **OECD average** | Hong Kong, China | Spain | Norway | Denmark | Quebec (CAN) | New Zealand | Netherlands | Ontario (CAN) | Alberta (CAN)* | United States | Canada* | Czech Republic* | Australia* | Ireland* | Finland* | England (UK) | Austria | Northern Ireland (UK)* | Portugal* | Indonesia* | South Africa* | Andalusia (ESP)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 56 | 61 | 50 | 69 | 47 | 70 | 46 | 70 | 71 | 76 | 78 | 56 | 37 | 85 | 51 | **70** | 59 | 52 | 81 | 92 | 92 | 91 | 64 | 90 | m | 94 | 93 | 40 | 93 | 43 | 72 | 80 | 69 | 65 | 72 | m | m | 69 |
| | 2011 | 49 | 72 | 60 | 76 | 52 | 85 | 43 | m | 80 | 84 | 82 | 54 | 41 | 85 | m | **71** | 53 | 51 | 89 | 94 | 95 | 94 | 48 | 94 | 93 | 95 | 93 | 40 | 93 | 42 | 70 | 62 | 62 | 61 | 67 | 62 | 63 | 46 |
| | 2006 | 93 | 91 | 80 | 98 | 75 | 96 | 70 | 94 | 90 | 95 | 97 | 75 | 52 | 100 | 65 | **84** | 72 | 63 | 91 | 97 | 97 | 95 | 67 | 93 | 95 | 95 | m | m | m | m | m | 78 | 65 | m | m | 56 | 48 | m |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905436

## 67. Access to desktop computers for students' use at school

### Why it matters

In a time where even students from disadvantaged backgrounds have a computer at home, access to desktop computers for student use at schools may be less important. Mobile phones, tablets, laptops, etc., may also have made desktop computers redundant. However, while access to computers may have become less of an issue, use of digital devices in school remains important for schools to be an integral part of our digital societies, whether these devices belong to the school or the students.

### Change at the OECD level: moderate

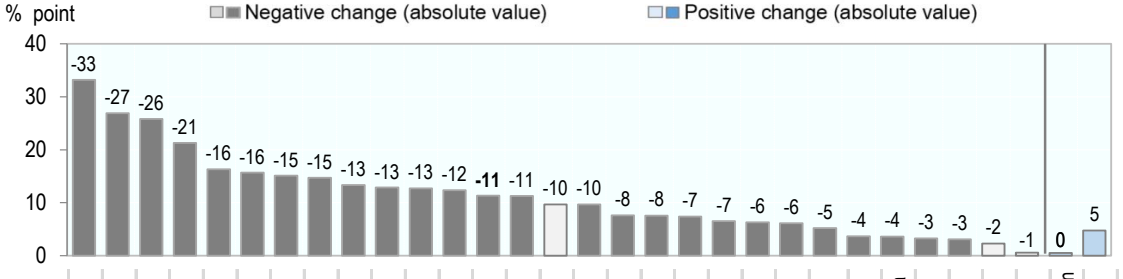
With the exception of Greece, all OECD systems covered experienced falling access to desktop computers in schools. Between 2009 and 2015, the share of 15 year old students with access to this resource at school decreased by 11 percentage points on average. The average absolute change was 12 percentage points, corresponding to a moderate effect size of 0.34. Despite the declining trend, in 2015, on average, 80% of students in the OECD area still had access to desktop computers in school.

### Countries where there has been the most change

Innovation took the form of important reductions in the availability of desktop computers in schools. Sweden stood out with a decline of 33 percentage points in the share of 15 year old students having access to desktop computers, as well as Poland and Denmark where access declined by 27 and 26 percentage points respectively.

**Figure 11.8. 15 year old students with access to desktop computers at school**

Change in and share of students who have access to desktop computers at school, 2009-2015, students report




| | | Sweden | Poland | Denmark | Japan | Switzerland | Slovenia | Belgium | Czech Republic | Spain | Slovak Republic | Latvia | Finland | **OECD average** | Singapore | Korea | Austria | Australia | Chile | Estonia | Italy | Israel | Hungary | Netherlands | New Zealand | Hong Kong, China | Ireland | Iceland | Portugal | Lithuania | Russian Federation | Greece |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 63 | 66 | 70 | 64 | 75 | 68 | 74 | 79 | 75 | 81 | 77 | 83 | **80** | 85 | 77 | 87 | 91 | 81 | 81 | 77 | 79 | 89 | 94 | 94 | 94 | 92 | 91 | 87 | 90 | 94 | 89 |
| | 2009 | 96 | 93 | 96 | 85 | 92 | 84 | 89 | 94 | 88 | 94 | 90 | 96 | **92** | 96 | 87 | 97 | 98 | 89 | 89 | 83 | 85 | 95 | 100 | 98 | 98 | 95 | 94 | 89 | 91 | 93 | 84 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933905455

## 68. Availability of portable laptops or notebooks for use at school

### Why it matters

Digital technologies mainly reached schools through the availability of computers. Technology is now increasingly seen as "mobile" thanks to the availability of portable devices. While the availability of desktop computers has decreased over the past years, digitalisation is reflected by the availability of other forms of digital computing devices: laptops (or notebooks) are some of them. To produce good results, these devices need to support good pedagogical practices.

### Change at the OECD level: large

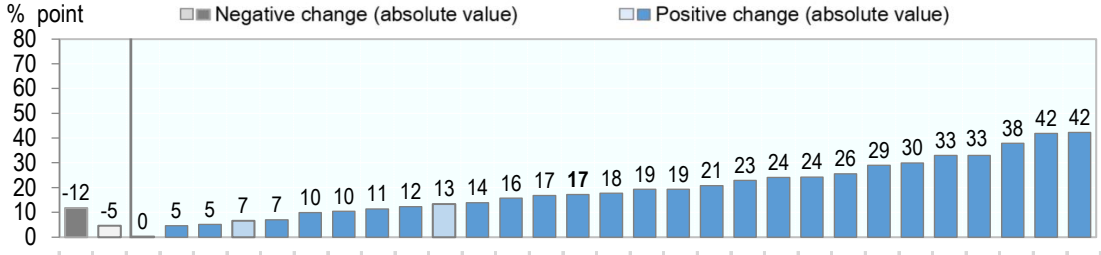
Among OECD countries, by and large, access to laptops and notebooks for students at school has scaled up. Between 2009 and 2015, the share of 15 year old students having access to these devices in their schools rose by 17 percentage points on average. The average absolute change amounted to 18 percentage points, corresponding to a large effect size of 0.40. While one in two secondary students had access to laptops at school on average in OECD countries, the span ranged from 92% in Denmark to 27% in Japan in 2015.

### Countries where there has been the most change

Increased access to laptops was a noticeable innovation in most countries. In Sweden and New Zealand, the share of students with access to laptops at school increased by 42 percentage points between 2009 and 2015. Finland, Greece, Singapore and Lithuania saw also significant increases above 30 percentage points. Only Portugal and Japan experienced declines in access (12 and 5 percentage points respectively).

**Figure 11.9. 15 year old students with access to laptops or notebooks at school**

Change in and share of students who have access to laptops or notebooks at school, 2009-2015, students report




| | | Portugal | Japan | Hong Kong, China | Iceland | Denmark | Korea | Switzerland | Ireland | Slovenia | Austria | Hungary | Poland | Belgium | Estonia | Italy | **OECD average** | Czech Republic | Slovak Republic | Latvia | Netherlands | Russian Federation | Spain | Israel | Australia | Chile | Lithuania | Singapore | Greece | Finland | New Zealand | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 43 | 27 | 41 | 51 | 92 | 51 | 53 | 41 | 32 | 36 | 35 | 34 | 39 | 36 | 32 | **50** | 29 | 51 | 43 | 68 | 79 | 48 | 43 | 84 | 47 | 48 | 79 | 57 | 66 | 75 | 85 |
| | 2009 | 55 | 32 | 41 | 46 | 87 | 44 | 46 | 31 | 21 | 25 | 23 | 21 | 26 | 21 | 15 | **33** | 11 | 32 | 24 | 47 | 57 | 24 | 19 | 58 | 18 | 18 | 46 | 24 | 28 | 33 | 42 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases.

StatLink https://doi.org/10.1787/888933905474

## 69. Availability of computers and tablets to use during reading lessons

### Why it matters

Computers and tablets can support reading in different ways, at the very least by providing students immediate access to the variety of digital texts and writing styles they are expected to learn to understand. Specific software can also support the learning of reading for children with difficulties, or allow for the personalisation of reading instruction.

### Change at the OECD level: very large

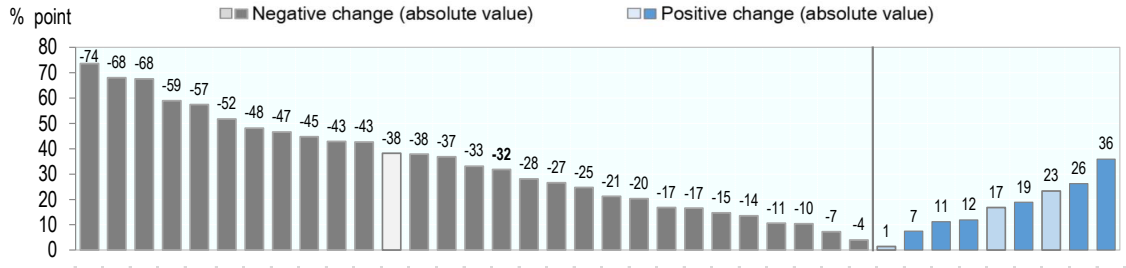
The share of students with computers available during 4th grade reading lessons has decreased by 32 percentage points on average in OECD education systems. The average absolute change was 35 percentage points, corresponding to a very large absolute effect size of 0.85. In 2016, 51% of primary students had a computer available during reading lessons, the span ranged from 93% in New Zealand to 7% in Belgium (Fr.).

### Countries where there has been the most change

The decline of computer availability in reading lessons was a significant innovation in many countries. The share of students having computers in reading lesson decreased by over 50 percentage points in Slovenia (74), France (68), the Slovak Republic (68), Italy (59), Hong Kong, China (57) and Belgium (Fr.) (52). Notable increases above 25 percentage points occurred in Israel and the Russian Federation.

**Figure 11.10. 4th grade students with computers or tablets available during reading lessons**

Change in and share of students who have computers or tablets available during lessons, 2006-2016, teachers report




| | | Slovenia | France | Slovak Republic | Italy | Hong Kong, China | Belgium Fr. | Spain | Quebec (CAN) | Belgium Fl. | England (UK) | Poland | Alberta (CAN)* | Singapore | Austria | Portugal* | **OECD average** | United States | Lithuania | Norway | Ontario (CAN) | Germany | Ireland* | Latvia | Hungary | Sweden | Czech Republic* | Netherlands | Australia* | New Zealand | Denmark | Finland* | Andalusia (ESP)* | Northern Ireland (UK)* | South Africa* | Canada* | Indonesia* | Russian Federation | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2016 | 17 | 25 | 19 | 21 | 35 | 7 | 30 | 45 | 54 | 55 | 25 | m | 55 | 53 | 14 | **51** | 70 | 30 | 66 | 77 | 65 | 39 | 37 | 37 | 83 | 29 | 87 | 75 | 93 | 92 | 72 | 31 | 77 | m | 65 | m | 56 | 62 |
| | 2011 | 36 | 11 | 37 | 24 | 45 | 2 | 20 | 30 | m | 47 | 20 | 61 | 64 | 79 | 47 | **50** | 74 | 45 | 88 | 47 | 73 | 56 | m | 38 | 73 | 39 | 85 | 82 | 86 | 87 | 64 | 20 | 65 | 39 | 46 | 37 | 29 | 40 |
| | 2006 | 90 | 93 | 86 | 80 | 93 | 58 | 78 | 92 | 99 | 98 | 68 | 99 | 93 | 90 | m | **83** | 98 | 57 | 91 | 98 | 85 | m | 54 | 52 | 96 | m | 97 | m | 97 | 91 | m | m | m | 23 | m | 14 | 29 | 26 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2006, 2011 and 2016.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933905569

## 70. Availability of computers and tablets to use during mathematics lessons

### Why it matters

As computers and tablets calculate far better than humans, computers could be used to release to some extent this burden from students and allow them to focus on more conceptual issues in maths. They can also help students drill and acquire procedural knowledge in mathematics. The decrease in this availability shows that teachers have not become more dependent on these tools over time. Perhaps they prefer calculators, or they still emphasise human calculation.

## Primary education

### Change at the OECD level: moderate

At the primary level, most OECD countries innovated by reducing the availability of computers and tablets during 4th grade maths lessons. Between 2007 and 2015, the share of 4th grade students with access to these resources during maths lessons decreased by 12 percentage points on average. Moreover, positive and negative changes lead to a mean absolute change of 15 percentage points, corresponding to a moderate effect size of 0.32. In an average OECD system, one in two primary students had access to a computer during maths lessons, with a share of students ranging from 89% in New Zealand to 14% in Korea in 2015.

### Countries where there has been the most change

Innovation mainly took the form of large decreases in the availability of these resources. Singapore saw the largest decrease in the share of maths students accessing these devices during lessons (44 percentage points). In Czech Republic and Japan, access concerned around 30 students less in 100. Fewer countries innovated by providing more access to these resources. For example, in the Russian Federation the practice spread by 48 percentage points.

## Secondary education

### Change at the OECD level: moderate-high

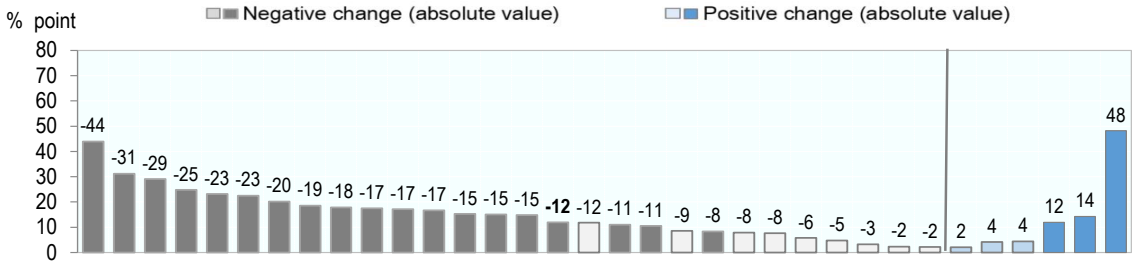
The availability of computers and tablets during 8th grade maths lessons decreased significantly in OECD countries (10 percentage points on average). The absolute change was 18 percentage points, corresponding to a moderate-high effect size of 0.37. At the OECD level, the share of 8th grade students with access to a computer or a tablet during maths lessons varied from 19% in Slovenia to 65% in Sweden in 2015.

### Countries where there has been the most change

Innovation often took the form of less students having access to computers and tablets. Between 2007 and 2015, the share of 8th grade students with access to computers during maths lessons decreased by over 30 percentage points in Lithuania, Slovenia, Japan and England. Access expanded in Sweden (27 percentage points) and Italy (13 percentage points) between 2007 and 2015, as well as in New Zealand between 2011 and 2015 (18 percentage points).

**Figure 11.11. 4th grade students with computers or tablets available during maths lessons**

Change in and share of students who have computers or tablets available during lessons, 2007-2015, teachers report



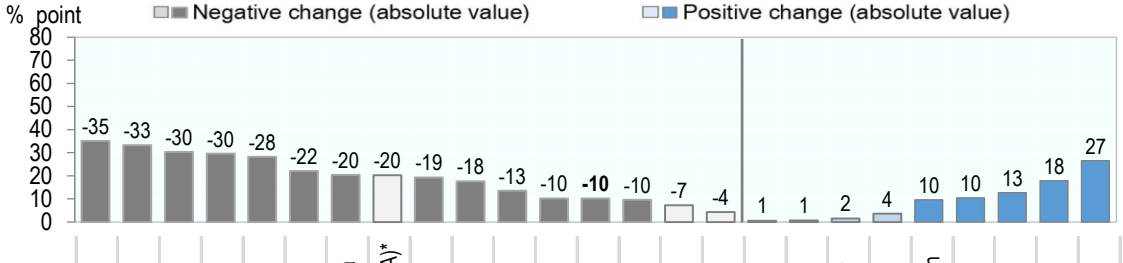

| | | Singapore | Czech Republic | Japan | Slovak Republic | Slovenia | Portugal* | Quebec (CAN) | United States | Korea* | England (UK) | Chile* | Australia | Ireland* | Belgium (Fl.)* | Ontario (CAN) | **OECD average** | Alberta (CAN)* | Hong Kong, China | Denmark | Lithuania | Netherlands | Norway | Austria* | Turkey* | Northern Ireland (UK)* | Finland* | Spain* | Sweden | Hungary | Germany | Italy | New Zealand | Poland* | Russian Federation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 37 | 28 | 48 | 22 | 16 | 20 | 25 | 46 | 14 | 58 | 43 | 60 | 40 | 37 | 50 | **50** | m | 46 | 84 | 30 | 76 | 60 | m | 30 | 71 | 56 | 33 | 65 | 25 | 58 | 35 | 89 | 31 | 62 |
| | 2011 | 65 | 50 | 57 | 38 | 31 | 43 | 30 | 62 | 31 | 69 | 60 | 79 | 55 | 52 | 44 | **56** | 60 | 39 | 70 | 44 | 83 | 77 | 62 | 36 | 75 | 59 | 36 | 60 | 34 | 57 | 25 | 87 | 16 | 31 |
| | 2007 | 81 | 59 | 78 | 47 | 39 | m | 45 | 65 | m | 76 | m | 77 | m | m | 64 | **62** | 72 | 57 | 95 | 39 | 84 | 68 | 69 | m | m | m | m | 67 | 23 | 54 | 31 | 77 | m | 14 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905493

**Figure 11.12. 8th grade students with computers or tablets available during maths lessons**

Change in and share of students who have computers or tablets available during lessons, 2007-2015, teachers report




| | | Lithuania | Slovenia | Japan | England (UK) | Norway | Israel | Hong Kong, China | Massachusetts (USA)* | Singapore | Korea | Turkey | South Africa* | **OECD average** | Hungary | Quebec (CAN) | United States | Chile* | Indonesia* | Minnesota (USA)* | Ontario (CAN) | Russian Federation | Australia | Italy | New Zealand* | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 38 | 19 | 41 | 29 | 42 | 19 | 21 | m | 35 | 39 | 16 | 9 | **37** | 30 | 20 | 39 | 49 | m | m | 63 | 49 | 61 | 43 | 47 | 65 |
| | 2011 | 43 | 31 | 58 | 52 | 75 | 34 | 24 | 36 | 56 | 56 | 32 | 20 | **45** | 42 | 22 | 44 | 48 | 19 | 30 | 53 | 44 | 64 | 31 | 29 | 40 |
| | 2007 | 73 | 52 | 71 | 58 | 70 | 41 | 42 | 57 | 54 | 56 | 30 | m | **48** | 39 | 27 | 43 | m | 19 | 28 | 60 | 39 | 51 | 30 | m | 39 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905512

## 71. Availability of computers and tablets to use during science lessons

### Why it matters

Computers and tablets can support science lessons in different ways, including the use of remote or virtual laboratories, real-time assessment, or learning through science games. They can also support collaborative science projects. They might be less useful for more traditional teaching strategies that may just rely on calculators. In any case, unless they remain unused, the availability of computers and tablets allow teachers to use a broader range of teaching strategies.

## Primary education

### Change at the OECD level: moderate

In the majority of OECD countries, the share of students with computers and tablets during 4th grade science lessons has decreased between 2007 and 2015, with an average net decrease of 8 percentage points. Taking into account both increases and decreases, on average this practice changed by 12 percentage points, corresponding to a modest effect size of 0.26. With an average at 57%, the share of students having computers or tablets available in science lessons varies across the OECD area: from 22% in Slovenia to 91% in New Zealand in 2015.

### Countries where there has been the most change

The Russian Federation saw the greatest increase in the availability of computers during science lessons between 2007 and 2015 (50 percentage points). Between 2011 and 2015, this was also a big innovation in Poland where the share of students concerned increased by 24 percentage points. Contractions were particularly notable in Singapore, Slovenia and the United States (around 30 percentage points in all cases).

## Secondary education

### Change at the OECD level: moderate-high

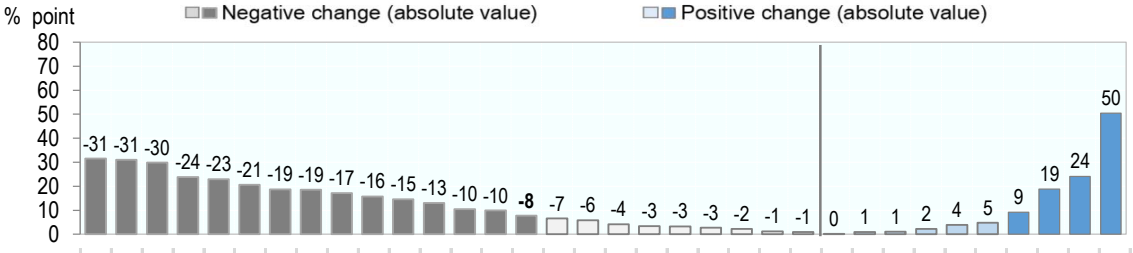
At the OECD level, contractions overcome expansions in the availability of computers and tablets in science lessons, leading to an average net decline of 12 percentage points in the share of 8th grade students. Regardless of its direction, the absolute change was 18 percentage points on average, corresponding to a moderate-high effect size of 0.38. Across the OECD region, the prevalence of this practice varies considerably: in 2015, only 26% of the 8th grade students had computers or tablets available during science lessons in Quebec (Canada) compared to more than 80% in Sweden.

### Countries where there has been the most change

Between 2007 and 2015, the share of students using computers during their lessons declined by over 30 percentage points in Quebec (Canada), Hong Kong, China and Slovenia, and by over 20 percentage points in Korea, Norway, the United States and Japan. This has been a significant innovation in the learning process for many students. In Sweden and New Zealand, students experienced significantly more computer availability.

**Figure 11.13. 4th grade students with computers or tablets available during science lessons**

Change in and share of students who have computers or tablets available during lessons, 2007-2015, teachers report



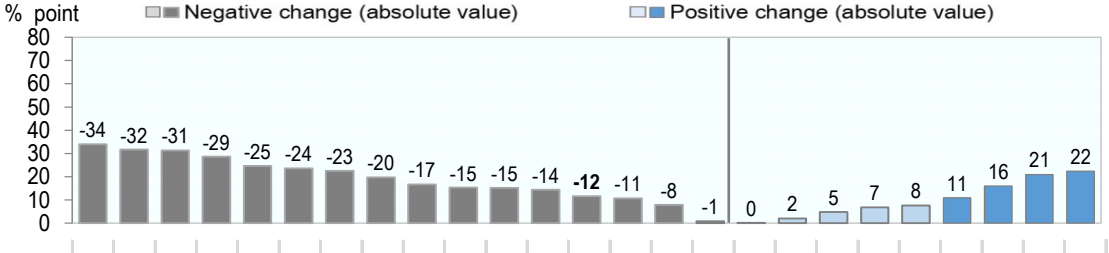

| | | Singapore | Slovenia | United States | Portugal* | Hong Kong, China | Ireland* | Japan | Czech Republic | Quebec (CAN) | Slovak Republic | Australia | Korea* | Chile* | Germany | **OECD average** | England (UK) | Belgium (Fl.)* | Sweden | Alberta (CAN)* | Turkey* | Northern Ireland (UK)* | Finland* | Austria* | Denmark | Ontario (CAN) | Netherlands | Spain* | New Zealand | Lithuania | Norway | Hungary | Italy | Poland* | Russian Federation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 49 | 22 | 47 | 23 | 48 | 42 | 65 | 35 | 55 | 35 | 63 | 23 | 49 | 54 | **57** | 71 | 79 | 73 | m | 33 | 75 | 63 | m | 90 | 62 | 63 | 41 | 91 | 41 | 66 | 33 | 44 | 43 | 66 |
| | 2011 | 62 | 41 | 65 | 47 | 61 | 62 | 75 | 53 | 51 | 45 | 78 | 36 | 59 | 61 | **60** | 71 | 84 | 68 | 75 | 36 | 78 | 66 | 73 | 81 | 52 | 64 | 40 | 85 | 49 | 72 | 36 | 31 | 19 | 33 |
| | 2007 | 80 | 53 | 77 | m | 71 | m | 84 | 54 | 72 | 51 | 77 | m | m | 64 | **65** | 77 | m | 77 | 78 | m | m | m | 74 | 91 | 62 | 62 | m | 89 | 37 | 62 | 24 | 25 | m | 16 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905531

**Figure 11.14. 8th grade students with computers or tablets available during science lessons**

Change in and share of students who have computers or tablets available during lessons, 2007-2015, teachers report




| | | Quebec (CAN) | Hong Kong, China | Slovenia | Korea | Norway | United States | Japan | Lithuania | Israel | England (UK) | Singapore | Chile* | **OECD average** | Turkey | South Africa* | Hungary | Massachusetts (USA)* | Minnesota (USA)* | Ontario (CAN) | Australia | Indonesia* | Italy | Russian Federation | New Zealand* | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 26 | 23 | 32 | 50 | 53 | 51 | 55 | 53 | 39 | 49 | 52 | 55 | **50** | 30 | 9 | 42 | m | m | 75 | 66 | m | 48 | 64 | 60 | 80 |
| | 2011 | 45 | 34 | 47 | 67 | 77 | 67 | 50 | 55 | 43 | 62 | 56 | 70 | **55** | 40 | 17 | 48 | 59 | 63 | 56 | 71 | 28 | 36 | 52 | 39 | 57 |
| | 2007 | 59 | 55 | 63 | 79 | 77 | 74 | 77 | 73 | 56 | 65 | 67 | m | **61** | 41 | m | 43 | 59 | 62 | 71 | 60 | 21 | 37 | 48 | m | 57 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905550

**Table 11.1. Effect sizes for changes in access and use of learning resources**

| | Availability of a science laboratory for students | | Availability of a school library | Availability of a library or a reading corner in the classroom | Allowing students to borrow books from the classroom library | Students visiting a library other than their classroom library |
|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th grade | 4th grade | 4th grade | 4th grade |
| Australia | 0.04 | -0.22 | 0.02 | -0.09 | 0.03 | 0.00 |
| Austria | 0.35 | m | 0.56 | 0.14 | -0.22 | 0.07 |
| Belgium (Fl.) | 0.14 | m | 0.16 | 0.00 | -0.02 | -0.30 |
| Belgium (Fr.) | m | m | -0.17 | 0.07 | -0.12 | -0.50 |
| Canada | m | m | -0.05 | -0.03 | 0.16 | -0.02 |
| Canada (Alberta) | -0.48 | m | 0.13 | 0.12 | -0.08 | -0.09 |
| Canada (Ontario) | -0.60 | -0.07 | 0.30 | -0.37 | -0.12 | -0.11 |
| Canada (Quebec) | 0.03 | 0.11 | 0.17 | 0.43 | -0.11 | -0.21 |
| Chile | 0.34 | 0.17 | m | m | m | m |
| Czech Republic | 0.06 | m | -0.18 | 0.39 | -0.07 | 0.00 |
| Denmark | -0.50 | m | -0.14 | 0.20 | -0.52 | -0.23 |
| Finland | 0.21 | m | -0.23 | -0.12 | 0.03 | 0.04 |
| France | m | m | -0.39 | 0.31 | -0.36 | -0.58 |
| Germany | 0.24 | m | -0.15 | 0.10 | -0.42 | -0.39 |
| Hungary | -0.53 | -0.25 | -0.53 | 0.03 | -0.03 | -0.90 |
| Ireland | 0.22 | m | 0.25 | -0.14 | 0.00 | 0.01 |
| Israel | m | 0.01 | -0.17 | 0.20 | 0.03 | -0.75 |
| Italy | 0.05 | 0.05 | -0.35 | 0.18 | -0.09 | -0.32 |
| Japan | -0.06 | 0.00 | m | m | m | m |
| Korea | -0.18 | -0.19 | m | m | m | m |
| Latvia | m | m | -0.07 | 0.15 | -0.34 | -0.64 |
| Lithuania | -0.06 | 0.29 | 0.02 | 0.10 | 0.17 | -0.62 |
| Netherlands | 0.24 | m | -0.03 | -0.21 | 0.04 | -0.07 |
| New Zealand | -0.07 | -0.11 | -0.04 | -0.13 | -0.07 | -0.14 |
| Norway | 0.31 | 0.14 | -0.13 | -0.40 | 0.24 | -0.29 |
| Poland | 1.33 | m | -0.01 | -0.14 | -0.97 | -0.76 |
| Portugal | 0.51 | m | 0.72 | -0.30 | 0.15 | 0.09 |
| Slovak Republic | -0.11 | m | -0.53 | -0.18 | 0.03 | -0.92 |
| Slovenia | 0.40 | -0.11 | -0.10 | 0.30 | -0.03 | -0.57 |
| Spain | -0.05 | m | -0.09 | 0.28 | -0.22 | -0.21 |
| Spain (Andalusia) | m | m | 0.41 | -0.14 | 0.20 | 0.46 |
| Sweden | -0.05 | 0.25 | 0.17 | -0.14 | -0.34 | -0.50 |
| Turkey | -0.44 | -0.17 | m | m | m | m |
| U.K. (England) | 0.06 | 0.00 | -0.17 | 0.25 | 0.11 | 0.06 |
| U.K. (Northern Ireland) | 0.00 | m | 0.11 | -0.16 | 0.16 | 0.08 |
| United States | 0.16 | -0.15 | -0.15 | 0.12 | 0.06 | -0.04 |
| U.S. (Massachusetts) | m | 0.05 | m | m | m | m |
| U.S. (Minnesota) | m | 0.58 | m | m | m | m |
| **OECD (average)** | **-0.03** | **-0.05** | **-0.08** | **0.04** | **-0.15** | **-0.34** |
| **OECD (av. absolute)** | **0.21** | **0.12** | **0.22** | **0.21** | **0.21** | **0.38** |

| | Availability of a science laboratory for students | | Availability of a school library | Availability of a library or a reading corner in the classroom | Allowing students to borrow books from the classroom library | Students visiting a library other than their classroom library |
|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th grade | 4th grade | 4th grade | 4th grade |
| Hong Kong, China | 0.28 | 0.19 | 0.30 | 0.23 | -0.53 | -0.28 |
| Indonesia | m | 0.18 | 0.04 | 0.20 | -0.02 | 0.11 |
| Russian Federation | 0.74 | 0.32 | 0.00 | -0.22 | -0.38 | -0.67 |
| Singapore | -0.01 | 0.00 | 0.00 | 0.16 | -0.02 | -0.64 |
| South Africa | m | 0.11 | 0.60 | 0.63 | 0.15 | 0.30 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PIRLS (2006, 2011 and 2016).

StatLink https://doi.org/10.1787/888933905588

**Table 11.2. Effect sizes for changes in access and use of ICT learning resources**

| | Availability of desktop computers for use at school | Availability of portable laptops or notebooks for use at school | Frequency of use of computer or a tablet at school | Availability of computers (including tablets) to use during lessons | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8th grade | 8th grade | 4th grade | 4th grade Maths | 8th grade Maths | 4th grade Science | 8th grade Science | 4th grade Reading |
| Australia | -0.35 | 0.58 | -0.28 | -0.36 | 0.21 | -0.32 | 0.14 | -0.18 |
| Austria | -0.38 | 0.25 | -0.28 | -0.16 | m | -0.03 | m | -0.86 |
| Belgium | -0.40 | 0.30 | m | m | m | m | m | m |
| Belgium (Fl.) | m | m | 0.02 | -0.30 | m | -0.15 | m | -1.26 |
| Belgium (Fr.) | m | m | -0.13 | m | m | m | m | -1.22 |
| Canada | m | m | -0.27 | m | m | m | m | 0.38 |
| Canada (Alberta) | m | m | -0.05 | -0.25 | m | -0.08 | m | -1.14 |
| Canada (Ontario) | m | m | -0.26 | -0.30 | 0.07 | 0.00 | 0.11 | -0.73 |
| Canada (Quebec) | m | m | -0.21 | -0.43 | -0.17 | -0.36 | -0.70 | -1.08 |
| Chile | -0.22 | 0.64 | m | -0.34 | 0.01 | -0.21 | -0.30 | m |
| Czech Republic | -0.45 | 0.46 | -0.50 | -0.64 | m | -0.38 | m | -0.22 |
| Denmark | -0.76 | 0.17 | 0.66 | -0.35 | m | -0.03 | m | 0.05 |
| Estonia | -0.21 | 0.35 | m | m | m | m | m | m |
| Finland | -0.43 | 0.78 | 0.08 | -0.06 | m | -0.05 | m | 0.16 |
| France | m | m | -0.41 | m | m | m | m | -1.56 |
| Germany | m | m | -0.26 | 0.08 | m | -0.20 | m | -0.48 |
| Greece | 0.14 | 0.69 | m | m | m | m | m | m |
| Hungary | -0.23 | 0.27 | 0.01 | 0.05 | -0.20 | 0.20 | -0.02 | -0.30 |
| Iceland | -0.12 | 0.09 | m | m | m | m | m | m |
| Ireland | -0.13 | 0.21 | -0.49 | -0.31 | m | -0.42 | m | -0.34 |
| Israel | -0.16 | 0.53 | -0.31 | m | -0.49 | m | -0.34 | 0.74 |
| Italy | -0.16 | 0.40 | -0.88 | 0.09 | 0.26 | 0.40 | 0.22 | -1.26 |
| Japan | -0.50 | -0.10 | m | -0.62 | -0.62 | -0.44 | -0.48 | m |
| Korea | -0.25 | 0.13 | m | -0.44 | -0.35 | -0.29 | -0.61 | m |
| Latvia | -0.35 | 0.41 | -0.04 | m | m | m | m | -0.33 |
| Lithuania | -0.02 | 0.65 | -0.26 | -0.18 | -0.72 | 0.08 | -0.41 | -0.54 |
| Netherlands | -0.36 | 0.42 | -0.14 | -0.21 | m | 0.02 | m | -0.41 |
| New Zealand | -0.19 | 0.87 | 0.53 | 0.32 | 0.37 | 0.08 | 0.42 | -0.19 |
| Norway | m | m | 0.27 | -0.16 | -0.58 | 0.10 | -0.53 | -0.63 |
| Poland | -0.71 | 0.30 | -0.16 | 0.34 | m | 0.53 | m | -0.88 |
| Portugal | -0.07 | -0.23 | -0.33 | -0.49 | m | -0.51 | m | -0.75 |
| Slovak Republic | -0.40 | 0.39 | 0.10 | -0.53 | m | -0.32 | m | -1.49 |
| Slovenia | -0.37 | 0.24 | -0.04 | -0.53 | -0.71 | -0.65 | -0.64 | -1.67 |
| Spain | -0.35 | 0.51 | -0.26 | -0.05 | m | 0.02 | m | -1.01 |
| Spain (Andalusia) | m | m | -0.16 | m | m | m | m | 0.26 |
| Sweden | -0.91 | 0.92 | 0.48 | -0.05 | 0.54 | -0.10 | 0.49 | -0.46 |
| Switzerland | -0.45 | 0.14 | m | m | m | m | m | m |
| Turkey | m | m | m | -0.12 | -0.32 | -0.07 | -0.22 | m |
| U.K. (England) | m | m | -0.57 | -0.37 | -0.61 | -0.15 | -0.31 | -1.19 |
| U.K. (Northern Ireland) | m | m | -0.38 | -0.11 | m | -0.07 | m | 0.27 |

| | Availability of desktop computers for use at school | Availability of portable laptops or notebooks for use at school | Frequency of use of computer or a tablet at school | Availability of computers (including tablets) to use during lessons | | | | |
|---|---|---|---|---|---|---|---|---|
| | 8th grade | 8th grade | 4th grade | 4th grade Maths | 8th grade Maths | 4th grade Science | 8th grade Science | 4th grade Reading |
| United States | m | m | -0.28 | -0.38 | -0.09 | -0.63 | -0.49 | -0.89 |
| U.S. (Massachusetts) | m | m | m | m | -0.41 | m | 0.00 | m |
| U.S. (Minnesota) | m | m | m | m | 0.03 | m | 0.04 | m |
| **OECD (average)** | **-0.33** | **0.35** | **-0.09** | **-0.24** | **-0.21** | **-0.16** | **-0.24** | **-0.70** |
| **OECD (av. absolute)** | **0.35** | **0.40** | **0.31** | **0.32** | **0.37** | **0.26** | **0.38** | **0.85** |
| Hong Kong, China | -0.19 | -0.01 | -0.31 | -0.22 | -0.44 | -0.47 | -0.66 | -1.32 |
| Indonesia | m | m | 0.09 | m | 0.02 | m | 0.18 | 0.55 |
| Russian Federation | 0.02 | 0.50 | 0.14 | 1.05 | 0.19 | 1.08 | 0.32 | 0.54 |
| Singapore | -0.41 | 0.70 | -0.22 | -0.93 | -0.39 | -0.67 | -0.31 | -0.93 |
| South Africa | m | m | 0.59 | m | -0.29 | m | -0.24 | 0.37 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PIRLS (2006, 2011 and 2016).

StatLink https://doi.org/10.1787/888933905607

# Chapter 12.
# Innovation in various school-level practices

*This chapter presents the change in a variety of school-level practices, aimed at students (ability grouping), teachers (incentives and hiring practices), and external stakeholders (for example parents). The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## 72. Student grouping by ability into different classes

### Why it matters

Ability grouping has little positive effect on academic achievement, and a significant negative effect on equity. Although parents, teachers, and school principals may find it convenient, it has become a controversial practice. While school principals' answers might just mirror the perceived social desirability of the practice rather than the practice itself, its decrease to low levels is welcome, assuming the ability grouping is not done at the school level or through other forms of tracking.

### Change at the OECD level: small

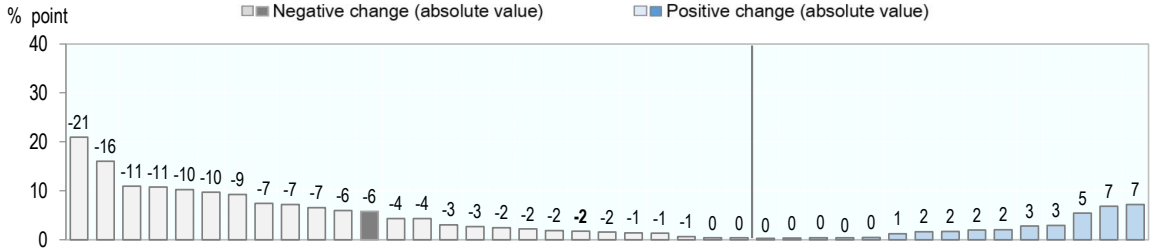
OECD systems present changes in both directions, although the average net change in the use of this practice was a slight decrease of about 2 percentage points. The absolute change amounted to 4 percentage points on average, corresponding to a small effect size of 0.17. Grouping students by ability into different classes is uncommon in most OECD education systems. In 2015 for instance, almost no school reported following this policy in Slovenia, Iceland, Denmark, Norway or Hungary. The Netherlands is an exception to the rule 50% of students were enrolled in schools doing so in 2015.

### Countries where there has been the most change

Between 2006 and 2015, Brazil and Luxembourg innovated by decreasing the use of this practice, the share of 15 year old students exposed to it reducing by more than 15 percentage points. Decreases also exceeded 10 percentage points in Portugal, the Russian Federation and Indonesia. No country in the sample experienced an increase in the use of this practice above 10 percentage points. Most countries experienced stability in this area.

**Figure 12.1. 15 year old students grouped by ability into different classes**

Change in and share of students enrolled in schools that have a policy of grouping students by ability into different classes, 2006-2015, school principals report




| | | Brazil | Luxembourg | Portugal | Russian Federation | Indonesia | Turkey | Colombia | Belgium | Latvia | Switzerland | Czech Republic | Slovenia | Sweden | Canada | Chile | Hungary | Ireland | Spain | Australia | **OECD average** | Iceland | Estonia | Israel | Denmark | Slovak Republic | Austria | New Zealand | United States | Hong Kong, China | Norway | Mexico | Japan | United Kingdom | Greece | Poland | Italy | Lithuania | Germany | Finland | Korea | Netherlands |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 9 | 27 | 4 | 9 | 20 | 5 | 9 | 13 | 3 | 27 | 2 | 0 | 3 | 6 | 6 | 0 | 2 | 5 | 1 | **8** | 0 | 7 | 8 | 0 | 13 | 3 | 1 | 4 | 16 | 0 | 13 | 8 | 7 | 2 | 5 | 6 | 7 | 12 | 5 | 12 | 50 |
| | 2006 | 30 | 43 | 15 | 20 | 30 | 15 | 18 | 21 | 10 | 34 | 8 | 6 | 7 | 10 | 9 | 3 | 4 | 7 | 3 | **9** | 2 | 8 | 9 | 1 | 13 | 4 | 1 | 4 | 16 | 0 | 13 | 7 | 6 | 1 | 3 | 4 | 4 | 9 | 0 | 5 | 42 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases

StatLink https://doi.org/10.1787/888933905626

## 73. Student grouping by ability within classes

### Why it matters

According to educational research, ability grouping has little positive effect on students' academic achievement, and a significant negative effect on equity. Teachers, parents, and even students themselves may however feel comfortable with it. There is a strong tradition of ability grouping, and its decrease to low levels of use is in principle welcome.

### Change at the OECD level: small

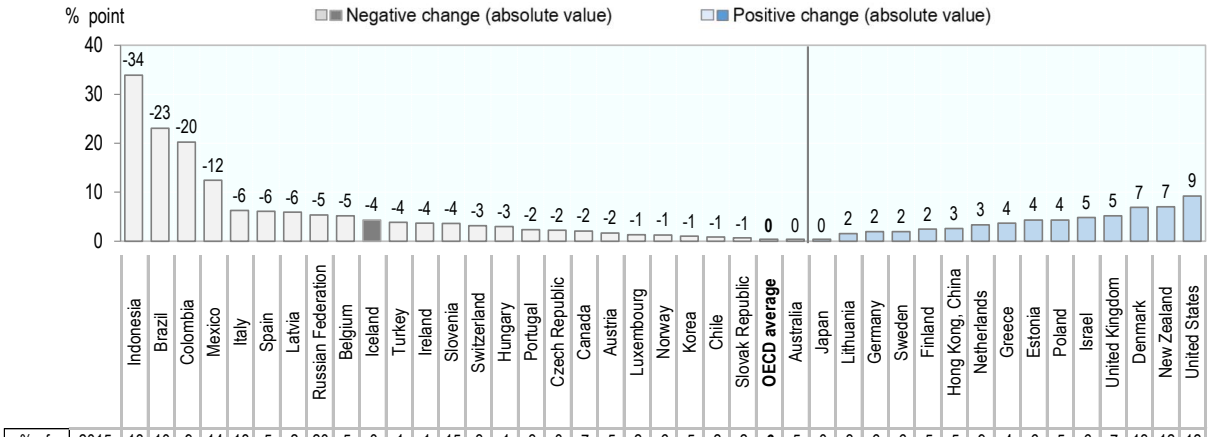
While contractions fully compensate expansions, on average the absolute change in the exposure of 15 year old students to this practice amounted to less than 4 percentage points for OECD countries, corresponding to a small effect size of 0.18. This practice is uncommon in the OECD countries covered: on average only 6% of 15 year old students were exposed to it in 2015 across all subjects.

### Countries where there has been the most change

Innovation took mainly the form of substantial decreases in the use of this practice. The largest change was seen in Indonesia, where the proportion of 15 year old students being grouped by ability within their classes decreased by 34 percentage points in. Similarly, Brazil and Colombia experienced declines of over 20 percentage points. Expansions remained modest with no country registering an increase greater than 10 percentage points, but in most cases this represented a significant novelty and thus an innovation as starting points were very low.

**Figure 12.2. 15 year old students grouped by ability within classes**

Change in and share of students enrolled in schools that have a policy of grouping students by ability within classes, 2006-2015, school principals report




*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases;

StatLink https://doi.org/10.1787/888933905645

## 74. Tracking achievement data over time by an administrative authority

### Why it matters

With the increased focus on learning outcomes over the past decade, most systems have put in place regular national or regional assessments that allow them to monitor the performance of their education. With the development of technology, and sometimes as part of their accountability policy or of a school choice agenda, achievement data are increasingly available at the school level. This helps support school improvement, provided other types of data on the school are also collected and used.

### Change at the OECD level: moderate

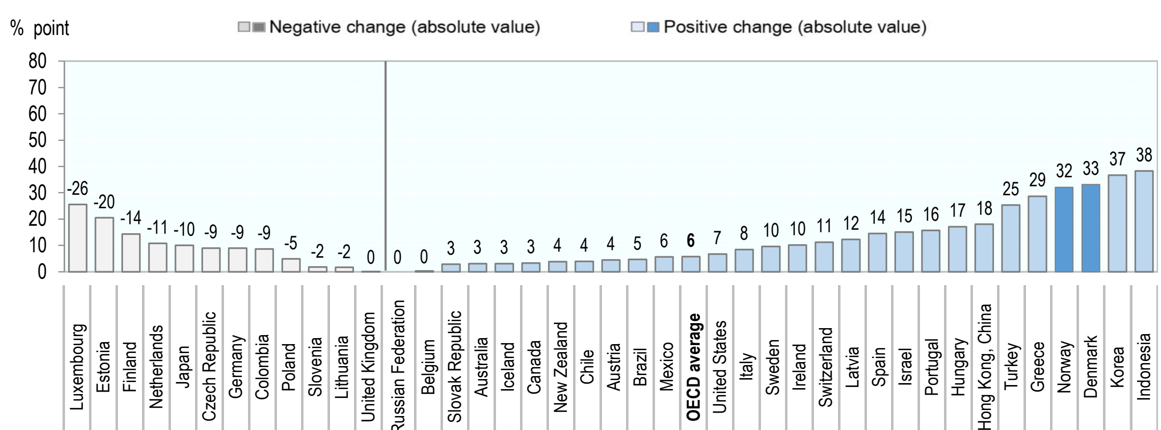
Most OECD countries show greater use of this practice, which recorded an average net increase of 6 percentage points between 2006 and 2015. The average absolute change was 12 percentage points, corresponding to a moderate effect size of 0.27. Within OECD countries, on average 68% were enrolled in a school that have their achievement data tracked by an administrative authority, with a span ranging from 8% in Japan to 98% in Turkey in 2015. In the Russian Federation, this practice was universal both in 2006 and 2015.

### Countries where there has been the most change

This practice expanded strongly in Indonesia, Korea, Denmark and Norway (over 30 percentage point increase in the share of 15 year old students concerned). Luxembourg and Estonia saw substantial falls of 26 and 20 percentage points respectively. In all these systems this was an innovation.

**Figure 12.3. Tracking achievement data over time by an administrative authority for 15 year old students**

Change in and share of students enrolled in schools that have their achievement data tracked by an administrative authority, 2006-2015, school principals report




| % of students | Luxembourg | Estonia | Finland | Netherlands | Japan | Czech Republic | Germany | Colombia | Poland | Slovenia | Lithuania | United Kingdom | Russian Federation | Belgium | Slovak Republic | Australia | Iceland | Canada | New Zealand | Chile | Austria |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 51 | 64 | 39 | 72 | 8 | 50 | 38 | 80 | 72 | 61 | 70 | 84 | 100 | 55 | 76 | 91 | 78 | 88 | 92 | 79 | 56 |
| 2006 | 77 | 84 | 53 | 83 | 18 | 59 | 47 | 88 | 77 | 63 | 72 | 84 | 100 | 55 | 74 | 88 | 75 | 85 | 89 | 75 | 52 |

| % of students | Brazil | Mexico | **OECD average** | United States | Italy | Sweden | Ireland | Switzerland | Latvia | Spain | Israel | Portugal | Hungary | Hong Kong, China | Turkey | Greece | Norway | Denmark | Korea | Indonesia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 88 | 92 | **68** | 96 | 30 | 80 | 58 | 43 | 64 | 78 | 83 | 87 | 47 | 80 | 98 | 77 | 74 | 67 | 86 | 93 |
| 2006 | 83 | 86 | **62** | 89 | 22 | 70 | 48 | 32 | 52 | 64 | 68 | 71 | 30 | 62 | 73 | 48 | 42 | 34 | 49 | 55 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases

StatLink https://doi.org/10.1787/888933905664

## 75. Public posting of school achievement data (e.g. in the media)

### Why it matters

With the increasing availability of learning outcome data at school level, it becomes increasingly common to provide information to the public about how schools are performing, at least in some specific areas. This allows for comparison and may provide incentives to schools to improve. It also allows families to know how their neighbourhood schools are doing (or provides them with information about where to enrol their children, provided such choice is possible in their context). Whether this reinforces inequalities or allows students from disadvantaged backgrounds to access better schools remains a heated debate.

### Change at the OECD level: moderate

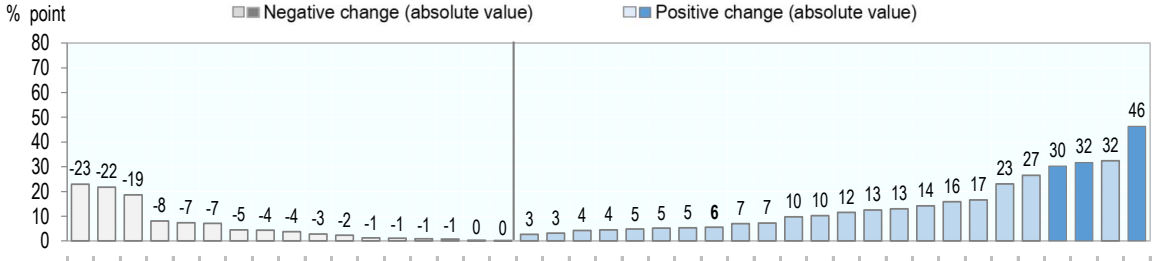
This practice has more spread than retracted in the past few years, leading to an average net increase of 6 percentage points in the share of students enrolled in schools posting achievement data publicly. Within the OECD area, the absolute change was 11 percentage points, corresponding to a moderate effect size of 0.25. Large differences exist in the use of this practice across education systems. For instance, only 2% of the 15 year old students were exposed to it in Japan compared to 84% in the United Kingdom.

### Countries where there has been the most change

The Slovak Republic highly innovated by increasing the use of this practice: the share of secondary students enrolled in a school posting publicly its achievement data increased by 46 percentage points between 2006 and 2015. Korea, Portugal and Slovenia also experienced increases above 30 percentage points. On the contrary, substantial decreases in the use of this public posting were experienced in Estonia (23 percentage points), Luxembourg (22 percentage points) and the Czech Republic (19 percentage points).

**Figure 12.4. Public posting of school achievement data for 15 year old students**

Change in and share of students enrolled in schools posting achievement data publicly, 2006-2015, school principals report




| | | Estonia | Luxembourg | Czech Republic | Hong Kong, China | United Kingdom | Mexico | Japan | Canada | Latvia | Switzerland | Iceland | Germany | Greece | Netherlands | Austria | Belgium | Russian Federation | Lithuania | Finland | Denmark | Hungary | Sweden | United States | Colombia | **OECD average** | Israel | Italy | Australia | Spain | Poland | Chile | Ireland | Norway | New Zealand | Indonesia | Brazil | Turkey | Slovenia | Portugal | Korea | Slovak Republic |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 19 | 35 | 29 | 46 | 84 | 19 | 2 | 47 | 28 | 4 | 25 | 11 | 21 | 77 | 5 | 4 | 72 | 23 | 7 | 48 | 33 | 57 | 83 | 38 | **39** | 35 | 34 | 66 | 21 | 53 | 50 | 31 | 52 | 79 | 26 | 41 | 52 | 54 | 59 | 51 | 70 |
| | 2006 | 42 | 57 | 47 | 54 | 91 | 26 | 6 | 52 | 32 | 7 | 27 | 12 | 22 | 78 | 6 | 4 | 72 | 20 | 4 | 44 | 28 | 53 | 78 | 32 | **34** | 28 | 26 | 56 | 11 | 42 | 38 | 18 | 38 | 64 | 9 | 18 | 26 | 24 | 28 | 19 | 24 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on PISA Databases

StatLink https://doi.org/10.1787/888933905683

## 76. Incentives to recruit or retain 8th grade teachers

### Why it matters

Attracting quality teachers and retaining them so that they can contribute to a professional learning community at the school level is an important policy objective. Depending on the countries, these incentives may come from other levels than the school (e.g. local, regional or even national education authority), so changes in this practice may reflect broader changes than just school practices.

## Mathematics

### Change at the OECD level: small

The average net change in the use of this practice was slightly negative in the OECD area. Between 2007 and 2015, the share of 15 year old students enrolled in schools with this incentive policy for mathematics teachers decreased by 2 percentage points on average. The use of this practice remained stable during this time period, the absolute change only amounting to 4 percentage points, corresponding to a small effect size of 0.15. In 2015, secondary schools in OECD systems rarely have incentives in place to recruit or retain 8th grade mathematics teachers. On average, only 8% of secondary students were enrolled in schools having such policy.

### Countries where there has been the most change

This was mainly an area of stability. Change occurred in both directions albeit it was generally of small magnitude. The largest changes in this school practice were recorded in Singapore, with an increase of 16 percentage points between 2007 and 2015, and in Indonesia with a fall of the same magnitude between 2007 and 2011. Decreases over 10 percentage points in the use of this policy incentive occurred in Lithuania and Turkey, which also experienced innovation in this area.

## Science

### Change at the OECD level: small

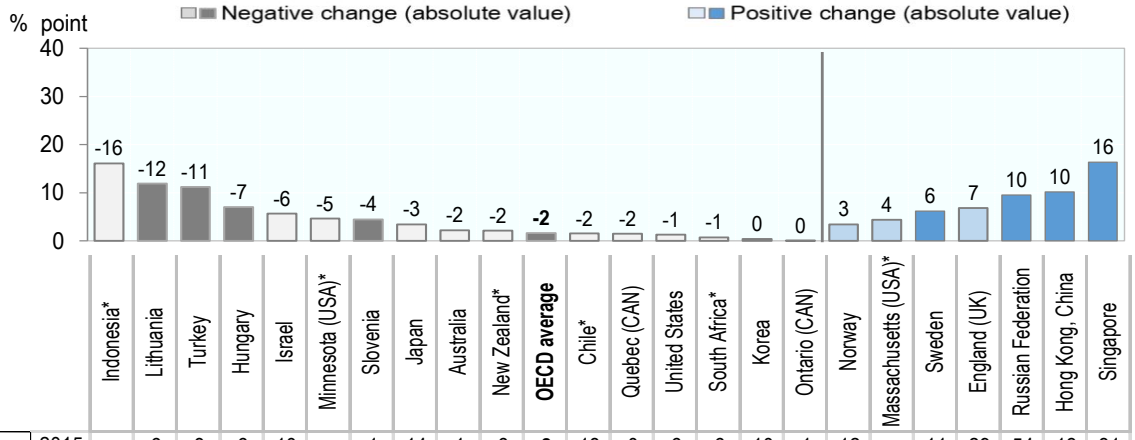
Between 2007 and 2015, this school practice decreased on average by 1 percentage point in OECD systems. The positive and negative variations together amounted to an average absolute change of 3 percentage points, corresponding to a small effect size of 0.15. In line with the situation for 8th grade maths teachers, this incentive policy for 8th grade science teachers is rather unusual in secondary schools in OECD countries.

### Countries where there has been the most change

Singapore saw (again) the largest increase in the use of this practice (16 percentage points), followed by the Russian Federation and Hong Kong, China (increases by 11 and 10 percentage points). This incentive policy lost ground in Lithuania and Turkey, with decreases of 12 and 13 percentage points respectively between 2007 and 2015. Indonesia exhibited as well a notable decrease of 18 percentage points between 2007 and 2011.

### Figure 12.5. Incentives to recruit or retain 8th grade maths teachers

Change in and share of 8th grade students enrolled in schools that use incentives to recruit or retain 8th grade teachers, 2007-2015, school principal reports



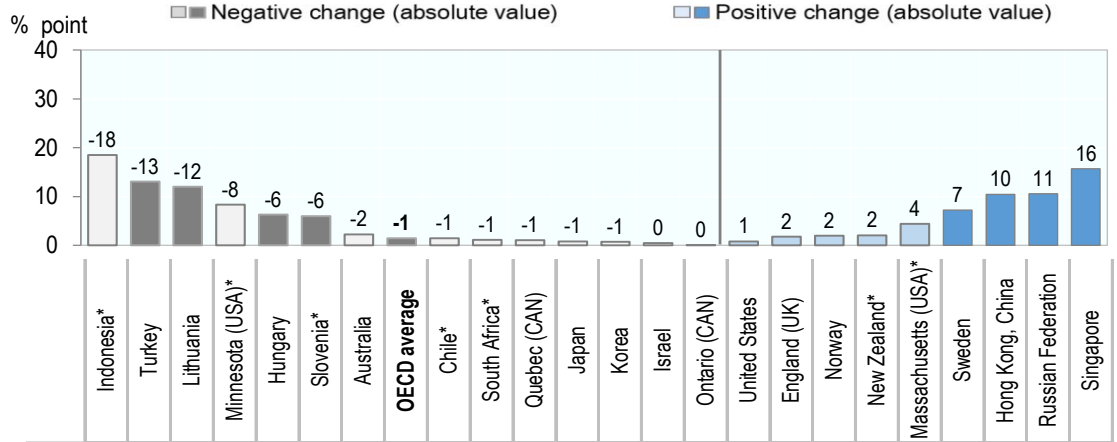

| | | Indonesia* | Lithuania | Turkey | Hungary | Israel | Minnesota (USA)* | Slovenia | Japan | Australia | New Zealand* | **OECD average** | Chile* | Quebec (CAN) | United States | South Africa* | Korea | Ontario (CAN) | Norway | Massachusetts (USA)* | Sweden | England (UK) | Russian Federation | Hong Kong, China | Singapore |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 6 | 8 | 6 | 10 | m | 1 | 14 | 1 | 6 | **8** | 18 | 0 | 6 | 6 | 10 | 1 | 12 | m | 11 | 29 | 54 | 13 | 31 |
| | 2011 | 21 | 8 | 11 | 14 | 23 | 1 | 1 | 14 | 5 | 9 | **9** | 20 | 3 | 7 | 6 | 7 | 2 | 6 | 4 | 4 | 19 | 62 | 7 | 47 |
| | 2007 | 37 | 18 | 19 | 13 | 16 | 6 | 5 | 17 | 4 | m | **10** | m | 2 | 7 | m | 10 | 1 | 9 | 0 | 5 | 22 | 44 | 3 | 14 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905702

### Figure 12.6. Incentives to recruit or retain 8th grade science teachers

Change in and share of 8th grade students enrolled in schools that use incentives to recruit or retain 8th grade teachers, 2007-2015, school principals report




| | | Indonesia* | Turkey | Lithuania | Minnesota (USA)* | Hungary | Slovenia* | Australia | **OECD average** | Chile* | South Africa* | Quebec (CAN) | Japan | Korea | Israel | Ontario (CAN) | United States | England (UK) | Norway | New Zealand* | Massachusetts (USA)* | Sweden | Hong Kong, China | Russian Federation | Singapore |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 8 | 7 | m | 4 | m | 1 | **7** | 16 | 6 | 0 | 5 | 9 | 10 | 1 | 6 | 21 | 9 | 10 | m | 12 | 13 | 55 | 31 |
| | 2011 | 19 | 11 | 8 | 1 | 14 | 1 | 4 | **8** | 18 | 7 | 1 | 6 | 7 | 20 | 2 | 7 | 14 | 4 | 8 | 4 | 5 | 5 | 63 | 47 |
| | 2007 | 38 | 21 | 19 | 10 | 10 | 6 | 4 | **8** | m | m | 1 | 5 | 10 | 10 | 1 | 5 | 19 | 7 | m | 0 | 5 | 2 | 44 | 15 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905721

## Other subjects than Mathematics and Science

### Change at the OECD level: small

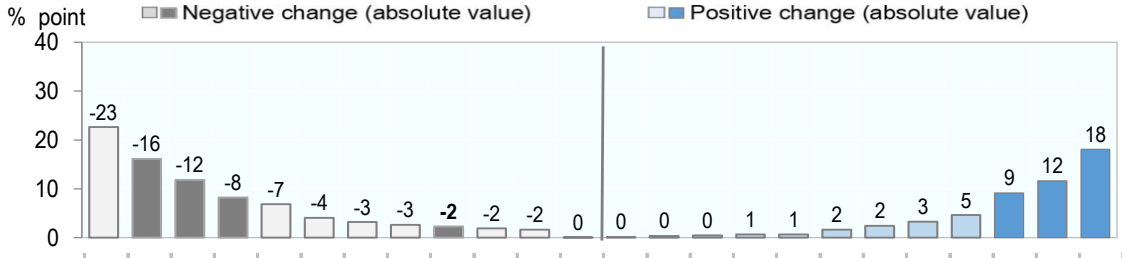
This school incentive policy to recruit and retain secondary teachers has more often lost than gained ground, resulting in an average net decrease of 2 percentage points for OECD systems. The average absolute change was 3 percentage points, corresponding to a small effect size of 0.13. At the OECD level, on average 6% of 8th grade students were enrolled in schools with an incentive policy to hire or retain teachers teaching subjects other than maths and science. The levels are similar for all subjects.

### Countries where there has been the most change

Innovation took the form of increases and decreases in the use of this practice, which remained overall very stable. In Singapore and the Russian Federation, the practice spread with 18 and 12 more students in hundred enrolled in schools with such human resource policy. On the other hand, Indonesia experienced a considerable decline of 23 percentage points in this practice between 2007 and 2011.

**Figure 12.7. Incentives to recruit and retain 8th grade teachers besides maths and science**

Change in and share of students enrolled in schools that use incentives to recruit or retain 8th grade teachers for subjects other than mathematics or science, 2007-2015, school principal reports




| | | Indonesia* | Turkey | Lithuania | Slovenia | Minnesota (USA)* | Japan | Australia | Hungary | **OECD average** | England (UK) | New Zealand* | Ontario (CAN) | Quebec (CAN) | United States | Norway | South Africa* | Korea | Sweden | Chile* | Israel | Massachusetts (USA)* | Hong Kong, China | Russian Federation | Singapore |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 7 | 7 | 1 | m | 5 | 1 | 7 | **6** | 17 | 7 | 1 | 0 | 6 | 7 | 7 | 10 | 6 | 15 | 11 | m | 14 | 57 | 33 |
| | 2011 | 19 | 13 | 9 | 1 | 1 | 8 | 4 | 15 | **7** | 10 | 8 | 2 | 1 | 4 | 6 | 6 | 10 | 5 | 12 | 17 | 5 | 11 | 64 | 46 |
| | 2007 | 41 | 23 | 19 | 9 | 8 | 9 | 5 | 9 | **8** | 19 | m | 1 | 0 | 5 | 7 | m | 10 | 5 | m | 8 | 0 | 5 | 46 | 15 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905740

## 77. Degree of parental involvement

### Why it matters

Parents play a key role in the successful school education of their children. Their involvement in school activities eases a constructive dialogue with school teachers and administrators, and a more personalised education and learning path for their children. Parents' continuous interest in their children's school life and learning contributes to better results.

## Primary education

### Change at the OECD level: small

At the OECD level, decreases and increases have compensated each other, hiding some variations as the absolute change in the share of 15 year old students with high levels of parental involvement in school activities was 7 percentage points on average between 2007 and 2015. This translates into a small effect size of 0.15. In 2015, the proportion of 4th grade students whose schools reported high degrees of parental engagement ranged from 14% in the Czech Republic to 66% in Quebec (Canada), with an OECD mean at 36%.

### Countries where there has been the most change

Parental involvement in 4th grade education significantly increased in Quebec (Canada), between 2007 and 2015, as well as in Spain and Poland between 2011 and 2015, all three recording increases above 22 percentage points in this domain. These increases contrast with significant decreases in Denmark, Australia and Ontario (Canada) (19, 14 and 13 percentage points respectively).

## Secondary education

### Change at the OECD level: moderate

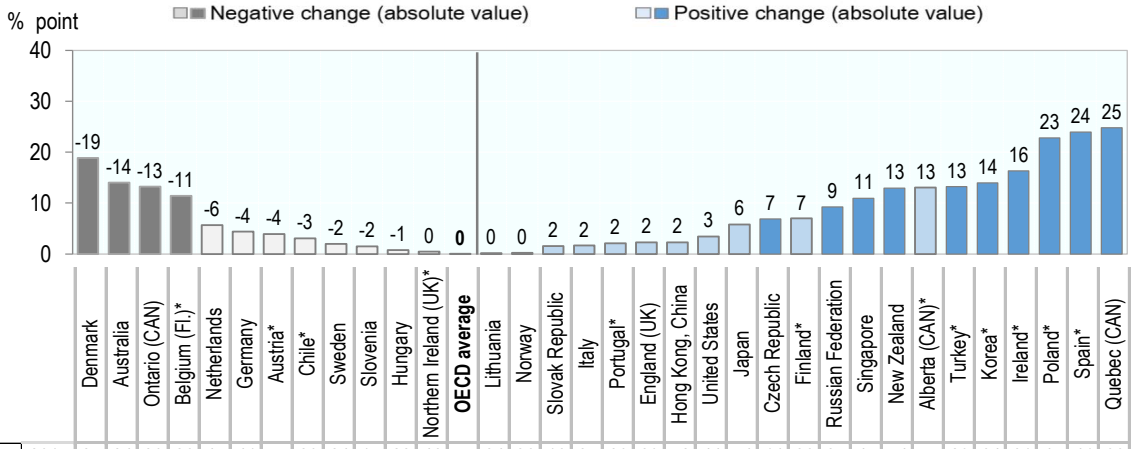
At the secondary level, most OECD countries covered have experienced an increase of parental involvement in students' education. Between 2007 and 2015, the percentage of 8th grade students enrolled in schools with high or very high parental involvement in school activities increased by 7 percentage points on average. Considering both positive and negative variations, the average absolute change was 11 percentage points, corresponding to a moderate effect size of 0.26. On average, only 30% of 8th grade students were enrolled in schools reporting high degrees of parental engagement in 2015, ranging from 62% in Korea to 12% in Slovenia.

### Countries where there has been the most change

Like in primary education, Quebec (Canada) experienced the most innovation in this domain with an increase by 35 percentage points in the share of secondary students enrolled in schools where parents are highly involved in school activities. England (United Kingdom) and Korea also experienced large increases around 25 percentage points. Where parental involvement lost ground, only in Quebec (Canada) it decreased by over 10 percentage points.

### Figure 12.8. Parental involvement in 4th grade school activities

Change in and share of students enrolled in schools with high or very high levels of parental involvement in school activities, 2007-2015, school principals report



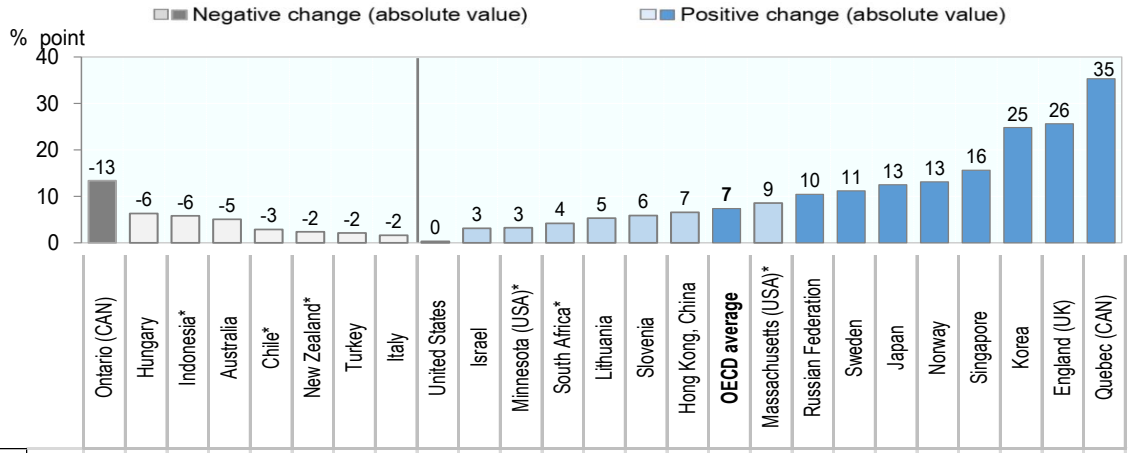

| % of students | Denmark | Australia | Ontario (CAN) | Belgium (Fl.)* | Netherlands | Germany | Austria* | Chile* | Sweden | Slovenia | Hungary | Northern Ireland (UK)* | **OECD average** | Lithuania | Norway | Slovak Republic | Italy | Portugal* | England (UK) | Hong Kong, China | United States | Japan | Czech Republic | Finland* | Russian Federation | Singapore | New Zealand | Alberta (CAN)* | Turkey* | Korea* | Ireland* | Poland* | Spain* | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 37 | 34 | 30 | 26 | 45 | 41 | m | 20 | 24 | 15 | 23 | 46 | **36** | 34 | 36 | 16 | 35 | 30 | 39 | 52 | 44 | 54 | 14 | 36 | 35 | 45 | 54 | m | 29 | 64 | 61 | 47 | 41 | 66 |
| 2011 | 54 | 40 | 33 | 38 | 35 | 50 | 44 | 23 | 17 | 15 | 25 | 47 | **32** | 28 | 19 | 12 | 31 | 28 | 30 | 43 | 45 | 46 | 4 | 29 | 24 | 30 | 57 | 58 | 16 | 50 | 45 | 24 | 17 | 40 |
| 2007 | 56 | 48 | 44 | m | 51 | 46 | 48 | m | 26 | 16 | 23 | m | **36** | 33 | 36 | 15 | 33 | m | 37 | 50 | 41 | 48 | 7 | m | 25 | 34 | 42 | 45 | m | m | m | m | m | 42 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905759

### Figure 12.9. Parental involvement in 8th grade school activities

Change in and share of students enrolled in schools with high or very high levels of parental involvement in school activities, 2007-2015, school principals report




| % of students | Ontario (CAN) | Hungary | Indonesia* | Australia | Chile* | New Zealand* | Turkey | Italy | United States | Israel | Minnesota (USA)* | South Africa* | Lithuania | Slovenia | Hong Kong, China | **OECD average** | Massachusetts (USA)* | Russian Federation | Sweden | Japan | Norway | Singapore | Korea | England (UK) | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | 27 | 16 | m | 24 | 18 | 25 | 13 | 19 | 31 | 26 | m | 16 | 19 | 12 | 24 | **30** | m | 20 | 21 | 44 | 31 | 30 | 62 | 43 | 51 |
| 2011 | 27 | 18 | 29 | 24 | 21 | 27 | 16 | 21 | 33 | 26 | 42 | 12 | 15 | 12 | 23 | **23** | 42 | 13 | 10 | 37 | 23 | 21 | 43 | 23 | 14 |
| 2007 | 41 | 22 | 34 | 29 | m | m | 15 | 21 | 31 | 22 | 39 | m | 13 | 7 | 17 | **22** | 33 | 9 | 10 | 31 | 18 | 15 | 37 | 17 | 15 |

*Note*: Darker tones correspond to statistically significant values;
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905778

**Table 12.1. Effect sizes for changes in school practices**

| | Student grouping by ability into different classes | Student grouping by ability within classes | Incentives to recruit or retain 8th grade teachers | | | Degree of parental involvement in school activities | | Tracking achievement data by an administrative authority | Public posting of school achievement data |
|---|---|---|---|---|---|---|---|---|---|
| | 8th grade | 8th grade | 8th grade Math | 8th grade Science | 8th grade Other | 4th grade | 8th grade | 8th grade | 8th grade |
| Australia | -0.13 | -0.02 | -0.14 | -0.14 | -0.19 | -0.29 | -0.12 | 0.10 | 0.20 |
| Austria | -0.02 | -0.07 | m | m | m | -0.08 | m | 0.09 | -0.03 |
| Belgium | -0.20 | -0.20 | m | m | m | m | m | 0.00 | -0.02 |
| Belgium (Fl.) | m | m | m | m | m | -0.25 | m | m | m |
| Canada | -0.16 | -0.08 | m | m | m | m | m | 0.10 | -0.09 |
| Canada (Alberta) | m | m | m | m | m | 0.26 | m | m | m |
| Canada (Ontario) | m | m | 0.00 | 0.00 | -0.01 | -0.28 | -0.28 | m | m |
| Canada (Quebec) | m | m | -0.16 | -0.12 | 0.03 | 0.50 | 0.78 | m | m |
| Chile | -0.12 | -0.05 | -0.04 | -0.04 | 0.07 | -0.07 | -0.07 | 0.09 | 0.25 |
| Czech Republic | -0.28 | -0.22 | m | m | m | 0.23 | m | -0.18 | -0.39 |
| Denmark | -0.09 | 0.24 | m | m | m | -0.38 | m | 0.68 | 0.09 |
| Estonia | -0.05 | 0.23 | m | m | m | m | m | -0.47 | -0.51 |
| Finland | 0.47 | 0.14 | m | m | m | 0.15 | m | -0.29 | 0.14 |
| Germany | 0.10 | 0.09 | m | m | m | -0.09 | m | -0.18 | -0.04 |
| Greece | 0.15 | 0.39 | m | m | m | m | m | 0.60 | -0.03 |
| Hungary | -0.33 | -0.21 | -0.24 | -0.25 | -0.10 | -0.02 | -0.16 | 0.35 | 0.10 |
| Iceland | -0.25 | -0.42 | m | m | m | m | m | 0.07 | -0.05 |
| Ireland | -0.15 | -0.22 | m | m | m | 0.33 | m | 0.20 | 0.30 |
| Israel | -0.05 | 0.27 | -0.17 | -0.01 | 0.11 | m | 0.07 | 0.35 | 0.15 |
| Italy | 0.10 | -0.15 | m | m | m | 0.04 | -0.04 | 0.19 | 0.16 |
| Japan | 0.05 | 0.12 | -0.10 | -0.04 | -0.16 | 0.12 | 0.26 | -0.30 | -0.24 |
| Korea | 0.26 | -0.04 | -0.01 | -0.02 | 0.02 | 0.28 | 0.50 | 0.82 | 0.70 |
| Latvia | -0.31 | -0.29 | m | m | m | m | m | 0.25 | -0.08 |
| Lithuania | 0.12 | 0.10 | -0.38 | -0.37 | -0.37 | 0.00 | 0.15 | -0.04 | 0.07 |
| Luxembourg | -0.34 | -0.08 | m | m | m | m | m | -0.54 | -0.44 |
| Mexico | 0.01 | -0.31 | m | m | m | m | m | 0.18 | -0.17 |
| Netherlands | 0.14 | 0.13 | m | m | m | -0.11 | m | -0.26 | -0.02 |
| New Zealand | 0.03 | 0.26 | -0.08 | 0.07 | -0.06 | 0.26 | -0.06 | 0.13 | 0.36 |
| Norway | 0.13 | -0.05 | 0.11 | 0.07 | 0.02 | 0.00 | 0.31 | 0.66 | 0.29 |
| Poland | 0.10 | 0.27 | m | m | m | 0.48 | m | -0.11 | 0.23 |
| Portugal | -0.39 | -0.11 | m | m | m | 0.05 | m | 0.39 | 0.65 |
| Slovak Republic | -0.01 | -0.04 | m | m | m | 0.04 | m | 0.06 | 0.97 |
| Slovenia | -0.38 | -0.10 | -0.28 | -0.49 | -0.43 | -0.04 | 0.20 | -0.04 | 0.63 |
| Spain | -0.10 | -0.23 | m | m | m | 0.54 | m | 0.32 | 0.28 |
| Sweden | -0.21 | 0.09 | 0.23 | 0.26 | 0.07 | -0.05 | 0.32 | 0.22 | 0.10 |
| Switzerland | -0.14 | -0.16 | m | m | m | m | m | 0.23 | -0.12 |
| Turkey | -0.33 | -0.22 | -0.34 | -0.38 | -0.47 | 0.32 | -0.06 | 0.81 | 0.55 |
| United Kingdom | 0.07 | 0.28 | m | m | m | m | m | 0.00 | -0.22 |

| | Student grouping by ability into different classes | Student grouping by ability within classes | Incentives to recruit or retain 8th grade teachers | | | Degree of parental involvement in school activities | | Tracking achievement data by an administrative authority | Public posting of school achievement data |
|---|---|---|---|---|---|---|---|---|---|
| | 8th grade | 8th grade | 8th grade Math | 8th grade Science | 8th grade Other | 4th grade | 8th grade | 8th grade | 8th grade |
| U.K. (England) | m | m | 0.16 | 0.04 | -0.05 | 0.05 | 0.57 | m | m |
| U.K. (Northern Ireland) | m | m | m | m | m | -0.01 | m | m | m |
| United States | 0.02 | 0.38 | -0.05 | 0.03 | 0.01 | 0.07 | 0.01 | 0.26 | 0.13 |
| US (Massachusetts) | m | m | 0.42 | 0.42 | 0.43 | m | 0.18 | m | m |
| US (Minnesota) | m | m | -0.26 | -0.39 | -0.34 | m | 0.07 | m | m |
| **OECD (average)** | **-0.06** | **-0.02** | **-0.06** | **-0.06** | **-0.09** | **0.00** | **0.17** | **0.12** | **0.11** |
| **OECD (av. absolute)** | **0.17** | **0.18** | **0.15** | **0.15** | **0.13** | **0.15** | **0.26** | **0.27** | **0.25** |
| Brazil | -0.55 | -0.58 | m | m | m | m | m | 0.13 | 0.51 |
| Colombia | -0.28 | -0.53 | m | m | m | m | m | -0.24 | 0.11 |
| Hong Kong, China | 0.01 | 0.15 | 0.39 | 0.43 | 0.32 | 0.05 | 0.16 | 0.40 | -0.16 |
| Indonesia | -0.24 | -0.73 | -0.36 | -0.41 | -0.50 | m | -0.13 | 0.94 | 0.45 |
| Russian Federation | -0.31 | -0.13 | 0.19 | 0.21 | 0.23 | 0.20 | 0.30 | 0.00 | 0.00 |
| Singapore | m | m | 0.40 | 0.38 | 0.43 | 0.22 | 0.38 | m | m |
| South Africa | m | m | -0.03 | -0.05 | 0.03 | m | 0.12 | m | m |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015) and PISA (2006 and 2015).

StatLink https://doi.org/10.1787/888933905797

# Chapter 13.
# Innovation in teacher professional development and collaborative practices

*This chapter presents the change in teacher professional development practices. They typically take two forms: formal training (in content knowledge or pedagogy) and peer learning through collaborative practices (for example collaboration in the preparation of lessons). The change within countries is presented as an increase or decrease in the share of students exposed to the practice. The percentage point change is also expressed as a standardised effect size in the final table.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

# 78. Teacher participation in professional development in mathematics and science content

## Why it matters

Continued in-service teacher professional development can take different formats, including training related to content knowledge in their discipline. It is particularly important for primary education teachers to feel comfortable with science and mathematics content in countries where they primarily studied humanities. For secondary education teachers, who are usually more specialised, it can broaden their knowledge and allow them to master more approaches to teaching.

## Mathematics

### Primary education

**Change at the OECD level: small**

While on average positive and negative changes have cancelled each other across OECD countries, the absolute change in this practice amounted to 10 percentage points, corresponding to a small effect size of 0.2. At the OECD level, the share of 4th grade students with a maths teachers who recently had a training on maths content ranged from less than 5% in Turkey and the Slovak Republic to 85% in Poland in 2015.

**Countries where there has been the most change**

Albeit stable in most countries, innovation took the form of both expansion and contraction of the practice. While the share of students taught by a teacher who recently had a training decreased by over 20 percentage points in the Russian Federation, Hungary and Slovenia, it increased by over 20 percentage points in Quebec (Canada), Sweden and Poland.

### Secondary education

**Change at the OECD level: moderate-low**

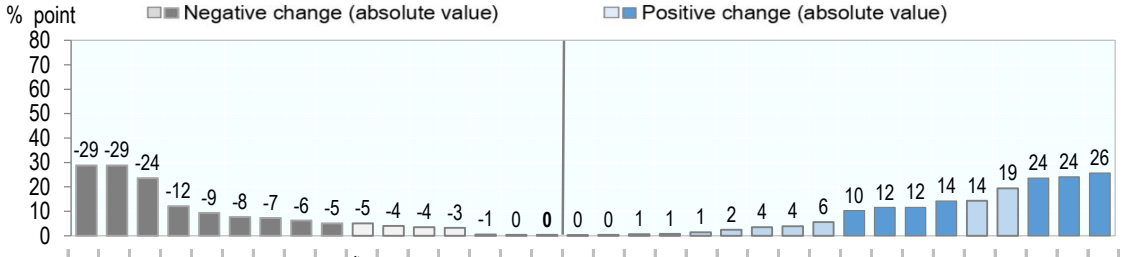
At the OECD level, negative changes overshadow positive ones, leading to an average decrease of 5 percentage points in the share of 8th grade students with maths teachers participating in content-related professional development. Increases and decreases together lead to an average absolute change of 11 percentage points, corresponding to a moderate-low effect size of 0.25. Across the OECD area in 2015, about half of the students were instructed by teachers who participated in this kind of professional development during the last two years.

**Countries where there has been the most change**

The share of students taught by a teacher who had content-related training in maths decreased by over 22 percentage points in Turkey, Lithuania, Hungary and Norway. Only a small number of countries experienced substantial increases between 2007 and 2015, for example Sweden (18 percentage points) and Israel (12 percentage points). Additionally, South Africa experienced a 12-percentage point increase between 2007 and 2011.

**Figure 13.1. 4th grade teacher participation in mathematics content**

Change in and share of students whose teachers participated in professional development by means of content in the last two years, 2007-2015, teachers report



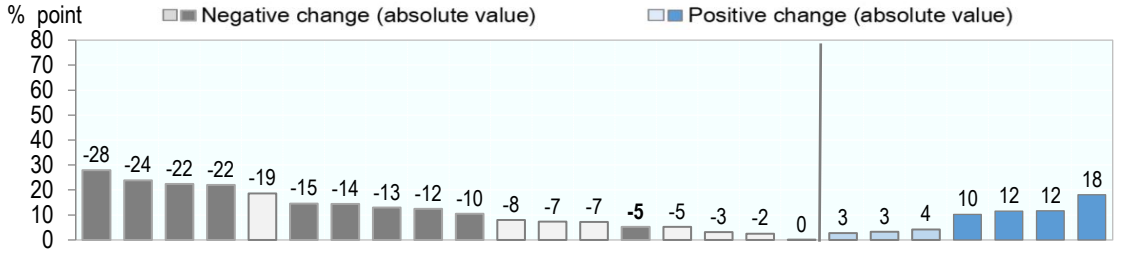

| | | Russian Federation | Hungary | Slovenia | Portugal* | New Zealand | Norway | Slovak Republic | Italy | Turkey* | Northern Ireland (UK)* | Lithuania | Finland* | Chile* | Japan | Denmark | **OECD average** | Germany | Korea* | Australia | Czech Republic | Ontario (CAN) | Belgium (Fl.)* | England (UK) | Hong Kong, China | Singapore | United States | Netherlands | Spain* | Ireland* | Alberta (CAN)* | Austria* | Poland* | Sweden | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 37 | 14 | 20 | 46 | 74 | 17 | 5 | 16 | 5 | 50 | 13 | 6 | 44 | 47 | 22 | **41** | 44 | 32 | 70 | 21 | 69 | 14 | 64 | 78 | 64 | 71 | 22 | 27 | 46 | m | m | 85 | 56 | 62 |
| | 2011 | 58 | 28 | 32 | 58 | 72 | 25 | 11 | 28 | 10 | 55 | 33 | 9 | 48 | 52 | 29 | **42** | 55 | 32 | 67 | 16 | 52 | 12 | 54 | 66 | 68 | 67 | 21 | 15 | 32 | 71 | 75 | 61 | 53 | 58 |
| | 2007 | 66 | 43 | 43 | m | 83 | 25 | 13 | 22 | m | m | 17 | m | m | 48 | 23 | **41** | 44 | m | 69 | 20 | 68 | m | 60 | 74 | 59 | 61 | 11 | m | m | 57 | 56 | m | 32 | 36 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905816

**Figure 13.2. 8th grade teacher participation in mathematics content**

Change in and share of students whose teachers participated in professional development by means of content in the last two years, 2007-2015, teachers report




| | | Turkey | Lithuania | Hungary | Norway | Massachusetts (USA)* | Hong Kong, China | Chile* | Singapore | Russian Federation | Slovenia | Ontario (CAN) | England (UK) | Quebec (CAN) | **OECD average** | Japan | Australia | United States | Indonesia* | New Zealand* | Korea | Minnesota (USA)* | Italy | Israel | South Africa* | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 19 | 62 | 28 | 17 | m | 63 | 48 | 68 | 71 | 60 | 74 | 59 | 49 | **52** | 69 | 65 | 78 | m | 66 | 51 | m | 26 | 70 | 84 | 58 |
| | 2011 | 30 | 76 | 34 | 21 | 76 | 69 | 63 | 67 | 68 | 61 | 64 | 60 | 53 | **50** | 65 | 53 | 73 | 71 | 64 | 51 | 82 | 23 | 80 | 73 | 36 |
| | 2007 | 47 | 85 | 51 | 39 | 95 | 78 | m | 81 | 84 | 70 | 82 | 66 | 57 | **57** | 74 | 68 | 81 | 71 | m | 48 | 78 | 16 | 58 | m | 40 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905835

## Science

### Primary education

**Change at the OECD level: small**

Between 2007 and 2015, the share of 4th grade students taught by science teachers who took a training on science content decreased by 2 percentage points on average in OECD systems. Increases and reductions combined resulted in an absolute change of 8 percentage points, corresponding to a small effect size of 0.2. Within OECD countries, the percentage of 4th grade students whose teachers received training on science content in the last two years was 22%, ranging from 74% in Poland to 3% in Finland, Turkey and the Netherlands.

**Countries where there has been the most change**

Slovenia, the Russian Federation and Hungary witnessed noticeable decreases of over 20 percentage points in this kind of professional development. At the other end of the spectrum, Poland saw the largest increase in this practice between 2011 and 2015 (40 percentage points).

### Secondary education

**Change at the OECD level: moderate-low**

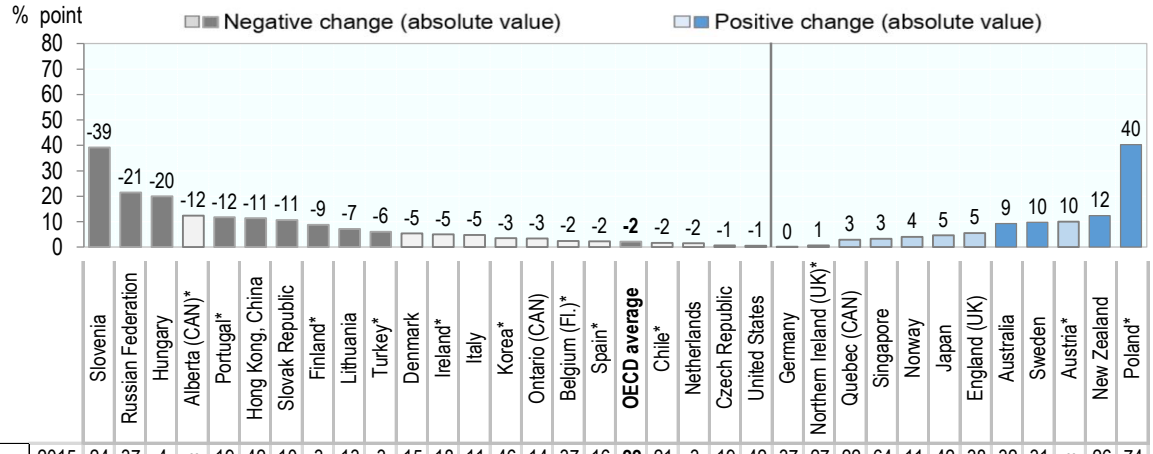
This practice has mainly decreased across the OECD area. The average net decrease amounted to 10 percentage points, with 49% of 8th grade science students instructed by teachers engaged in professional development about science content in 2015 against 59% in 2007. The absolute change amounted to 11 percentage, corresponding to a moderate effect size of 0.23. On average, in 2015, one student in two had a teacher who recently took a science content training, with a span ranging from 76% in the United States and Japan to 12% in Norway.

**Countries where there has been the most change**

Turkey is by far the country that experienced the largest decrease in this teacher professional development practice, with a contraction of 41 percentage points of students concerned. Ontario (Canada), Norway and Hungary show the same pattern with reductions between 17 and 20 percentage points. On the contrary, South Africa, Indonesia and the Russian Federation recorded relatively substantial increases in this teacher practice, but overall change in that direction was slight. Change in this practice is nonetheless an innovation in all these countries.

### Figure 13.3. 4th grade teacher participation in science content

Change in and share of students whose teachers participated in professional development by means of content in the last two years, 2007-2015, teachers report



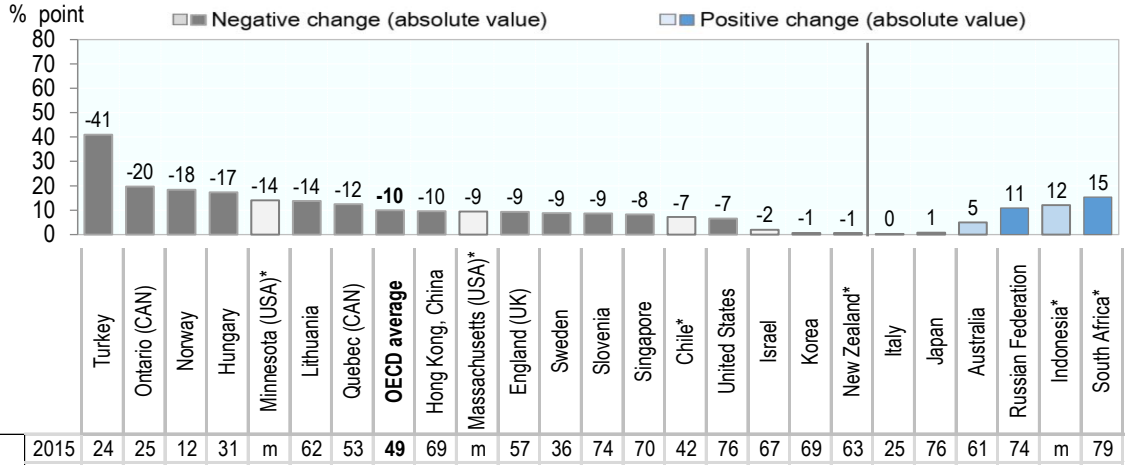

| % of students | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 24 | 37 | 4 | m | 19 | 42 | 10 | 3 | 13 | 3 | 15 | 18 | 11 | 46 | 14 | 37 | 16 | **22** | 21 | 3 | 19 | 42 | 37 | 27 | 22 | 64 | 11 | 42 | 38 | 32 | 31 | m | 26 | 74 |
| | 2011 | 43 | 46 | 16 | 25 | 31 | 43 | 16 | 11 | 27 | 9 | 20 | 23 | 21 | 49 | 12 | 39 | 19 | **23** | 23 | 5 | 18 | 39 | 37 | 26 | 23 | 74 | 10 | 38 | 27 | 31 | 20 | 45 | 16 | 34 |
| | 2007 | 63 | 58 | 24 | 37 | m | 53 | 21 | m | 21 | m | 21 | m | 16 | m | 17 | m | m | **25** | m | 5 | 20 | 43 | 37 | m | 19 | 61 | 7 | 37 | 32 | 22 | 21 | 35 | 14 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905854

### Figure 13.4. 8th grade teacher participation in science content

Change in and share of students whose teachers participated in professional development by means of content in the last two years, 2007-2015, teachers report




| % of students | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 24 | 25 | 12 | 31 | m | 62 | 53 | **49** | 69 | m | 57 | 36 | 74 | 70 | 42 | 76 | 67 | 69 | 63 | 25 | 76 | 61 | 74 | m | 79 | | | | | | |
| | 2011 | 36 | 37 | 19 | 31 | 75 | 69 | 49 | **50** | 72 | 75 | 57 | 29 | 81 | 71 | 49 | 75 | 75 | 65 | 64 | 22 | 78 | 54 | 67 | 74 | 64 | | | | | | |
| | 2007 | 65 | 44 | 31 | 48 | 90 | 75 | 66 | **59** | 79 | 85 | 66 | 44 | 82 | 78 | m | 82 | 69 | 69 | m | 24 | 75 | 56 | 63 | 62 | m | | | | | | |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905873

## 79. Teacher participation in professional development on pedagogy or instruction

### Why it matters

While good teachers must master the content that they teach, their effectiveness as teachers also comes from their pedagogical knowledge, and in particular the breadth of their pedagogical portfolio. This breadth allows them to personalise their instruction, and make teaching and learning more varied and interesting for students, and change strategy if one does not work with some student groups.

## Mathematics

### Primary education

**Change at the OECD level: moderate-low**

Negative changes marginally outweigh positive ones, leading to an average net decrease of 1 percentage point in this practice between 2007 and 2015. At the OECD level, the absolute change was 11 percentage points, corresponding to a moderate-low effect size of 0.25. The extent of teachers' participation in this varied a lot among OECD countries: in 2015, the proportion of students whose teachers had participated in recent times ranged from 6% in Turkey to 81% in Ontario (Canada), with an OECD mean at 43%.

**Countries where there has been the most change**

Innovation has materialised in both large increases and reductions in this professional development practice. It has been substantially increased in Poland (38 percentage points), Quebec (Canada) (24 percentage points) and Austria (23 percentage points), whereas it has decreased by more than 20 percentage points in the Slovak Republic, Hungary and the Russian Federation.

### Secondary education

**Change at the OECD level: moderate-low**

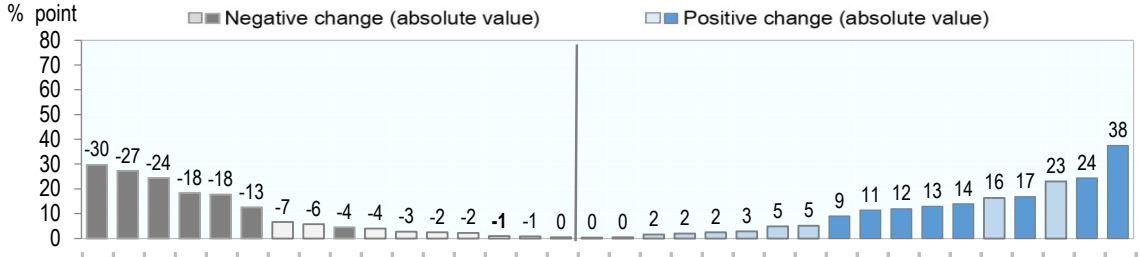
On average, this teacher practice saw a small net decline of 3 percentage points across the OECD area. Positive and negative changes together led to an absolute change of 12 percentage points, corresponding to a moderate-low effect size of 0.25. In 2015, slightly more than half of the 8th grade students in OECD countries were instructed by mathematics teachers having participated in this professional development in recent times, ranging from 79% in Ontario (Canada) to 24% in Norway.

**Countries where there has been the most change**

Turkey, Indonesia, Lithuania, Hungary, Quebec (Canada) and Norway experienced large reductions of over 15 percentage points in the share of students with teachers having recently participated in this pedagogy-focused professional development practice. Conversely, the practice has increased notably in Sweden and Korea (with a spread of students touched above 10 percentage points).

**Figure 13.5. 4th grade maths teacher participation in programmes on pedagogy**

Change in and share of students whose teachers have participated in professional development on pedagogy/instruction in the last two years, 2007-2015, teachers report



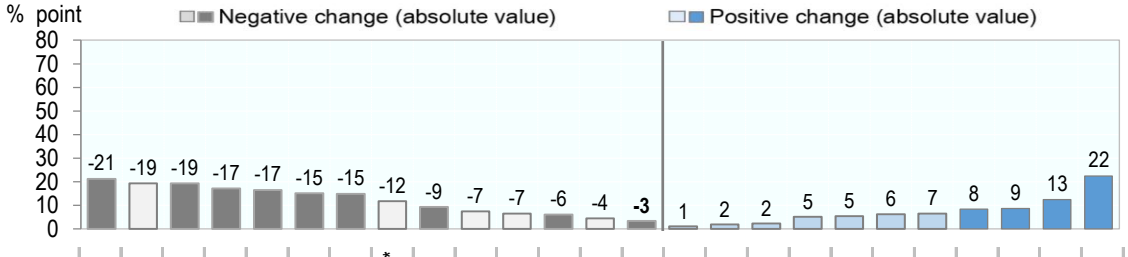

| | | Slovak Republic | Hungary | Russian Federation | Slovenia | Portugal* | Norway | Lithuania | New Zealand | Turkey* | Czech Republic | Germany | Finland* | England (UK) | **OECD average** | Northern Ireland (UK)* | Korea* | Denmark | Hong Kong, China | Australia | Chile* | Italy | Japan | Ireland* | Belgium (Fl.)* | Spain* | Singapore | United States | Netherlands | Ontario (CAN) | Alberta (CAN)* | Sweden | Austria* | Quebec (CAN) | Poland* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 11 | 20 | 43 | 17 | 37 | 17 | 15 | 70 | 6 | 31 | 34 | 17 | 68 | **43** | 63 | 40 | 23 | 82 | 62 | 33 | 28 | 57 | 37 | 16 | 34 | 81 | 62 | 28 | 81 | m | 58 | m | 63 | 69 |
| | 2011 | 20 | 45 | 59 | 23 | 54 | 30 | 31 | 67 | 11 | 26 | 43 | 19 | 72 | **46** | 64 | 40 | 33 | 81 | 65 | 31 | 38 | 59 | 32 | 11 | 25 | 82 | 54 | 27 | 60 | 70 | 60 | 55 | 55 | 31 |
| | 2007 | 41 | 47 | 67 | 35 | m | 30 | 21 | 76 | m | 35 | 36 | m | 70 | **44** | m | m | 23 | 82 | 61 | m | 25 | 54 | m | m | m | 70 | 50 | 15 | 67 | 54 | 41 | 32 | 39 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905892

**Figure 13.6. 8th grade maths teacher participation in programmes on pedagogy**

Change in and share of students whose teachers have participated in professional development on pedagogy/instruction in the last two years, 2007-2015, teachers report




| | | Turkey | Indonesia* | Lithuania | Hungary | Quebec (CAN) | Norway | England (UK) | Massachusetts (USA)* | Japan | Slovenia | Hong Kong, China | United States | Chile* | **OECD average** | Singapore | Minnesota (USA)* | New Zealand* | Ontario (CAN) | Australia | Italy | Russian Federation | Israel | South Africa* | Korea | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 27 | m | 61 | 36 | 58 | 24 | 65 | m | 68 | 57 | 64 | 70 | 41 | **57** | 90 | m | 63 | 79 | 66 | 40 | 80 | 71 | 58 | 63 | 70 |
| | 2011 | 41 | 50 | 60 | 67 | 46 | 27 | 73 | 80 | 70 | 59 | 67 | 73 | 46 | **59** | 79 | 77 | 60 | 71 | 65 | 45 | 69 | 77 | 50 | 61 | 46 |
| | 2007 | 48 | 69 | 81 | 53 | 74 | 39 | 80 | 91 | 78 | 65 | 71 | 76 | m | **60** | 88 | 75 | m | 73 | 61 | 34 | 73 | 63 | m | 50 | 48 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905911

## Science

### Primary education

**Change at the OECD level: moderate**

Across the OECD area, there was an average net decrease of 4 percentage points in the share of students instructed by teachers who were trained in science pedagogy. The absolute change amounted to 11 percentage points, corresponding to a moderate effect size of 0.26. In 2015, teachers who received training in science pedagogy across OECD education systems taught 20% of 4th grade students, with a span ranging from 49% in Poland to 3% in the Netherlands. (The share was 78% in Singapore).

**Countries where there has been the most change**

Between 2007 and 2015, the share of 4th grade students instructed by teachers recently trained in science pedagogy decreased by 42 percentage points in Slovenia. During the same period, the Slovak Republic also experienced a remarkable decrease of 35 percentage points. On the other hand, teachers recently trained in pedagogy in Poland taught 30 students more in hundred between 2011 and 2015.

### Secondary education

**Change at the OECD level: moderate-low**

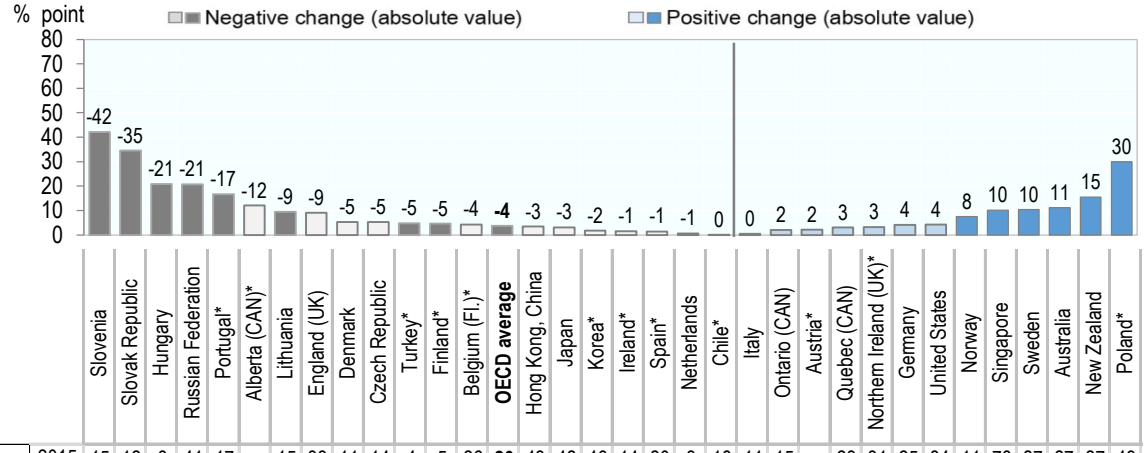
At the OECD level, increases and reductions in this teacher professional development practice let do a negative net average change of 3 percentage points. Counting changes in both directions, the absolute change amounted to 11 percentage points, corresponding to a moderate-low effect size of 0.24. While one in two secondary students is taught by a teacher that was recently trained in science pedagogy, this practice is disparate across OECD systems. In Japan, 75% of students have such teachers, against only 10% in Norway.

**Countries where there has been the most change**

Innovation more often took the form of less students taught by teachers trained in pedagogy than more. Turkey experienced the largest decrease with a drop of students taught by students with a formal training in science pedagogy by 42 percentage points between 2007 and 2015. Indonesia and Norway registered reductions of over 15 percentage points. On the contrary, a few countries experienced noticeable expansion of this teacher practice, especially Korea, Slovenia and South Africa, with increases above 15 percentage points.

**Figure 13.7. 4th grade science teacher participation in programmes on pedagogy**

Change in and share of students whose teachers have participated in professional development on pedagogy/instruction in the last two years, 2007-2015, teachers report



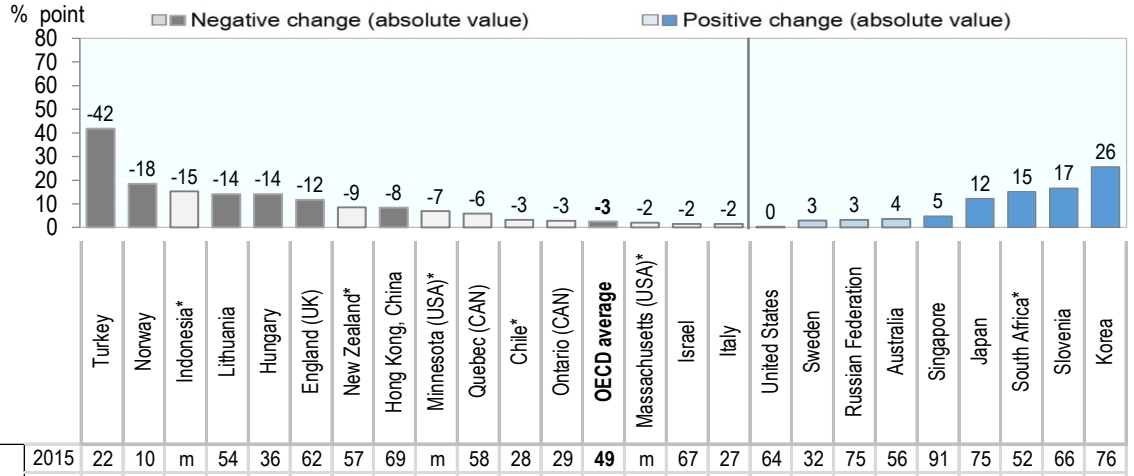

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 15 | 12 | 8 | 41 | 17 | m | 15 | 33 | 11 | 14 | 4 | 5 | 26 | **20** | 43 | 42 | 46 | 14 | 20 | 3 | 18 | 11 | 15 | m | 23 | 31 | 25 | 34 | 11 | 78 | 27 | 27 | 27 | 49 |
| | 2011 | 31 | 18 | 26 | 49 | 34 | 20 | 27 | 42 | 17 | 10 | 9 | 10 | 30 | **21** | 45 | 42 | 48 | 16 | 22 | 4 | 18 | 21 | 9 | 26 | 23 | 28 | 24 | 28 | 9 | 77 | 14 | 32 | 14 | 19 |
| | 2007 | 57 | 47 | 29 | 62 | m | 32 | 25 | 42 | 17 | 19 | m | m | m | **24** | 47 | 45 | m | m | m | 4 | m | 10 | 12 | 24 | 20 | m | 21 | 29 | 4 | 68 | 16 | 16 | 12 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905930

**Figure 13.8. 8th grade science teacher participation in programmes on pedagogy**

Change in and share of students whose teachers have participated in professional development on pedagogy/instruction in the last two years, 2007-2015, teachers report




| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 22 | 10 | m | 54 | 36 | 62 | 57 | 69 | m | 58 | 28 | 29 | **49** | m | 67 | 27 | 64 | 32 | 75 | 56 | 91 | 75 | 52 | 66 | 76 |
| | 2011 | 40 | 18 | 51 | 51 | 51 | 74 | 65 | 64 | 70 | 49 | 31 | 29 | **52** | 74 | 77 | 35 | 67 | 23 | 74 | 47 | 88 | 72 | 37 | 74 | 66 |
| | 2007 | 64 | 29 | 66 | 68 | 50 | 73 | m | 78 | 77 | 64 | m | 32 | **51** | 76 | 68 | 28 | 64 | 29 | 72 | 53 | 86 | 63 | m | 49 | 50 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905949

## 80. Teacher participation in professional development on curriculum

### Why it matters

Depending on the countries, teachers contribute or not to their school curriculum. In most countries, and regardless of their involvement in school curriculum or not, they have a pre-set curriculum that they have to deliver and that change regularly. Professional development about curriculum helps them keep a good mastery of the curriculum content and of its evolutions.

## Mathematics

### Primary education

**Change at the OECD level: moderate-low**

Decreases in professional development on curriculum have prevailed over increases. Between 2007 and 2015, OECD systems experienced a net decline of the share of 4th grade students with teachers participating in maths curriculum professional development by 4 percentage points. Ignoring the direction of country-level variations, the absolute change amounted to 9 percentage points on average, corresponding to an effect size of 0.22. In 2015, teachers who had participated in training on maths curriculum during the last two years instructed 34% of 4th grade students on average.

**Countries where there has been the most change**

Poland and Austria saw noticeable increases in this teacher practice, above 20 percentage points (between 2011 and 2015, and 2007 and 2011, respectively). Conversely, this practice was significantly reduced in the Slovak Republic (20 percentage points), Ontario (Canada) (19 percentage points) and Hong Kong, China (17 percentage points) between 2007 and 2015.

### Secondary education

**Change at the OECD level: moderate**

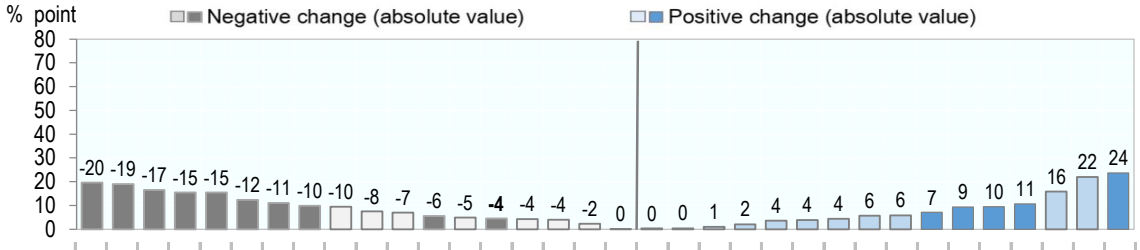
In most OECD countries, less 8th grade teachers have participated in training programmes on mathematics curriculum. On average, the percentage of 8th grade students taught by teachers who recently received science curriculum training decreased by 11 percentage points between 2007 and 2015. The absolute change amounted to 16 percentage points, corresponding to a moderate effect size of 0.35. Across the OECD area, on average 42% of 8th grade students had teachers who engaged in this practice in 2015, ranging from 84% in the United States to 11% in Norway.

**Countries where there has been the most change**

Quebec (Canada) recorded the largest innovation in this area, with the share of concerned students going down from 78% in 2007 to 26% in 2015. Decreases of 44 percentage and 32 percentage points in Turkey and Norway reveal similar declines.

### Figure 13.9. 4th grade maths teacher participation in programmes on curriculum

Change in and share of students whose teachers have participated in professional development on curriculum in the last two years, 2007-2015, teachers report



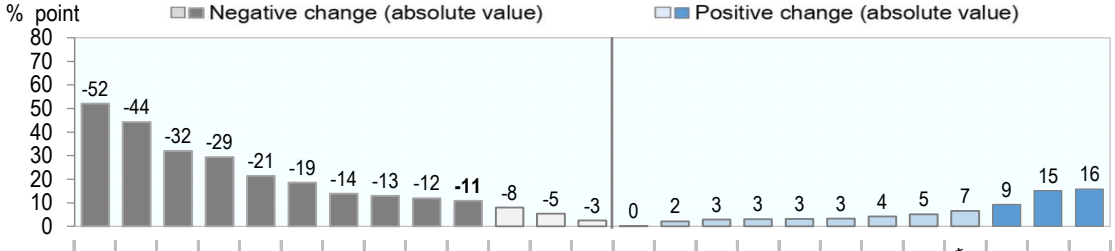

| | | Slovak Republic | Ontario (CAN) | Hong Kong, China | New Zealand | Norway | Portugal* | Czech Republic | Hungary | Quebec (CAN) | Slovenia | Northern Ireland (UK)* | Turkey* | Australia | **OECD average** | Lithuania | Germany | Korea* | Russian Federation | Japan | Finland* | Denmark | Belgium (Fl.)* | Chile* | Ireland* | Spain* | Italy | England (UK) | United States | Netherlands | Singapore | Sweden | Alberta (CAN)* | Austria* | Poland* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 27 | 56 | 53 | 63 | 6 | 49 | 9 | 9 | 31 | 30 | 54 | 6 | 66 | **34** | 14 | 34 | 44 | 68 | 16 | 4 | 10 | 22 | 28 | 38 | 23 | 20 | 72 | 70 | 15 | 60 | 43 | m | m | 72 |
| | 2011 | 45 | 44 | 52 | 68 | 11 | 61 | 8 | 13 | 35 | 45 | 61 | 12 | 63 | **36** | 51 | 33 | 47 | 76 | 23 | 4 | 13 | 20 | 24 | 34 | 19 | 27 | 47 | 67 | 12 | 58 | 58 | 68 | 33 | 49 |
| | 2007 | 46 | 75 | 69 | 78 | 21 | m | 20 | 19 | 41 | 38 | m | m | 71 | **39** | 18 | 38 | m | 68 | 16 | m | 9 | m | m | m | m | 14 | 66 | 63 | 6 | 50 | 33 | 52 | 11 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905968

### Figure 13.10. 8th grade maths teacher participation in programmes on curriculum

Change in and share of students whose teachers have participated in professional development on curriculum in the last two years, 2007-2015, teachers report




| | | Quebec (CAN) | Turkey | Norway | Slovenia | Hong Kong, China | Ontario (CAN) | Lithuania | Hungary | New Zealand* | **OECD average** | Chile* | Indonesia* | Japan | Singapore | Sweden | Korea | Australia | England (UK) | United States | Russian Federation | Minnesota (USA)* | Massachusetts (USA)* | Israel | Italy | South Africa* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 26 | 25 | 11 | 36 | 51 | 57 | 57 | 15 | 61 | **42** | 30 | m | 28 | 65 | 39 | 44 | 71 | 64 | 84 | 78 | m | m | 59 | 30 | 86 |
| | 2011 | 49 | 31 | 14 | 46 | 69 | 52 | 88 | 14 | 73 | **47** | 38 | 71 | 41 | 55 | 50 | 53 | 55 | 62 | 78 | 64 | 85 | 83 | 84 | 29 | 71 |
| | 2007 | 78 | 69 | 43 | 66 | 72 | 76 | 71 | 28 | m | **53** | m | 77 | 30 | 65 | 37 | 41 | 68 | 61 | 80 | 74 | 80 | 76 | 50 | 15 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933905987

## Science

### Primary education

**Change at the OECD level: small**

OECD countries experienced both expansions and contractions in students being taught by teachers who received training in the science curriculum, with a slight net average decline of the practice (2 percentage points). In OECD systems, the absolute change was 9 percentage points, corresponding to a small effect size of 0.2. In the majority of OECD countries covered, only one in five 4th grade students get a teacher who recently received this kind of training. In 2015, almost no student had such a teacher in the Czech Republic (3%) against three in five in Poland.

**Countries where there has been the most change**

This was a bit innovation in Poland, where the practice spread to an additional 35 percentage students between 2011 and 2015, followed by Austria with an increase of 18 percentage points between 2007 and 2011. The Slovak Republic experienced a significant reduction by 18 percentage points between 2007 and 2015, and Portugal, a decrease by 16 percentage points between 2011 and 2015.

### Secondary education

**Change at the OECD level: moderate-high**

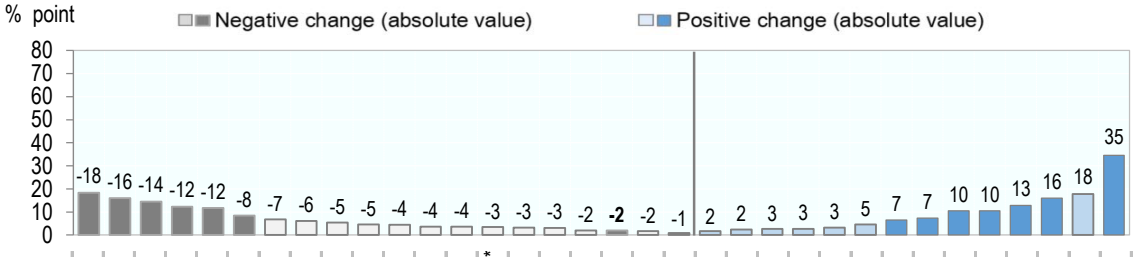
In most countries, 8th grade teacher participated less in science curriculum training than they used to. OECD systems experienced a decline by 9 percentage points on average between 2007 and 2015. The average absolute change of 16 percentage points corresponds to a moderate-high effect size of 0.36. In 2015, there were big variations around the 40% average of students concerned across the OECD area. In the United States, 76% of 8th grade students were instructed by science teachers having recently participated in science curriculum professional development, as opposed to only 5% in Norway.

**Countries where there has been the most change**

The most substantial innovation in this domain took the form of large contractions of this practice. The share of students whose teachers recently participated in training on curriculum decreased by 60 percentage points in Turkey, and by 34 and 23 percentage points respectively in Quebec (Canada) and Norway. At the other end of the spectrum, the practice increased by 23 percentage points in Korea.

**Figure 13.11. 4th grade science teacher participation in programmes on curriculum**

Change in and share of students whose teachers have participated in professional development on curriculum in the last two years, 2007-2015, teachers report.



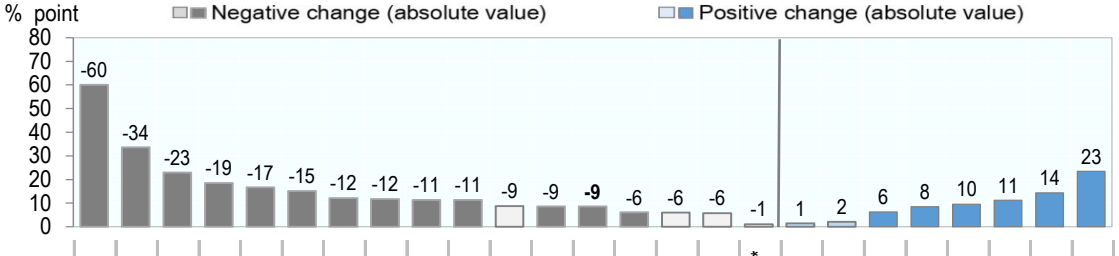

| | | Slovak Republic | Portugal* | Slovenia | Czech Republic | Ontario (CAN) | Hungary | Chile* | Alberta (CAN)* | Norway | Korea* | Ireland* | Germany | Denmark | Northern Ireland (UK)* | Japan | Turkey* | Hong Kong, China | **OECD average** | United States | Quebec (CAN) | Italy | Spain* | Netherlands | Finland* | Belgium (Fl.)* | Russian Federation | Lithuania | New Zealand | Sweden | Singapore | England (UK) | Australia | Austria* | Poland* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 33 | 10 | 29 | 3 | 14 | 4 | 15 | m | 6 | 54 | 20 | 29 | 10 | 25 | 11 | 5 | 36 | **21** | 43 | 14 | 10 | 18 | 5 | 5 | 50 | 66 | 15 | 24 | 30 | 58 | 47 | 40 | m | 61 |
| | 2011 | 41 | 25 | 37 | 9 | 16 | 6 | 22 | 25 | 6 | 59 | 24 | 18 | 13 | 28 | 19 | 8 | 29 | **20** | 39 | 12 | 17 | 15 | 3 | 2 | 47 | 66 | 44 | 16 | 24 | 66 | 27 | 38 | 26 | 26 |
| | 2007 | 51 | m | 43 | 15 | 26 | 13 | m | 31 | 12 | m | m | 32 | 13 | m | 14 | m | 38 | **23** | 45 | 15 | 8 | m | 3 | m | m | 62 | 9 | 17 | 19 | 47 | 35 | 24 | 8 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906006

**Figure 13.12. 8th grade science teacher participation in programmes on curriculum**

Change in and share of students whose teachers have participated in professional development on curriculum in the last two years, 2007-2015, teachers report




| | | Turkey | Quebec (CAN) | Norway | New Zealand* | Ontario (CAN) | Israel | Lithuania | Hong Kong, China | Hungary | Singapore | Minnesota (USA)* | England (UK) | **OECD average** | United States | Chile* | Indonesia* | Massachusetts (USA)* | Sweden | Japan | Slovenia | Russian Federation | Italy | Australia | South Africa* | Korea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 18 | 34 | 5 | 60 | 23 | 57 | 54 | 64 | 18 | 67 | m | 62 | **40** | 76 | 31 | m | m | 37 | 34 | 49 | 79 | 22 | 68 | 81 | 57 |
| | 2011 | 37 | 40 | 13 | 78 | 34 | 76 | 82 | 61 | 14 | 67 | 79 | 64 | **47** | 73 | 37 | 68 | 88 | 47 | 49 | 70 | 72 | 19 | 60 | 67 | 60 |
| | 2007 | 78 | 68 | 28 | m | 40 | 72 | 66 | 75 | 29 | 78 | 88 | 71 | **49** | 82 | m | 73 | 90 | 35 | 32 | 43 | 70 | 13 | 57 | m | 34 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906025

## 81. Teacher participation in a programme to integrate information technology into mathematics and science

### Why it matters

The integration of information technology in pedagogy is still in its infancy, partly because information technology powers pedagogical approaches that can be challenging to teachers. Professional development programmes can help teachers to learn how to use information technology to support experiential learning, hands-on learning, problem-based learning, or just to practice procedural knowledge in mathematics and science – especially if they have a chance to apply this pedagogical knowledge in their classroom.

## Mathematics

### Primary education

**Change at the OECD level: small**

On average, OECD countries experienced a slight net increase of 2 percentage points in this practice. The absolute change amounted to 7 percentage points, corresponding to a small effect size of 0.17. There was thus little innovation overall in this professional development practice. OECD countries differ quite a lot in this domain: in 2015, the proportion of students instructed by maths teachers having recently participated in a training to integrate information technology into maths ranged from 68% in Poland to less than 2% in Germany, with an average at 27%.

**Countries where there has been the most change**

Poland experienced the largest innovation in this domain, with a 35-percentage point increase of the practice between 2011 and 2015. Teachers in Quebec (Canada) and Hong Kong, China also received more maths-related ICT training, with increases over 20 percentage points between 2007 and 2015. Conversely, the Slovak Republic and Northern Ireland experienced declines in this practice over 15 percentage points.

### Secondary education

**Change at the OECD level: moderate-low**

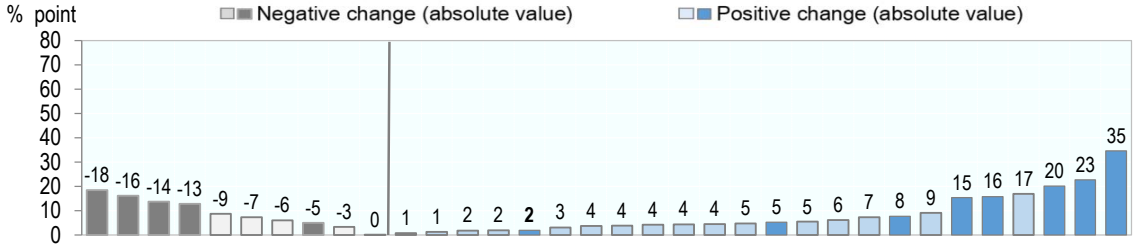
Between 2007 and 2015, the share of 8th grade students instructed by teachers having participated in a training to integrate ICT to their maths teaching increased by 7 percentage points on average in OECD countries. The absolute change was 11 percentage points, corresponding to a moderate effect size of 0.24. In 2015, this practice remained modest across OECD education systems covered, albeit more common than in primary education. In 2015, on average almost one in two students had a teacher that received such training, ranging from 18% in Sweden to 70% in Quebec (Canada).

**Countries where there has been the most change**

Quebec (Canada) and Israel saw a substantial spread of this practice. The share of secondary students taught by a maths teacher who got an ICT integration training increased by 43 and 32 percentage points respectively between 2007 and 2015. A very significant change. By contrast, England experienced a substantial decline by 21 percentage points between 2007 and 2015, as well as Chile between 2011 and 2015.

**Figure 13.13. 4th grade teacher participation in programmes to integrate IT into maths**

Change in and share of students whose teachers have participated in professional development aiming to integrate information technology into maths, in the last two years, 2007-2015, teachers report



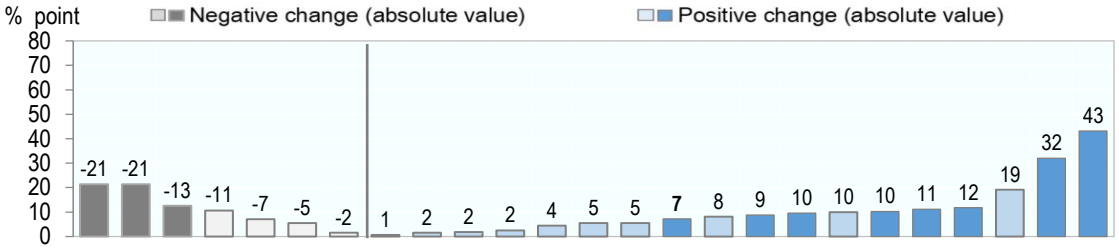

| | | Slovak Republic | Northern Ireland (UK)* | England (UK) | Portugal* | Chile* | Italy | Spain* | Germany | Turkey* | Netherlands | Australia | Denmark | Finland* | United States | **OECD average** | Ireland* | Hungary | Belgium (Fl.)* | Norway | Lithuania | Slovenia | Japan | Sweden | Korea* | Czech Republic | Ontario (CAN) | Singapore | Austria* | New Zealand | Russian Federation | Alberta (CAN)* | Hong Kong, China | Quebec (CAN) | Poland* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 37 | 40 | 30 | 23 | 27 | 26 | 34 | 2 | 9 | 18 | 35 | 23 | 11 | 41 | **27** | 34 | 15 | 25 | 15 | 60 | 29 | 23 | 10 | 16 | 40 | 37 | 59 | m | 42 | 67 | m | 70 | 33 | 68 |
| | 2011 | 47 | 56 | 30 | 36 | 36 | 22 | 40 | 5 | 12 | 20 | 52 | 20 | 9 | 49 | **27** | 31 | 22 | 21 | 11 | 66 | 44 | 23 | 10 | 10 | 22 | 23 | 57 | 15 | 35 | 65 | 50 | 57 | 18 | 34 |
| | 2007 | 55 | m | 44 | m | m | 33 | m | 7 | m | 18 | 34 | 21 | m | 39 | **25** | m | 11 | m | 11 | 56 | 25 | 19 | 5 | m | 33 | 30 | 51 | 6 | 26 | 51 | 33 | 50 | 11 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906044

**Figure 13.14. 8th grade teacher participation in programmes to integrate IT into maths**

Change in and share of students whose teachers have participated in professional development aiming to integrate information technology into maths, in the last two years, 2007-2015, teachers report




| | | Chile* | England (UK) | Singapore | Massachusetts (USA)* | Slovenia | Hong Kong, China | Italy | Lithuania | Norway | Korea | Australia | United States | New Zealand* | Hungary | **OECD average** | Indonesia* | Turkey | Sweden | Ontario (CAN) | South Africa* | Japan | Russian Federation | Minnesota (USA)* | Israel | Quebec (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 27 | 41 | 62 | m | 55 | 57 | 41 | 70 | 35 | 33 | 60 | 65 | 58 | 31 | **46** | m | 27 | 18 | 60 | 45 | 38 | 78 | m | 66 | 70 |
| | 2011 | 49 | 48 | 68 | 55 | 67 | 50 | 45 | 63 | 19 | 27 | 69 | 68 | 53 | 46 | **41** | 37 | 29 | 11 | 48 | 35 | 23 | 72 | 76 | 36 | 43 |
| | 2007 | m | 63 | 74 | 65 | 62 | 62 | 43 | 69 | 34 | 31 | 57 | 60 | m | 26 | **39** | 29 | 18 | 8 | 51 | m | 26 | 67 | 57 | 34 | 27 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906063

## Science

### Primary education

**Change at the OECD level: small**

Teachers in OECD countries have both increased and decreased their participation in science-related ICT training, leading to a slightly negative average net change (-1 percentage point) between 2007 and 2015. Increases and decreases combined lead to an absolute change of 4 percentage points, corresponding to a very small effect size of 0.1. This practice has remained very stable at a modest level. In 2015, primary teachers having received training on integrating information technology in their science instruction taught 17% of 4th grade students in OECD systems on average.

**Countries where there has been the most change**

Poland experienced the most innovation in this domain: between 2011 and 2015, the share of students taught by teachers who recently took a training in ICT integration increased by 42 percentage points. Increases in Lithuania, the Russian Federation, the Czech Republic and Quebec (Canada) were also significant. Only a small number of countries saw significant decreases in this domain, especially England with a decrease of 12 percentage points.

### Secondary education

**Change at the OECD level: moderate-low**

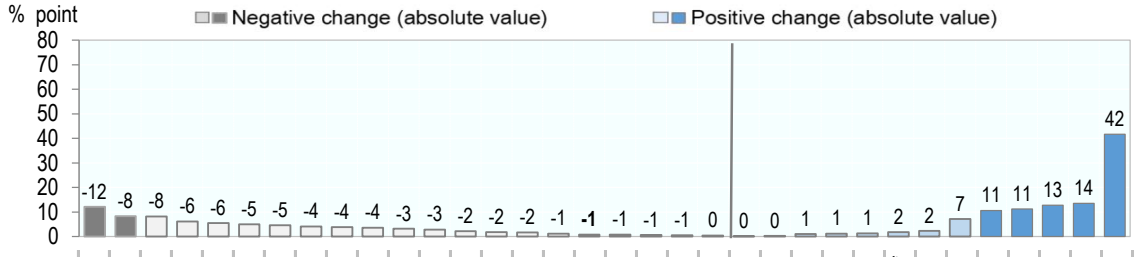
Both increases and reductions in this practice took place across OECD systems, leading to a positive net change of 4 percentage points. Regardless of the direction, the absolute change was 10 percentage points on average, corresponding to a moderate-low effect size of 0.23. In 2015, there were large differences in the use of this practice across the OECD area, although training on how to integrate ICT in science education is fairly common. Recently trained teachers on ICT integration taught on average 42% of secondary students in science, but with a range going from 65% in Slovenia to only 4% in Norway.

**Countries where there has been the most change**

Slovenia and Quebec (Canada) experienced the largest innovation in this teacher practice, with increases of 22 and 19 percentage points respectively. Increases also exceeded 15 percentage points in Indonesia, Sweden and Korea. Innovation in the other direction was notable in Chile, with a fall of the share of students taught by trained teachers by 18 percentage points between 2011 and 2015. Norway and England experienced decreases over 10 percentage points between 2007 and 2015.

**Figure 13.15. 4th grade teacher participation in programmes to integrate IT into science**

Change in and share of students whose teachers have participated in professional development aiming to integrate information technology into science, in the last two years, 2007-2015, teachers report



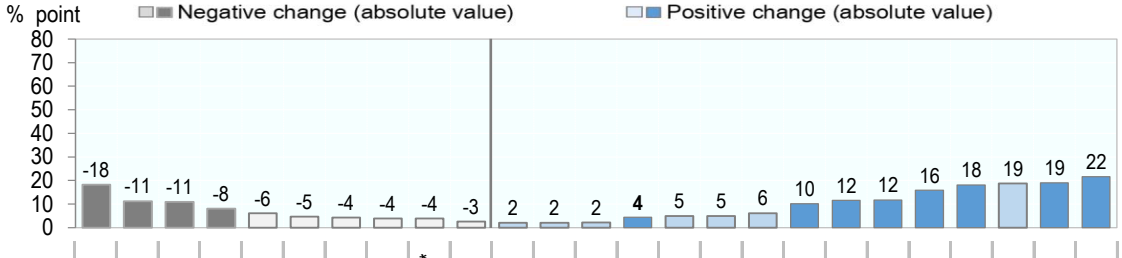

| | | England (UK) | Portugal* | Chile* | Slovak Republic | Alberta (CAN)* | Spain* | Ireland* | Italy | Australia | Hungary | Austria* | Japan | Netherlands | Norway | Slovenia | Singapore | **OECD average** | Hong Kong, China | Turkey* | Germany | Belgium (Fl.)* | United States | Ontario (CAN) | Sweden | New Zealand | Denmark | Northern Ireland (UK)* | Finland* | Korea* | Quebec (CAN) | Czech Republic | Russian Federation | Lithuania | Poland* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 16 | 12 | 15 | 39 | m | 35 | 12 | 13 | 16 | 10 | m | 21 | 5 | 3 | 28 | 50 | **17** | 44 | 9 | 6 | 29 | 28 | 19 | 6 | 20 | 7 | 24 | 7 | 30 | 22 | 28 | 60 | 49 | 67 |
| | 2011 | 23 | 20 | 23 | 43 | 30 | 40 | 17 | 10 | 26 | 20 | 10 | 18 | 9 | 5 | 36 | 59 | **17** | 44 | 9 | 6 | 30 | 27 | 11 | 4 | 14 | 10 | 22 | 5 | 23 | 16 | 15 | 56 | 52 | 25 |
| | 2007 | 28 | m | m | 45 | 35 | m | m | 17 | 20 | 14 | 13 | 23 | 7 | 4 | 29 | 52 | **18** | 45 | m | 7 | m | 28 | 19 | 5 | 18 | 6 | m | m | m | 11 | 17 | 48 | 35 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906082

**Figure 13.16. 8th grade teacher participation in programmes to integrate IT into science**

Change in and share of students whose teachers have participated in professional development aiming to integrate information technology into science, in the last two years, 2007-2015, teachers report




| | | Chile* | Norway | England (UK) | United States | Turkey | Hong Kong, China | Lithuania | Australia | Massachusetts (USA)* | Singapore | Ontario (CAN) | Minnesota (USA)* | Hungary | **OECD average** | New Zealand* | Israel | Japan | Russian Federation | South Africa* | Italy | Korea | Sweden | Indonesia* | Quebec (CAN) | Slovenia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 29 | 4 | 34 | 62 | 22 | 52 | 64 | 53 | m | 67 | 38 | m | 37 | **42** | 58 | 63 | 37 | 77 | 50 | 37 | 47 | 28 | m | 61 | 65 |
| | 2011 | 47 | 6 | 35 | 70 | 35 | 40 | 64 | 63 | 68 | 70 | 36 | 67 | 39 | **39** | 53 | 52 | 33 | 74 | 39 | 28 | 29 | 10 | 45 | 39 | 74 |
| | 2007 | m | 15 | 45 | 70 | 28 | 56 | 69 | 57 | 72 | 70 | 36 | 65 | 35 | **38** | m | 58 | 31 | 67 | m | 25 | 31 | 10 | 27 | 42 | 43 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906101

## 82. Teacher participation in a programme for improving students' critical thinking or problem-solving skills

### Why it matters

Fostering students' critical thinking and problem-solving skills is one of the key education objectives of curricula in most OECD countries, and a key competency for students both for economic and social reasons. One condition for these innovation skills or "21st century" competencies to be taught and learnt is that teachers understand how they could adjust their practice to this effect. Professional development is one of the ways for them to learn this.

## Mathematics

### Primary education

**Change at the OECD level: small**

OECD countries experienced both expansions and contractions of this practice, although on average it has expanded by 4 percentage points. Positive and negative trends together resulted in an 8-percentage point absolute change, corresponding to a small effect size of 0.18. In Ontario (Canada), teacher training around critical thinking and problem solving were very common in 2015, with over 80% of 4th grade students being instructed by teachers having recently had training in developing students' critical thinking or problem solving skills. By contrast, such teachers taught only one in ten students in Denmark.

**Countries where there has been the most change**

Innovation in Sweden and Ontario (Canada) took the form of a scale up of this teacher practice with an increased coverage of concerned students in the system by 29 and 28 percentage points respectively. Similarly, Slovenia and the United States experiences increases of over 10 percentage points.

### Secondary education

**Change at the OECD level: small**

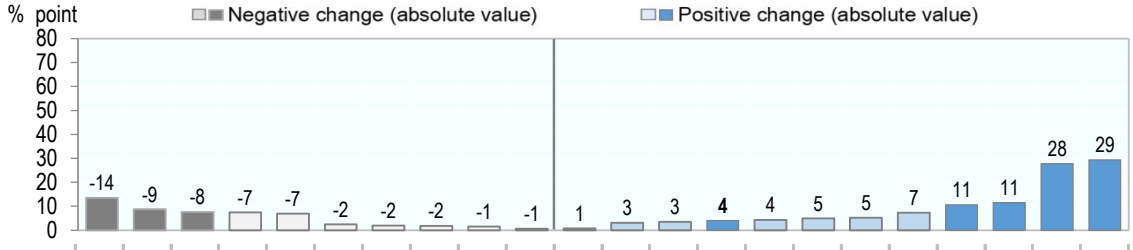
OECD countries experienced both expansions and contractions in this practice, leading to a slightly positive average net change of 2 percentage points. The absolute change in this practice was 8 percentage points, corresponding to a small effect size of 0.19. Like in primary education, Ontario (Canada) stood out with 81% of 8th grade students with teachers recently trained on teaching critical thinking and problem solving in 2015. The scenario is quite different in other countries. In Norway for instance, teacher participation in this kind of professional development concerned only 12% of the students.

**Countries where there has been the most change**

Sweden experienced the most innovation with an increase by 24 percentage points of students taught by a teacher recently trained on fostering critical thinking and problem solving between 2007 and 2015. A similar trend is observed in Italy, Ontario (Canada) and Korea with increases above 10 percentage points. The Russian Federation, Hong Kong, China, Massachusetts (United States) and Hungary experienced significant contractions of the practice, exceeding 15 percentage points in all cases.

**Figure 13.17. 4th grade maths teacher participation in programmes for improving students' critical thinking or problem-solving skills**

Change in and share of students whose teachers participated in professional development for improving students' critical thinking or problem-solving skills in the last two years, 2007-2015, teachers report



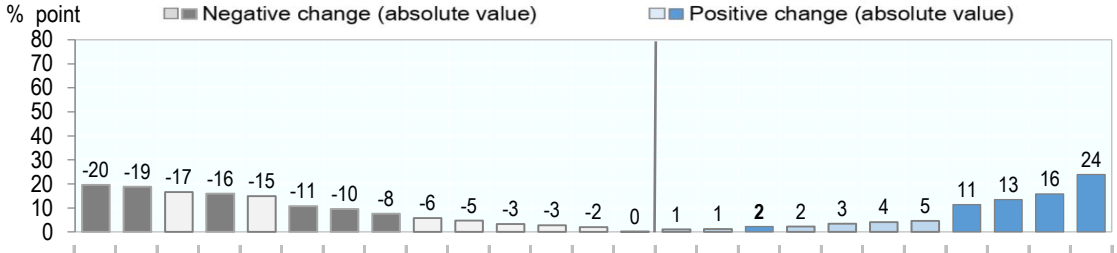

| | | Slovak Republic | Hungary | Singapore | Russian Federation | England (UK) | Czech Republic | Norway | Italy | Australia | Hong Kong, China | Denmark | Lithuania | Netherlands | **OECD average** | Germany | Japan | New Zealand | Quebec (CAN) | United States | Slovenia | Ontario (CAN) | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 17 | 17 | 58 | 51 | 52 | 29 | 16 | 20 | 50 | 71 | 10 | 53 | 23 | **36** | 32 | 32 | 59 | 38 | 62 | 29 | 81 | 50 |
| | 2007 | 30 | 26 | 65 | 58 | 59 | 31 | 18 | 22 | 51 | 72 | 9 | 50 | 19 | **32** | 28 | 27 | 54 | 31 | 51 | 17 | 53 | 20 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906120

**Figure 13.18. 8th grade maths teacher participation in programmes for improving students' critical thinking or problem-solving skills**

Change in and share of students whose teachers participated in professional development for improving students' critical thinking or problem-solving skills in the last two years, 2007-2015, teachers report




| | | Russian Federation | Hong Kong, China | Massachusetts (USA)* | Hungary | Minnesota (USA)* | Japan | New Zealand* | Singapore | Norway | Quebec (CAN) | Chile* | United States | Israel | Slovenia | Lithuania | Indonesia* | **OECD average** | Turkey | England (UK) | Australia | South Africa* | Korea | Ontario (CAN) | Italy | Sweden |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 42 | 41 | m | 18 | m | 29 | 37 | 55 | 12 | 30 | 30 | 62 | 43 | 36 | 53 | m | **39** | 26 | 43 | 49 | 56 | 34 | 81 | 25 | 52 |
| | 2011 | 43 | 48 | 49 | 38 | 47 | 32 | 47 | 48 | 15 | 17 | 33 | 61 | 43 | 35 | 37 | 58 | **37** | 31 | 53 | 48 | 51 | 32 | 70 | 13 | 24 |
| | 2007 | 61 | 60 | 66 | 34 | 62 | 40 | m | 63 | 18 | 35 | m | 65 | 45 | 37 | 52 | 57 | **36** | 24 | 39 | 45 | m | 23 | 67 | 9 | 28 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906139

## Science

### Primary education

**Change at the OECD level: small**

At the OECD level, the average net change was negative albeit very small (1 percentage point). With an absolute change of 4 percentage points and a small effect size of 0.11, this professional development practice experienced little change. We observe low to moderate levels of teacher participation across OECD countries: in 2015 levels ranged from 47% of the 4th grade students in Lithuania with science teachers having recently engaged in such a programme as opposed to 6% in Norway.

**Countries where there has been the most change**

Very few countries saw significant changes in this professional development practice. We can highlight decreases above 10 percentage points in Hungary and New Zealand. On the other hand, the only positive change above 10 percentage points was witnessed by Ontario (Canada).

### Secondary education

**Change at the OECD level: small**

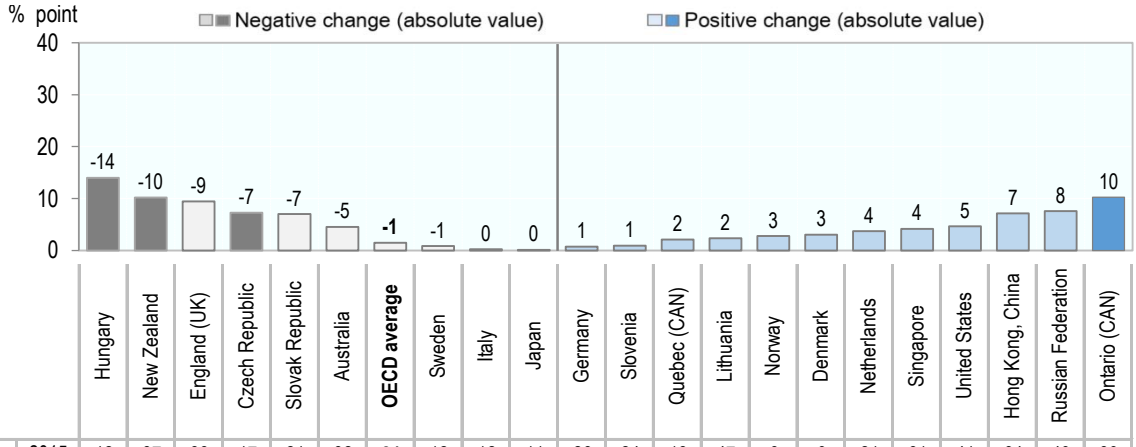
While positive and negative changes have nullified each other across OECD countries surveyed, there has been an average absolute change of 7 percentage points in the share of 8th grade students with science teachers participating in this kind of professional development. This corresponds to an effect size of 0.16, which is quite small. At the OECD level, an average of 34% of the 8th grade students were instructed by science teachers having attended in recent times a programme aiming to develop students' creative and critical thinking skills.

**Countries where there has been the most change**

The biggest change was recorded in Hong Kong, China with a fall of 22 percentage points. Hungary also saw a notable negative change, of 16 percentage points. This is sharply contrasted by Slovenia which recorded an increase of 13 percentage points between 2007 and 2015.

**Figure 13.19. 4th grade science teacher participation in programmes for improving students' critical thinking or problem-solving skills**

Change in and share of students whose teachers participated in professional development for improving students' critical thinking or problem-solving skills in the last two years, 2007-2015, teachers report



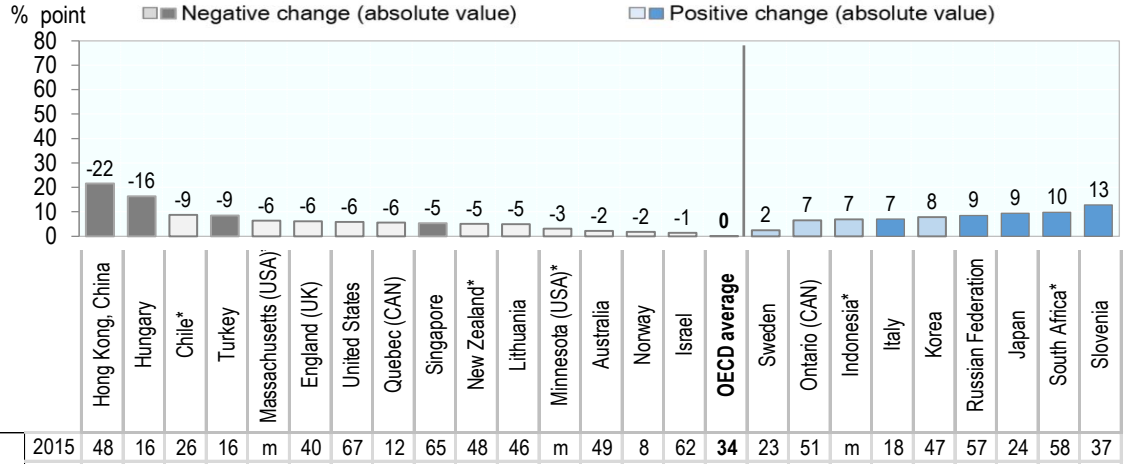

| | | Hungary | New Zealand | England (UK) | Czech Republic | Slovak Republic | Australia | **OECD average** | Sweden | Italy | Japan | Germany | Slovenia | Quebec (CAN) | Lithuania | Norway | Denmark | Netherlands | Singapore | United States | Hong Kong, China | Russian Federation | Ontario (CAN) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 12 | 37 | 33 | 17 | 21 | 32 | **21** | 12 | 12 | 11 | 26 | 24 | 13 | 47 | 6 | 9 | 21 | 61 | 41 | 64 | 49 | 39 |
| | 2007 | 26 | 47 | 42 | 24 | 28 | 36 | **23** | 13 | 12 | 11 | 25 | 23 | 11 | 44 | 3 | 6 | 17 | 57 | 36 | 56 | 41 | 29 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906158

**Figure 13.20. 8th grade science teacher participation in programmes for improving students' critical thinking or problem-solving skills**

Change in and share of students whose teachers participated in professional development for improving students' critical thinking or problem-solving skills in the last two years, 2007-2015, teachers report




| | | Hong Kong, China | Hungary | Chile* | Turkey | Massachusetts (USA) | England (UK) | United States | Quebec (CAN) | Singapore | New Zealand* | Lithuania | Minnesota (USA)* | Australia | Norway | Israel | **OECD average** | Sweden | Ontario (CAN) | Indonesia* | Italy | Korea | Russian Federation | Japan | South Africa* | Slovenia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 48 | 16 | 26 | 16 | m | 40 | 67 | 12 | 65 | 48 | 46 | m | 49 | 8 | 62 | **34** | 23 | 51 | m | 18 | 47 | 57 | 24 | 58 | 37 |
| | 2011 | 47 | 16 | 34 | 38 | 62 | 37 | 70 | 11 | 74 | 53 | 36 | 64 | 52 | 10 | 55 | **34** | 13 | 62 | 61 | 13 | 46 | 47 | 20 | 48 | 28 |
| | 2007 | 69 | 33 | m | 25 | 69 | 46 | 73 | 17 | 71 | m | 51 | 67 | 51 | 9 | 64 | **34** | 21 | 45 | 54 | 10 | 39 | 49 | 15 | m | 24 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906177

## 83. Teacher participation in professional development on mathematics and science assessments

### Why it matters

Assessment is an integral part of pedagogy. It should give students feedback on their learning, on their knowledge and skill gaps, and encourage them to learn more. Too often, assessment is perceived as a mere sorting tool ascribing students to different ability groups. It can create anxiety and become unhelpful. Professional development on how to assess and use assessment is thus helpful to help teachers improve their assessment practices and develop a healthy assessment culture.

## Mathematics

### Primary education

**Change at the OECD level: moderate-low**

OECD countries have experienced both increases and decreases in their primary teachers' participation in training on maths assessment, leading to a slight average decrease of 1 percentage point of this practice between 2007 and 2015. Taking variations in all directions into account, the absolute change was 9 percentage points, corresponding to a moderate-low effect size of 0.22. In 2015, teachers having recently been trained on maths-related assessment taught 30% of 4th grade student on average in an OECD system.

**Countries where there has been the most change**

This was a big innovation Sweden where the practice spread by over 20 percentage points between 2007 and 2015, as well as in Austria and Alberta (Canada) between 2007 and 2011. At the other end of the spectrum, a substantial decrease of 25 percentage points was recorded in Slovenia between 2007 and 2015. Decreases of a similar magnitude were also registered in Finland and Belgium (Fl.) between 2011 and 2015.

### Secondary education

**Change at the OECD level: moderate**

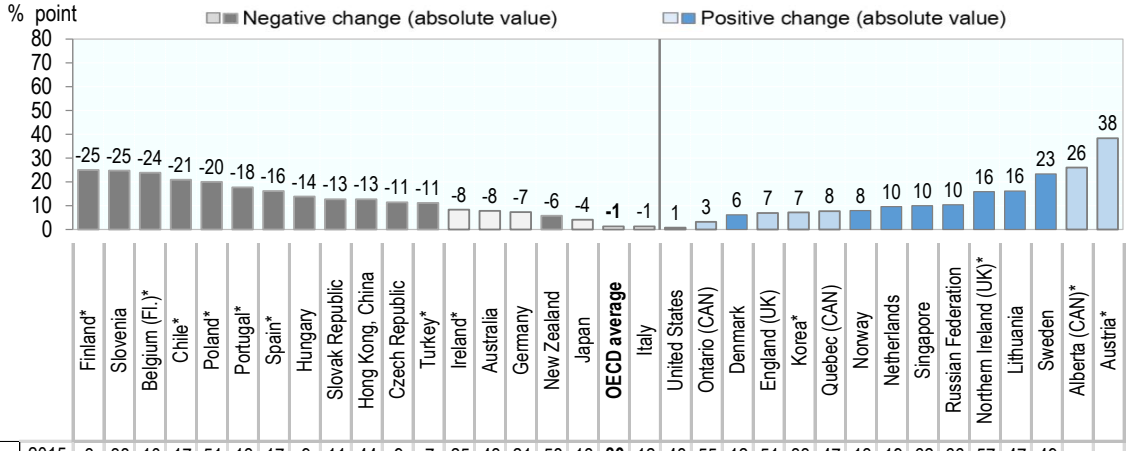
Mathematics teachers in the 8th grade across OECD education systems covered have more often reduced than increased their participation in assessment training, leading to an average net decrease of 8 percentage points. The absolute change accounted to 13 percentage points, with a moderate effect size of 0.26. In 2015, maths teachers having recently been trained on assessment taught 38% of 8th grade student on average in an OECD system.

**Countries where there has been the most change**

Innovation mostly took the shape of large reductions in assessment training. Quebec (Canada) experienced a substantial decline of 38 percentage points in the share of secondary students taught by teachers recently trained on assessment. In Slovenia, this shared dropped by 32 percentage points. Japan, England and Hong Kong, China also experienced a scale down of this practice. Increases were generally of a small magnitude. Only Korea saw an increase above 10 percentage points.

**Figure 13.21. 4th grade maths teacher participation in programmes on assessment**

Change in and share of students whose teachers participated in professional development on assessment in the last two years, 2007-2015, teachers report



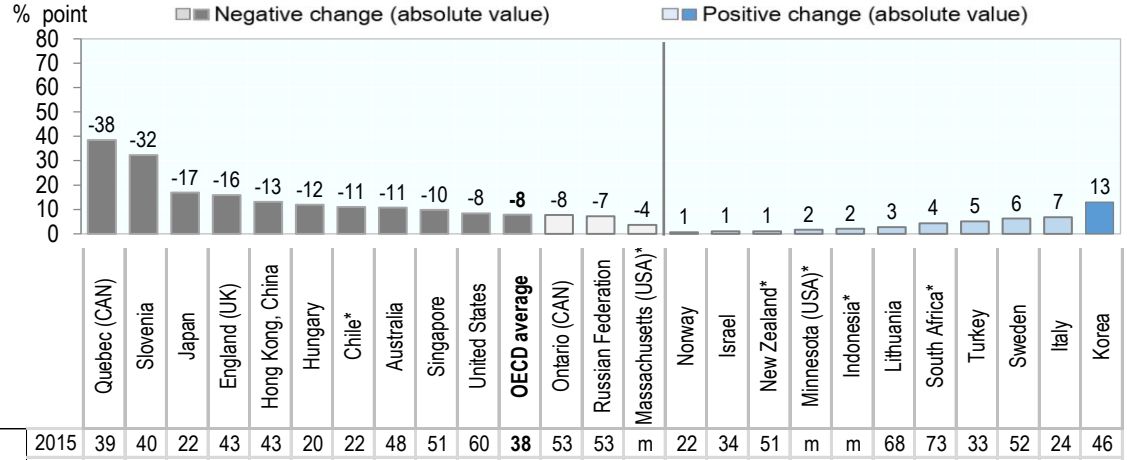

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 3 | 38 | 10 | 17 | 51 | 13 | 17 | 9 | 11 | 44 | 9 | 7 | 25 | 43 | 21 | 58 | 18 | **30** | 12 | 48 | 55 | 12 | 51 | 33 | 47 | 13 | 19 | 62 | 66 | 57 | 47 | 49 | m | m |
| | 2011 | 28 | 53 | 34 | 38 | 71 | 31 | 33 | 37 | 22 | 59 | 25 | 19 | 33 | 54 | 46 | 59 | 49 | **42** | 38 | 72 | 63 | 25 | 52 | 25 | 19 | 22 | 50 | 50 | 52 | 41 | 46 | 33 | 72 | 58 |
| | 2007 | m | 62 | m | m | m | m | m | 23 | 24 | 57 | 21 | m | m | 51 | 28 | 64 | 22 | **32** | 14 | 47 | 51 | 5 | 44 | m | 39 | 5 | 10 | 51 | 55 | m | 30 | 26 | 46 | 20 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906196

**Figure 13.22. 8th grade maths teacher participation in programmes on assessment**

Change in and share of students whose teachers participated in professional development on assessment in the last two years, 2007-2015, teachers report




| | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 39 | 40 | 22 | 43 | 43 | 20 | 22 | 48 | 51 | 60 | **38** | 53 | 53 | m | 22 | 34 | 51 | m | m | 68 | 73 | 33 | 52 | 24 | 46 |
| | 2011 | 62 | 38 | 27 | 51 | 62 | 24 | 33 | 39 | 58 | 61 | **40** | 52 | 46 | 58 | 29 | 40 | 50 | 65 | 71 | 62 | 69 | 26 | 41 | 26 | 46 |
| | 2007 | 78 | 72 | 39 | 58 | 56 | 32 | m | 58 | 61 | 69 | **46** | 61 | 60 | 62 | 21 | 33 | m | 63 | 69 | 65 | m | 27 | 45 | 17 | 33 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906215

## Science

### Primary education

**Change at the OECD level: small**

Overall, 4th grade teachers across OECD education systems received less training on assessment in science in 2015 than they used to in 2007. At the OECD level, the share of 4th grade students whose teachers were recently trained in assessment in science decreased by 4 percentage points on average. Country-level variations resulted in an average absolute change of 6 percentage points, corresponding to a small effect size of 0.18. This practice remained stable overall. In 2015, teachers who took a training in science assessment taught 12% of the students 4th grade students. This is not a common practice. (Only in Singapore and the Russian Federation is it more widespread.)

**Countries where there has been the most change**

In most countries, innovation occurred through big decreases in the use of this practice. Between 2007 and 2015, the share of primary students with a teacher recently trained in science assessment declined by 31 percentage points in Slovenia. A similar trend occurred in Portugal (23 percentage points) and Chile (17 percentage points) between 2011 and 2015. Only a few increases were significant. Between 2007 and 2011, Austria and Alberta (Canada) recorded increases of 19 and 18 percentage points respectively.

### Secondary education

**Change at the OECD level: moderate**

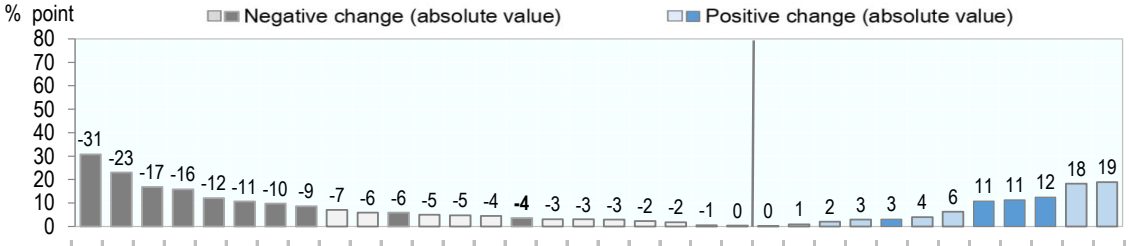
At the secondary level, most countries saw a decrease in this teacher practice. In 2015, 33% of 8th grade students had their science teachers participating in a programme on science assessment, against 43% in 2007. Positive and negative changes taken together lead to an absolute change of 13 percentage points, corresponding to a moderate effect size of 0.27. Science teachers recently trained in assessment teach 33% of secondary students on average in OECD countries. Only in Lithuania (60%) and England (55%) is this share more significant. The practice seems more common in non-OECD systems.

**Countries where there has been the most change**

Innovation mostly took the shape of substantial decreases in this professional development practice. The largest declines occurred in Quebec (Canada) and Slovenia (30 and 26 percentage points respectively). The share of secondary students taught by teachers with a recent training on assessment also decreased noticeably in Israel, Turkey and Hong Kong, China. Where the practice increased, this was by a small magnitude. Korea is the only country that experienced an increase above 10 percentage points.

**Figure 13.23. 4th grade science teacher participation in programmes on assessment**

Change in and share of students whose teachers participated in professional development on assessment in the last two years, 2007-2015, teachers report



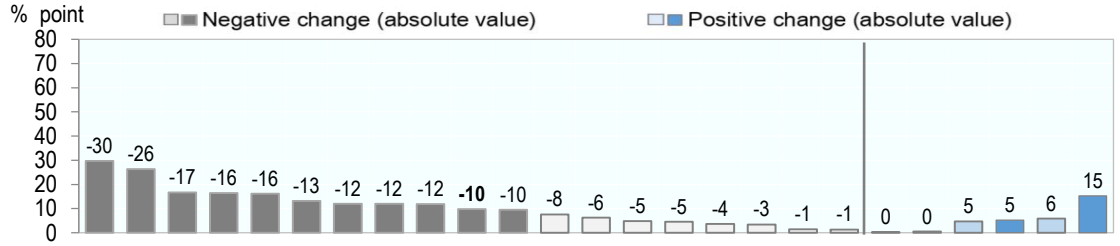

| | | Slovenia | Portugal* | Chile* | Slovak Republic | Finland* | Poland* | Spain* | Czech Republic | England (UK) | Hong Kong, China | Ireland* | Northern Ireland (UK)* | Turkey* | Japan | **OECD average** | Netherlands | Hungary | Germany | United States | Italy | Ontario (CAN) | Belgium (Fl.)* | New Zealand | Australia | Quebec (CAN) | Denmark | Norway | Lithuania | Korea* | Russian Federation | Sweden | Singapore | Alberta (CAN)* | Austria* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 26 | 6 | 17 | 10 | 2 | 35 | 15 | 4 | 29 | 25 | 7 | 7 | 10 | 10 | **12** | 2 | 4 | 12 | 22 | 5 | 10 | 15 | 11 | 16 | 12 | 7 | 4 | 28 | 30 | 63 | 21 | 65 | m | m |
| | 2011 | 39 | 29 | 34 | 18 | 14 | 45 | 24 | 24 | 30 | 55 | 12 | 12 | 14 | 25 | **24** | 30 | 28 | 22 | 44 | 25 | 38 | 16 | 20 | 20 | 9 | 17 | 8 | 37 | 24 | 44 | 8 | 45 | 49 | 23 |
| | 2007 | 57 | m | m | 26 | m | m | m | 13 | 36 | 31 | m | m | m | 15 | **16** | 5 | 7 | 15 | 25 | 6 | 10 | m | 11 | 15 | 10 | 4 | 1 | 24 | m | 52 | 10 | 53 | 31 | 4 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906234

**Figure 13.24. 8th grade science teacher participation in programmes on assessment**

Change in and share of students whose teachers participated in professional development on assessment in the last two years, 2007-2015, teachers report




| | | Quebec (CAN) | Slovenia | Israel | Turkey | Hong Kong, China | United States | Hungary | Australia | Japan | **OECD average** | England (UK) | Massachusetts (USA)* | Ontario (CAN) | Singapore | Sweden | New Zealand* | Minnesota (USA)* | Chile* | Lithuania | Indonesia* | Italy | South Africa* | Russian Federation | Norway | Korea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 44 | 41 | 36 | 28 | 40 | 48 | 13 | 42 | 29 | **33** | 55 | m | 16 | 59 | 32 | 41 | m | 22 | 60 | m | 16 | 67 | 60 | 13 | 51 |
| | 2011 | 43 | 47 | 44 | 26 | 51 | 57 | 16 | 39 | 32 | **35** | 54 | 53 | 18 | 65 | 34 | 45 | 57 | 24 | 59 | 70 | 16 | 63 | 53 | 25 | 44 |
| | 2007 | 74 | 67 | 53 | 44 | 56 | 61 | 25 | 54 | 41 | **43** | 64 | 61 | 22 | 64 | 36 | m | 60 | m | 62 | 70 | 15 | m | 54 | 7 | 36 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906253

## 84. Teachers having assistance available when students are conducting science experiments

### Why it matters

One impediment to the development of hands-on or experiential science education may sometimes lie in the difficulty for teachers to manage a class conducting science experiments. While it has a cost, having assistance during these learning practices may facilitate their wider adoption.

## Primary education

### Change at the OECD level: moderate

The expansion of this practice has outweighed its contraction, yielding an average net increase of 6 percentage points between 2007 and 2015. Negative and positive changes taken together, the absolute average change was 8 percentage points, corresponding to a moderate effect size of 0.26. In 2015, 19% of primary students had teachers with assistance available during science experiments in OECD systems, ranging from 4% in Germany, the Czech Republic and Lithuania to 62% in England (United Kingdom).

### Countries where there has been the most change

The positive changes in this area are mostly above 10 percentage points with Japan (26) and Singapore (23) topping the list. On the other hand, the negative changes were quite small in magnitude. At 6 percentage points and 5 percentage points, Norway and Lithuania registered the biggest declines.

## Secondary education

### Change at the OECD level: moderate-low

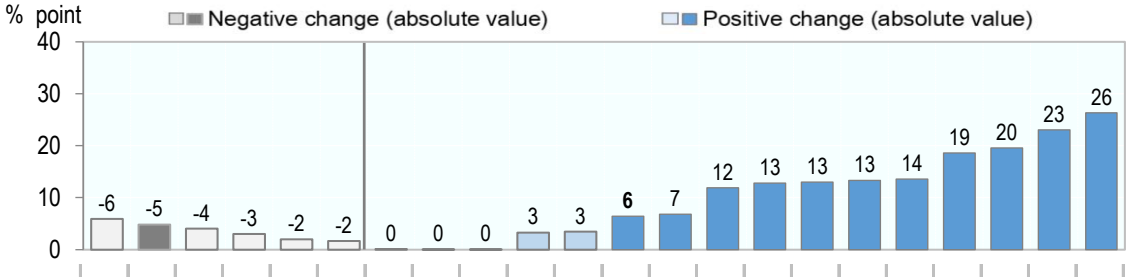
More countries have experienced an increase in this practice than a decrease. The average net increase for the covered OECD systems stood at 4 percentage points. Taking increases and decreases into account, the absolute average change was 9 percentage points, corresponding to a moderate-low effect size of 0.24. The share of 8th grade students having teachers with assistance available during science experiments amounted to 45% in 2015, with strong variations going from 95% in Quebec (Canada) to 12% in Italy and 13% in Turkey.

### Countries where there has been the most change

Innovation took the shape of substantial expansions or contractions of this practice. In Japan, the share of secondary students with teacher assistance for science experiments increased by 32 percentage points between 2007 and 2015, the biggest increase, followed by Hungary (17 percentage points). Conversely, the Russian Federation experienced a sharp decline by 30 percentage points in this practice, as did Korea, where the share of concerned students fell by 16 percentage points.

**Figure 13.25. 4th grade teachers with assistance when students are conducting experiments**

Change in and share of students whose teachers have assistance available when they are conducting experiments, 2007-2015, school principals report



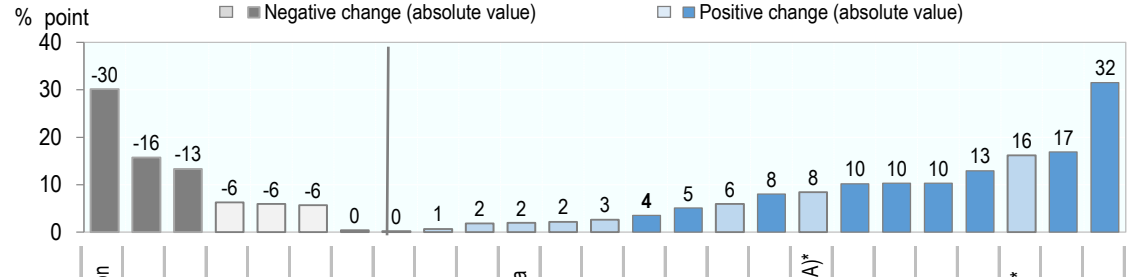

| | | Norway | Lithuania | Quebec (CAN) | Hong Kong, China | Ontario (CAN) | New Zealand | Italy | Australia | Germany | Czech Republic | United States | **OECD average** | Slovak Republic | Sweden | Slovenia | England (UK) | Denmark | Hungary | Netherlands | Russian Federation | Singapore | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 20 | 4 | 14 | 42 | 10 | 10 | 9 | 13 | 4 | 4 | 22 | **19** | 10 | 28 | 31 | 62 | 15 | 17 | 20 | 29 | 69 | 28 |
| | 2007 | 26 | 8 | 18 | 45 | 12 | 12 | 10 | 13 | 4 | 1 | 18 | **12** | 3 | 16 | 18 | 49 | 2 | 3 | 1 | 10 | 46 | 2 |

*Note*: Darker tones correspond to statistically significant values.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906443

**Figure 13.26. 8th grade teachers with assistance when students are conducting experiments**

Change in and share of students whose teachers have assistance available when they are conducting experiments, 2007-2015, school principals report




| | | Russian Federation | Korea | Australia | South Africa* | England (UK) | Slovenia | Turkey | Lithuania | Quebec (CAN) | Indonesia* | Hong Kong, China | Sweden | Italy | **OECD average** | Singapore | United States | Chile* | Massachusetts (USA)* | Ontario (CAN) | Norway | Israel | New Zealand* | Minnesota (USA)* | Hungary | Japan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 51 | 49 | 69 | 46 | 67 | 80 | 13 | 15 | 95 | m | 98 | 16 | 12 | **45** | 98 | 27 | 17 | m | 20 | 35 | 85 | 50 | m | 22 | 38 |
| | 2011 | 66 | 63 | 66 | 52 | 75 | 76 | 12 | 19 | 93 | 19 | 99 | 11 | 9 | **43** | 89 | 32 | 9 | 33 | 13 | 24 | 84 | 37 | 33 | 11 | 34 |
| | 2007 | 81 | 65 | 82 | m | 73 | 86 | 14 | 15 | 94 | 17 | 96 | 14 | 9 | **41** | 93 | 21 | m | 24 | 9 | 25 | 75 | m | 17 | 5 | 6 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906462

## 85. Discussing how to teach a particular topic

### Why it matters

An important aspect of teacher professional development lies in their participation in "professional learning communities" or "learning organisations". Teachers improve their professional practice by reflecting on others' practices and by learning from their peers. A key facet of this collaboration is for example a mere exchange of ideas or discussion about their teaching practice with teachers teaching the same subject or topic, a practice more common than peer observation.

## Primary education

### Change at the OECD level: moderate

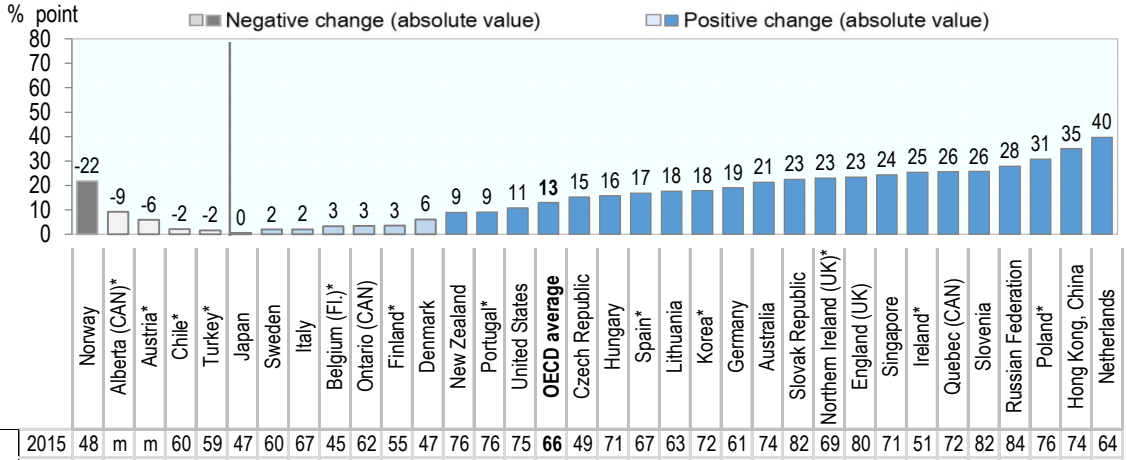
At the OECD level, this practice increased by 13 percentage points on average. Increases and decreases taken together yielded an average absolute change of 15 percentage points, corresponding to a moderate effect size of 0.33. The practice is common across OECD systems. In 2015, 66% of students had teachers who frequently discuss teaching with a colleague, with a span ranging from 45% in Belgium (Fl.) to 82% in Slovakia.

### Countries where there has been the most change

The increase of this practice has been a significant innovation in several countries. The Netherlands recorded the largest increase (45 percentage points), but Hong Kong, China and Poland also experienced increases above 30 percentage points. Only Norway experienced a significant decrease (22 percentage points).

**Figure 13.27. 4th grade teachers discussing how to teach a particular topic**

Change in and share of students whose teachers discuss with peers how to teach a particular topic very often or often, 2007-2015, teachers report




| | Norway | Alberta (CAN)* | Austria* | Chile* | Turkey* | Japan | Sweden | Italy | Belgium (Fl.)* | Ontario (CAN) | Finland* | Denmark | New Zealand | Portugal* | United States | **OECD average** | Czech Republic | Hungary | Spain* | Lithuania | Korea* | Germany | Australia | Slovak Republic | Northern Ireland (UK)* | England (UK) | Singapore | Ireland* | Quebec (CAN) | Slovenia | Russian Federation | Poland* | Hong Kong, China | Netherlands |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students 2015 | 48 | m | m | 60 | 59 | 47 | 60 | 67 | 45 | 62 | 55 | 47 | 76 | 76 | 75 | **66** | 49 | 71 | 67 | 63 | 72 | 61 | 74 | 82 | 69 | 80 | 71 | 51 | 72 | 82 | 84 | 76 | 74 | 64 |
| 2011 | 60 | 53 | 33 | 62 | 60 | 55 | 52 | 49 | 41 | 51 | 51 | 32 | 67 | 67 | 66 | **52** | 35 | 59 | 50 | 58 | 54 | 46 | 61 | 60 | 46 | 62 | 57 | 26 | 46 | 61 | 40 | 46 | 35 | 27 |
| 2007 | 70 | 62 | 39 | m | m | 46 | 58 | 65 | m | 59 | m | 40 | 67 | m | 65 | **53** | 33 | 55 | m | 45 | m | 42 | 53 | 59 | m | 56 | 47 | m | 47 | 56 | 56 | m | 39 | 24 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906272

## Secondary education

### Mathematics

**Change at the OECD level: large**

All countries covered experienced an increase in the use of this informal professional development practice in mathematics at the secondary level. The average net increase and absolute change were both 21 percentage points, corresponding to a large absolute effect size of 0.43. This was an area of strong innovation. In 2015, mathematics teachers who frequently discussed the teaching of a particular topic with other colleagues taught on average 62% of 8th grade students, with a span ranging from 78% in Israel to 39% in Japan.

**Countries where there has been the most change**

Innovation took the form of large increases in the share of students whose teachers often engage in these professional discussions. This was a major innovation in Israel, where the practice spread by 43 percentage points, followed by the Russian Federation, Australia and Italy where increases exceeded 30 percentage points.

### Science

**Change at the OECD level: large**

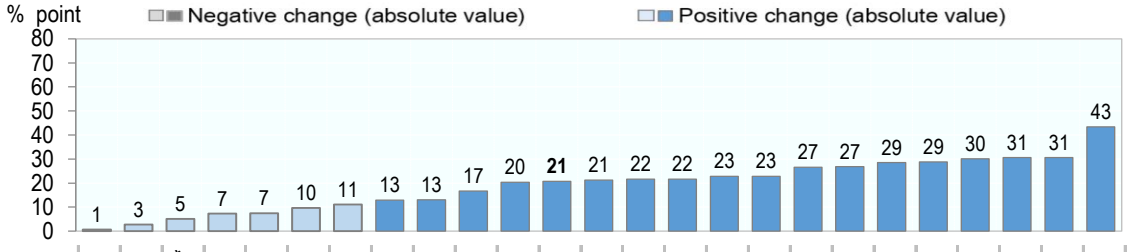
At the secondary level, the use of this practice among science teachers also increased in all OECD countries between 2007 and 2015. On average across the OECD region, 60% of secondary students had teachers frequently discussing the teaching of a topic with a colleague in 2015, against 39% in 2007. The overall change was 21 percentage points, corresponding to a large effect size of 0.44. Innovation was notable in this domain. The share of students taught by science teachers engaged in this kind of informal training ranged from 31% in Japan to 83% in Israel.

**Countries where there has been the most change**

Like in mathematics, 8th grade science teachers in Israel changed the most in this domain, with an increase of 48 percentage points in the share of concerned students. The Russian Federation, Slovenia and Italy also experienced a scale up of this practice above 30 percentage points. Overall, the change has been significant in a large number of countries.

**Figure 13.28. 8th grade maths teachers discussing how to teach a particular topic**

Change in and share of students whose teachers discuss with peers how to teach a particular topic very often or often, 2007-2015, teachers report



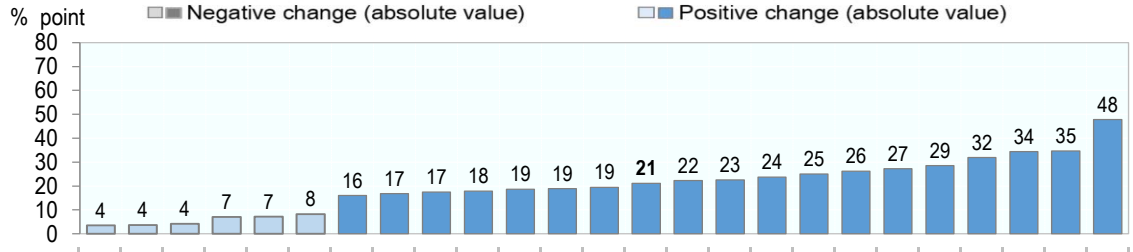

| | | Japan | Quebec (CAN) | Massachusetts (USA)* | Minnesota (USA)* | Ontario (CAN) | Chile* | Indonesia* | Turkey | England (UK) | Hong Kong, China | Slovenia | **OECD average** | South Africa* | United States | Lithuania | New Zealand* | Norway | Singapore | Sweden | Korea | Hungary | Italy | Australia | Russian Federation | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 39 | 54 | m | m | 54 | 63 | m | 58 | 59 | 53 | 76 | **62** | 67 | 63 | 45 | 70 | 61 | 64 | 66 | 52 | 65 | 60 | 77 | 74 | 78 |
| | 2011 | 35 | 38 | 50 | 47 | 55 | 53 | 56 | 42 | 50 | 24 | 68 | **47** | 45 | 53 | 37 | 47 | 42 | 39 | 42 | 22 | 41 | 38 | 53 | 38 | 76 |
| | 2007 | 38 | 51 | 44 | 40 | 46 | m | 45 | 45 | 46 | 37 | 56 | **41** | m | 42 | 24 | m | 38 | 38 | 39 | 24 | 36 | 30 | 46 | 44 | 35 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906291

**Figure 13.29. 8th grade science teachers discussing how to teach a particular topic**

Change in and share of students whose teachers discuss with peers how to teach a particular topic very often or often, 2007-2015, teachers report




| | | Indonesia* | Minnesota (USA)* | Turkey | Quebec (CAN) | Massachusetts (USA)* | Japan | Norway | Australia | Ontario (CAN) | Chile* | South Africa* | England (UK) | New Zealand* | **OECD average** | United States | Korea | Hungary | Sweden | Singapore | Lithuania | Hong Kong, China | Italy | Slovenia | Russian Federation | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | m | 48 | 57 | m | 31 | 54 | 74 | 53 | 66 | 67 | 66 | 69 | **60** | 62 | 61 | 54 | 68 | 68 | 44 | 58 | 62 | 66 | 70 | 83 |
| | 2011 | 48 | 36 | 43 | 44 | 51 | 33 | 43 | 63 | 55 | 48 | 49 | 47 | 50 | **45** | 52 | 25 | 28 | 46 | 42 | 26 | 29 | 39 | 38 | 22 | 72 |
| | 2007 | 45 | 32 | 44 | 50 | 44 | 23 | 38 | 57 | 35 | m | m | 47 | m | **39** | 40 | 39 | 30 | 43 | 42 | 16 | 30 | 30 | 31 | 35 | 35 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906310

## 86. Collaborating in planning and preparing instructional material

### Why it matters

Collaborating in planning and preparing instructional material is one of those activities that can structure professional learning communities. It may happen within schools or outside of schools, for example through collaborative teacher platforms. Because it allows teachers to share their views and learn from others' practices, collaboration in planning and preparing instructional is a strong source of professional development.

## Primary education

### Change at the OECD level: moderate

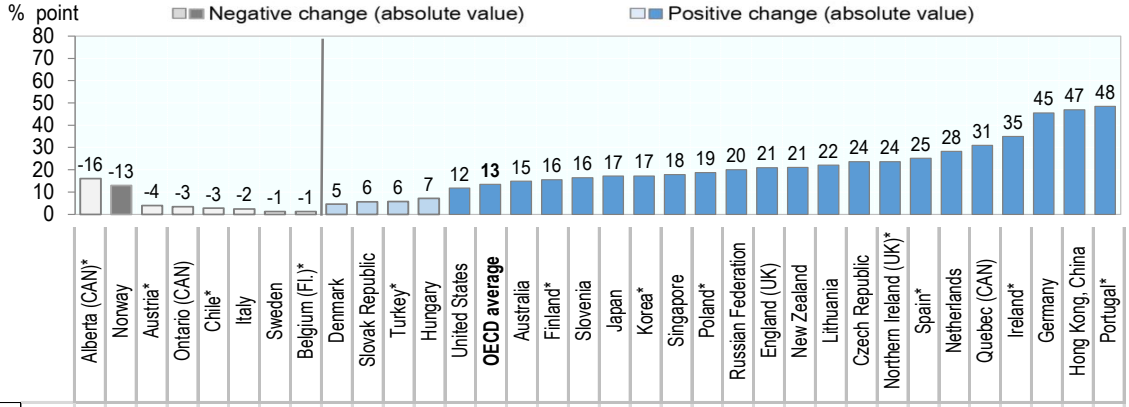
In primary education, this practice mainly expanded. With 63% of 4th grade students having teachers frequently collaborating with other teachers in planning and preparing instructional material in 2015, the OECD average has increased by 13 percentage points since 2007. The absolute change, mirroring both positive and negative trends, was 16 percentage points on average, corresponding to a moderate effect size of 0.33. The share of students with teachers often using this informal development practice ranged from 31% in Denmark to 87% in Portugal in 2015.

### Countries where there has been the most change

Hong Kong, China and Germany saw this practice skyrocket with an increase over 45 percentage points between 2007 and 2015. Portugal witnessed a change of similar magnitude between 2011 and 2015. The practice gained significant ground in many other countries.

**Figure 13.30. 4th grade teachers collaborating in planning and preparing lessons**

Change in and share of students whose teachers collaborate with peers in planning and preparing instructional material often or very often, 2007-2015, teachers report




| % of students | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2015 | m | 40 | m | 50 | 46 | 64 | 52 | 48 | 31 | 79 | 59 | 66 | 76 | **63** | 72 | 42 | 65 | 54 | 80 | 59 | 71 | 81 | 81 | 75 | 63 | 57 | 73 | 75 | 54 | 72 | 56 | 78 | 70 | 87 |
| 2011 | 33 | 56 | 36 | 39 | 49 | 43 | 51 | 50 | 13 | 44 | 54 | 37 | 65 | **45** | 56 | 27 | 55 | 44 | 63 | 37 | 53 | 33 | 62 | 48 | 43 | 25 | 49 | 50 | 32 | 42 | 21 | 46 | 23 | 38 |
| 2007 | 49 | 52 | 40 | 53 | m | 67 | 54 | m | 26 | 73 | m | 59 | 64 | **49** | 57 | m | 49 | 37 | m | 41 | m | 61 | 60 | 54 | 41 | 34 | m | m | 26 | 41 | m | 33 | 23 | m |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906329

## Secondary education

### Mathematics

**Change at the OECD level: large**

Apart from Japan and Minnesota (United States), all OECD systems experienced an expansion of this practice for secondary maths education, with an average net increase of 17 percentage points. The absolute change, accounting for increases and reductions, amounted to 20 percentage points, corresponding to a large effect size of 0.42. In 2015, on average 56% of 8th grade students were taught by teachers frequently collaborating to plan and prepare their instructional material, with a span ranging from 78% in Israel to 30% in Japan.

**Countries where there has been the most change**

Israel experienced the most innovation in this domain, with an expansion of 38 percentage points in this practice. Teachers in Italy and New Zealand also strongly innovated with an increase of 30 percentage points in the share of students with maths teachers working with colleagues to prepare their instructional materials. Only three negative changes were recorded across the sample, including two that are substantial and represent an innovation. Japan and Indonesia experienced a decline of 26 percentage points in this type of collaborative practice.

### Science

**Change at the OECD level: moderate**

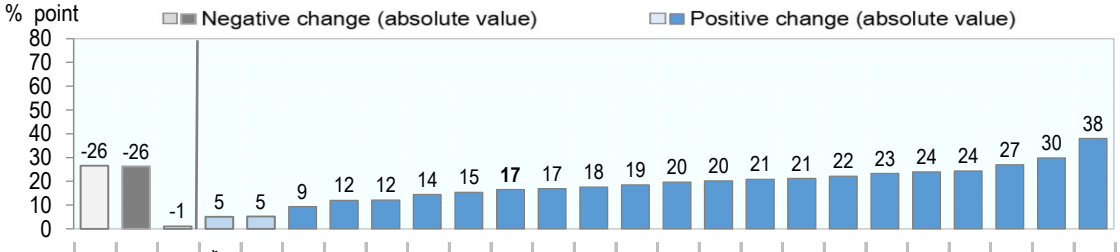
All OECD systems saw an increase in this form of teacher collaboration in 8th grade science. The share of secondary students with teachers frequently collaborating with colleagues to prepare and plan their science instructional materials rose by 19 percentage points between 2007 and 2015. The absolute change was of the same magnitude, corresponding to a moderate effect size of 0.29. Across OECD countries, science teachers frequently engaged in this collaborative practice taught 55% of 8th grade students in 2015, ranging from 29% in Japan to 78% in Israel.

**Countries where there has been the most change**

Innovation occurred through an increase in the use of this practice. Israel stands out with an increase of 43 percentage points, followed by New Zealand and Italy with increases of over 30 percentage points. A significant number of countries also saw large or moderate increases. Only Indonesia experienced a fall of 15 percentage points in this collaborative practice between 2007 and 2011.

**Figure 13.31. 8th grade maths teachers collaborating in planning and preparing lessons**

Change in and share of students whose teachers collaborate with peers in planning and preparing instructional material often or very often, 2007-2015, teachers report.



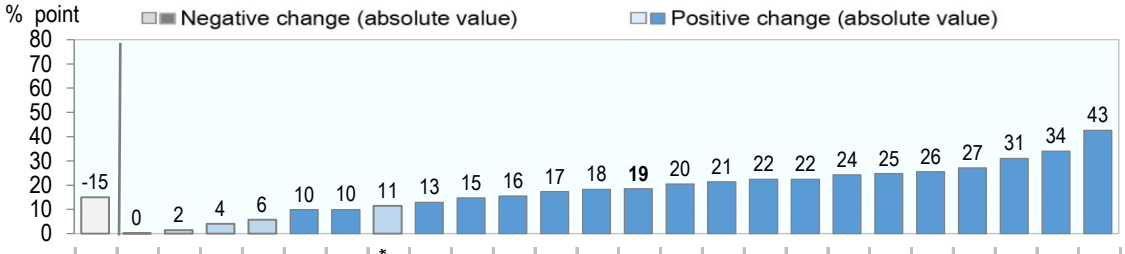

| | | Indonesia* | Japan | Minnesota (USA)* | Massachusetts (USA)* | Chile* | Slovenia | Ontario (CAN) | Hungary | Hong Kong, China | Korea | **OECD average** | England (UK) | Quebec (CAN) | Sweden | Norway | Singapore | Turkey | Lithuania | South Africa* | Australia | Russian Federation | United States | New Zealand* | Italy | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 30 | m | m | 46 | 53 | 49 | 54 | 35 | 63 | **56** | 47 | 69 | 56 | 51 | 60 | 55 | 50 | 65 | 68 | 72 | 61 | 56 | 51 | 78 |
| | 2011 | 45 | 25 | 38 | 45 | 41 | 43 | 37 | 23 | 15 | 27 | **37** | 30 | 36 | 32 | 41 | 28 | 38 | 22 | 43 | 50 | 17 | 52 | 29 | 15 | 74 |
| | 2007 | 72 | 56 | 39 | 40 | m | 44 | 37 | 41 | 21 | 47 | **40** | 30 | 52 | 37 | 31 | 40 | 35 | 28 | m | 45 | 48 | 37 | m | 21 | 40 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906348

**Figure 13.32. 8th grade science teachers collaborating in planning and preparing lessons**

Change in and share of students whose teachers collaborate with peers in planning and preparing instructional material often or very often, 2007-2015, teachers report




| | | Indonesia* | Hungary | Minnesota (USA)* | Lithuania | Ontario (CAN) | Japan | Turkey | Massachusetts (USA)* | Chile* | England (UK) | United States | Korea | Sweden | **OECD average** | Russian Federation | Slovenia | South Africa* | Australia | Hong Kong, China | Norway | Quebec (CAN) | Singapore | Italy | New Zealand* | Israel |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 49 | m | 36 | 45 | 29 | 55 | m | 45 | 53 | 62 | 71 | 56 | **55** | 63 | 42 | 67 | 71 | 44 | 49 | 61 | 69 | 52 | 65 | 78 |
| | 2011 | 47 | 15 | 44 | 20 | 38 | 25 | 42 | 52 | 32 | 29 | 49 | 39 | 31 | **35** | 12 | 21 | 45 | 54 | 17 | 41 | 36 | 32 | 15 | 31 | 62 |
| | 2007 | 62 | 49 | 43 | 32 | 39 | 19 | 45 | 41 | m | 38 | 46 | 54 | 38 | **37** | 42 | 20 | m | 49 | 20 | 24 | 35 | 42 | 21 | m | 36 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906367

## 87. Visiting another classroom to learn more about teaching

### Why it matters

An important source of teacher professional development comes from their participation in "professional learning communities" or "learning organisations". Teachers improve their professional practice by reflecting on others' practices and learn from each other. One professional practice that often contributes to this form of learning is the observation of other teachers in the teaching process. This practice is increasingly encouraged across countries.

## Primary education

### Change at the OECD level: large

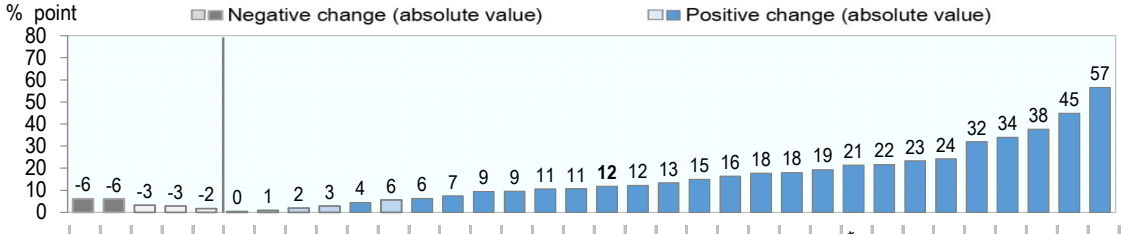
This practice has more often expanded than decreased across OECD systems. On average, the share of 4th grade students instructed by a teacher regularly visiting a colleague's classroom to learn about teaching increased by 12 percentage points. The absolute mean change, regardless of the direction, amounted to 13 percentage points, corresponding to a large effect size of 0.44. This practice is also a novelty as only 17% of the students with teachers reporting to undertake this professional collaboration practice in 2015, as opposed to only 5% in 2007.

### Countries where there has been the most change

This practice has been a major innovation in many countries. The Russian Federation experienced an outstanding increase of 57 percentage points between 2007 and 2015, and Lithuania, England and Hong Kong, China, an increase over 30 percentage points. In Korea, the practice also expanded by 45% between 2011 and 2015.

**Figure 13.33. 4th grade teachers visiting a colleague's classroom to learn about teaching**

Change in and share of students whose teachers visit another classroom often or very often to learn more about teaching, 2007-2015, teachers report




| | | Portugal* | Norway | Denmark | Italy | Austria* | Sweden | Belgium (Fl.)* | Turkey* | Germany | Finland* | Alberta (CAN)* | Chile* | Ireland* | Spain* | Quebec (CAN) | Ontario (CAN) | Czech Republic | **OECD average** | Australia | Poland* | Slovenia | United States | Slovak Republic | Netherlands | Hungary | Northern Ireland (UK)* | Japan | Singapore | New Zealand | Hong Kong, China | England (UK) | Lithuania | Korea* | Russian Federation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | 9 | 6 | 4 | 9 | m | 8 | 2 | 7 | 7 | 11 | m | 12 | 11 | 22 | 15 | 15 | 11 | **17** | 23 | 13 | 18 | 21 | 20 | 19 | 21 | 24 | 29 | 25 | 29 | 33 | 35 | 40 | 52 | 70 |
| | 2011 | 15 | 2 | 18 | 4 | 2 | 9 | 1 | 5 | 3 | 6 | 12 | 5 | 4 | 13 | 6 | 10 | 1 | **9** | 14 | m | 59 | 9 | 2 | 1 | 2 | 3 | 6 | 6 | 6 | 5 | 10 | 17 | 7 | 11 |
| | 2007 | m | 12 | 7 | 12 | 4 | 8 | m | m | 4 | m | 7 | m | m | m | 6 | 4 | 0 | **5** | 11 | m | 3 | 5 | 3 | 1 | 2 | m | 7 | 1 | 4 | 1 | 1 | 2 | m | 14 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906386

## Secondary education

### Mathematics

**Change at the OECD level: large**

In most OECD countries, more maths teachers have visited another classroom to learn about their maths teaching. The share of 8th grade students with teachers regularly visiting colleagues' classrooms has increased by 13 percentage points on average. The absolute change was also 13 percentage points, corresponding to a large effect size of 0.45. The practice remains relatively uncommon across OECD education systems: on average, maths teachers frequently taking part in peer observation taught 18% of 8th grade students in 2015, with a span ranging from 40% in Turkey to 4% in Quebec (Canada). This is a novelty that emerged in the last decade as teachers with such collaborative practice only taught 4% of secondary students on average in 2007.

**Countries where there has been the most change**

Innovation took the form of large increases. The share of 8th grade students with teachers frequently visiting other colleagues' classroom to improve their teaching strongly increased in the Russian Federation between 2007 and 2015 (40 percentage points). Korea and Turkey also experience big innovation in this domain, with increases of 38 and 37 percentage points respectively.

### Science

**Change at the OECD level: large**

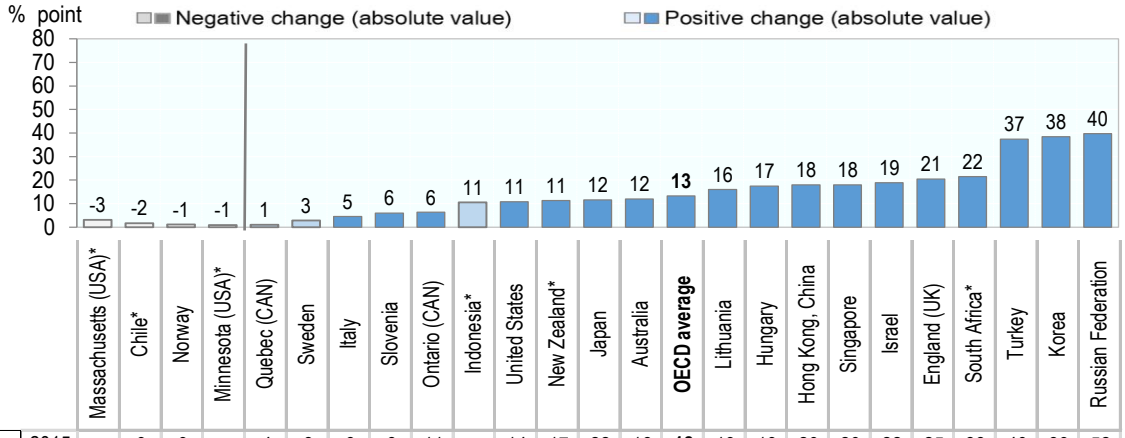
All OECD countries covered experienced an expansion of this teacher practice among secondary science teachers, resulting in a net increase and absolute change of 15 percentage points between 2007 and 2015. This corresponds to a large absolute effect size of 0.5. This has been a big innovation in this domain. In OECD countries, teachers who frequently engage in this practice taught on average 18% of 8th grade science students in 2015, with a span ranging from 37% in Korea and Turkey to 2% in Quebec (Canada). Like for maths teachers, this is a novelty that emerged in the last decade: science teachers with such collaborative practice only taught 3% of secondary students on average in 2007.

**Countries where there has been the most change**

While this has been a big innovation in many countries, Korea, Turkey and the Russian Federation are by far the countries that experienced the largest increases (around 35 percentage points). With increases above 20 percentage points of the students taught by teachers engaged in this collaborative practice, Hong Kong, China, Israel and England also experienced significant innovation in this area. No negative change was recorded.

## Figure 13.34. 8th grade maths teachers visiting a colleague's classroom to learn about teaching

Change in and share of students whose teachers visit another classroom often or very often to learn more about teaching, 2007-2015, teachers report



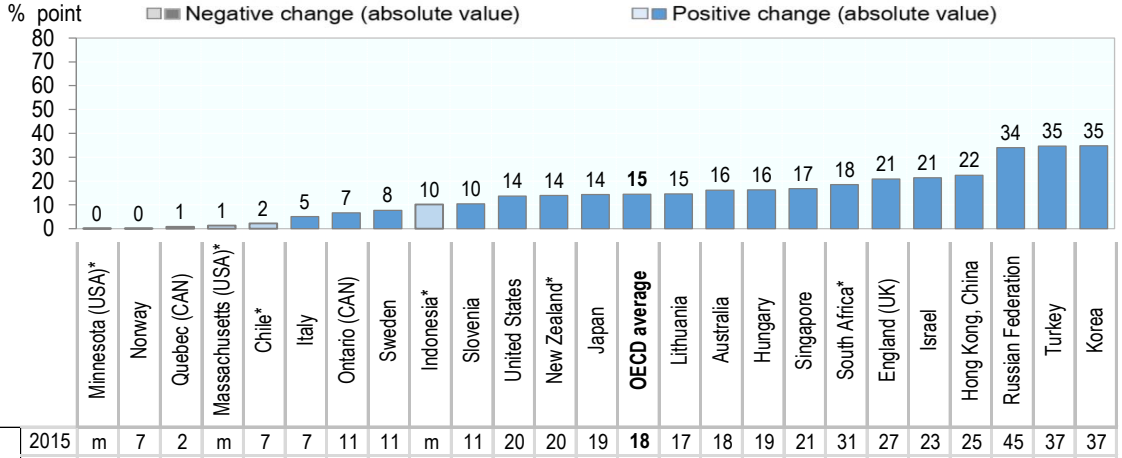

| | | Massachusetts (USA)* | Chile* | Norway | Minnesota (USA)* | Quebec (CAN) | Sweden | Italy | Slovenia | Ontario (CAN) | Indonesia* | United States | New Zealand* | Japan | Australia | **OECD average** | Lithuania | Hungary | Hong Kong, China | Singapore | Israel | England (UK) | South Africa* | Turkey | Korea | Russian Federation |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 9 | 9 | m | 4 | 8 | 6 | 8 | 11 | m | 14 | 17 | 22 | 16 | **18** | 19 | 19 | 20 | 20 | 22 | 25 | 33 | 40 | 39 | 52 |
| | 2011 | 1 | 10 | 2 | 1 | 3 | 3 | 2 | 11 | 12 | 23 | 6 | 6 | 11 | 4 | **5** | 3 | 3 | 5 | 3 | 5 | 7 | 11 | 2 | 2 | 10 |
| | 2007 | 4 | m | 11 | 2 | 3 | 5 | 2 | 2 | 5 | 12 | 4 | m | 11 | 4 | **4** | 3 | 1 | 2 | 2 | 3 | 5 | m | 3 | 1 | 13 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906405

## Figure 13.35. 8th grade science teachers visiting a colleague's classroom to learn about teaching

Change in and share of students whose teachers visit another classroom often or very often to learn more about teaching, 2007-2015, teachers report.




| | | Minnesota (USA)* | Norway | Quebec (CAN) | Massachusetts (USA)* | Chile* | Italy | Ontario (CAN) | Sweden | Indonesia* | Slovenia | United States | New Zealand* | Japan | **OECD average** | Lithuania | Australia | Hungary | Singapore | South Africa* | England (UK) | Israel | Hong Kong, China | Russian Federation | Turkey | Korea |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % of students | 2015 | m | 7 | 2 | m | 7 | 7 | 11 | 11 | m | 11 | 20 | 20 | 19 | **18** | 17 | 18 | 19 | 21 | 31 | 27 | 23 | 25 | 45 | 37 | 37 |
| | 2011 | 3 | m | 1 | 5 | 5 | 2 | 14 | 3 | 22 | 9 | 6 | 6 | 9 | **5** | 9 | 9 | 3 | 4 | 12 | 7 | 7 | 9 | 10 | 1 | 3 |
| | 2007 | 3 | 7 | 1 | 4 | m | 2 | 4 | 3 | 11 | 1 | 6 | m | 5 | **3** | 2 | 2 | 3 | 4 | m | 6 | 2 | 3 | 11 | 2 | 2 |

*Note*: Darker tones correspond to statistically significant values.
* refers to calculations based on other years, based on data availability.
The OECD average is based on OECD countries with available data in 2007, 2011 and 2015.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906424

**Table 13.1. Effect sizes for changes in teacher professional development in mathematics**

| | Teacher participation in a program on mathematics content | | Teacher participation in a program on maths pedagogy | | Teacher participation in a program on maths curriculum | | Teacher participation in a program integrate to information technology into maths | | Teacher participation in a program to improve students' critical thinking or problem-solving skills in maths | | Teacher participation in a program on mathematics assessments | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade |
| Australia | 0.01 | -0.07 | 0.03 | 0.11 | -0.11 | 0.07 | 0.02 | 0.05 | -0.03 | 0.08 | -0.16 | -0.21 |
| Austria | 0.41 | m | 0.47 | m | 0.55 | m | 0.30 | m | m | m | 0.81 | m |
| Belgium (Fl.) | 0.07 | m | 0.15 | m | 0.05 | m | 0.09 | m | m | m | -0.60 | m |
| Canada (Alberta) | 0.30 | m | 0.34 | m | 0.33 | m | 0.34 | m | m | m | 0.54 | m |
| Canada (Ontario) | 0.03 | -0.19 | 0.32 | 0.12 | -0.40 | -0.40 | 0.15 | 0.20 | 0.60 | 0.31 | 0.07 | -0.16 |
| Canada (Quebec) | 0.52 | -0.14 | 0.49 | -0.35 | -0.20 | -1.10 | 0.57 | 0.89 | 0.15 | -0.10 | 0.16 | -0.80 |
| Chile | -0.07 | -0.29 | 0.04 | -0.09 | 0.08 | -0.17 | -0.19 | -0.45 | m | -0.07 | -0.47 | -0.25 |
| Czech Republic | 0.02 | m | -0.08 | m | -0.32 | m | 0.13 | m | -0.05 | m | -0.33 | m |
| Denmark | -0.01 | m | 0.01 | m | 0.03 | m | 0.03 | m | 0.02 | m | 0.22 | m |
| Finland | -0.13 | m | -0.06 | m | 0.02 | m | 0.06 | m | m | m | -0.76 | m |
| Germany | 0.00 | m | -0.06 | m | -0.08 | m | -0.26 | m | 0.09 | m | -0.17 | m |
| Hungary | -0.66 | -0.46 | -0.59 | -0.35 | -0.28 | -0.32 | 0.11 | 0.12 | -0.21 | -0.37 | -0.39 | -0.27 |
| Ireland | 0.29 | m | 0.10 | m | 0.08 | m | 0.07 | m | m | m | -0.18 | m |
| Israel | m | 0.24 | m | 0.18 | m | 0.19 | m | 0.65 | m | -0.04 | m | 0.02 |
| Italy | -0.16 | 0.25 | 0.06 | 0.13 | 0.15 | 0.37 | -0.16 | -0.03 | -0.04 | 0.44 | -0.04 | 0.17 |
| Japan | -0.01 | -0.11 | 0.06 | -0.21 | 0.01 | -0.06 | 0.11 | 0.24 | 0.11 | -0.23 | -0.10 | -0.37 |
| Korea | 0.01 | 0.07 | -0.01 | 0.25 | -0.05 | 0.06 | 0.16 | 0.04 | m | 0.26 | 0.16 | 0.27 |
| Lithuania | -0.11 | -0.55 | -0.17 | -0.43 | -0.12 | -0.29 | 0.09 | 0.01 | 0.06 | 0.02 | 0.33 | 0.06 |
| Netherlands | 0.32 | m | 0.32 | m | 0.32 | m | 0.00 | m | 0.09 | m | 0.28 | m |
| New Zealand | -0.23 | 0.06 | -0.13 | 0.05 | -0.34 | -0.25 | 0.32 | 0.11 | 0.11 | -0.19 | -0.12 | 0.02 |
| Norway | -0.19 | -0.50 | -0.30 | -0.33 | -0.47 | -0.75 | 0.13 | 0.03 | -0.05 | -0.16 | 0.29 | 0.01 |
| Poland | 0.54 | m | 0.77 | m | 0.49 | m | 0.71 | m | m | m | -0.41 | m |
| Portugal | -0.24 | m | -0.36 | m | -0.25 | m | -0.28 | m | m | m | -0.43 | m |
| Slovak Republic | -0.26 | m | -0.71 | m | -0.41 | m | -0.37 | m | -0.32 | m | -0.34 | m |
| Slovenia | -0.52 | -0.22 | -0.42 | -0.15 | -0.16 | -0.60 | 0.10 | -0.14 | 0.27 | 0.00 | -0.50 | -0.66 |
| Spain | 0.29 | m | 0.20 | m | 0.11 | m | -0.12 | m | m | m | -0.38 | m |
| Sweden | 0.49 | 0.36 | 0.34 | 0.46 | 0.22 | 0.04 | 0.20 | 0.29 | 0.63 | 0.49 | 0.49 | 0.13 |
| Turkey | -0.20 | -0.61 | -0.16 | -0.44 | -0.20 | -0.92 | -0.11 | 0.21 | m | 0.05 | -0.34 | 0.11 |
| UK (England) | 0.07 | -0.15 | -0.05 | -0.34 | 0.13 | 0.07 | -0.28 | -0.43 | -0.14 | 0.07 | 0.14 | -0.32 |
| UK (Northern Ireland) | -0.10 | m | 0.00 | m | -0.14 | m | -0.32 | m | m | m | 0.32 | m |
| United States | 0.22 | -0.06 | 0.24 | -0.14 | 0.15 | 0.09 | 0.04 | 0.09 | 0.21 | -0.06 | 0.02 | -0.18 |
| US (Massachusetts) | m | -0.55 | m | -0.34 | m | 0.16 | m | -0.22 | m | -0.34 | m | -0.07 |
| US (Minnesota) | m | 0.10 | m | 0.04 | m | 0.14 | m | 0.41 | m | -0.30 | m | 0.04 |
| **OECD (average)** | **-0.01** | **-0.10** | **-0.02** | **-0.07** | **-0.09** | **-0.22** | **0.04** | **0.15** | **0.08** | **0.05** | **-0.03** | **-0.16** |
| **OECD (av. absolute)** | **0.22** | **0.25** | **0.25** | **0.26** | **0.22** | **0.36** | **0.18** | **0.24** | **0.19** | **0.19** | **0.22** | **0.26** |
| Hong Kong, China | 0.09 | -0.32 | 0.01 | -0.14 | -0.34 | -0.45 | 0.41 | -0.11 | -0.01 | -0.38 | -0.26 | -0.26 |
| Indonesia | m | 0.00 | m | -0.40 | m | -0.12 | m | 0.17 | m | 0.03 | m | 0.05 |
| Russian Federation | -0.59 | -0.30 | -0.49 | 0.16 | 0.00 | 0.10 | 0.32 | 0.26 | -0.15 | -0.39 | 0.21 | -0.14 |
| Singapore | 0.11 | -0.30 | 0.27 | 0.04 | 0.19 | 0.00 | 0.15 | -0.27 | -0.16 | -0.16 | 0.20 | -0.20 |
| South Africa | m | 0.29 | m | 0.17 | m | 0.39 | m | 0.21 | m | 0.09 | m | 0.09 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015).

StatLink https://doi.org/10.1787/888933906481

**Table 13.2. Effect sizes for changes in teacher professional development in science**

| | Teacher participation in a program on science content | | Teacher participation in a program on science pedagogy | | Teacher participation in a program on science curriculum | | Teacher participation in a program to integrate information technology into science | | Teacher participation in a program to improve students' critical thinking or problem-solving skills in science | | Teacher participation in a program on science assessments | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade | 4th Grade | 8th Grade |
| Australia | 0.21 | 0.10 | 0.27 | 0.07 | 0.35 | 0.23 | -0.10 | -0.08 | -0.10 | -0.04 | 0.03 | -0.24 |
| Austria | 0.20 | m | 0.05 | m | 0.50 | m | -0.10 | m | m | m | 0.60 | m |
| Belgium (Fl.) | -0.05 | m | -0.10 | m | 0.06 | m | -0.01 | m | m | m | -0.01 | m |
| Canada (Alberta) | -0.27 | m | -0.27 | m | -0.14 | m | -0.12 | m | m | m | 0.37 | m |
| Canada (Ontario) | -0.09 | -0.42 | 0.06 | -0.06 | -0.30 | -0.36 | 0.01 | 0.04 | 0.22 | 0.13 | -0.02 | -0.16 |
| Canada (Quebec) | 0.07 | -0.25 | 0.07 | -0.12 | -0.03 | -0.69 | 0.29 | 0.38 | 0.06 | -0.16 | 0.07 | -0.61 |
| Chile | -0.04 | -0.14 | 0.00 | -0.07 | -0.18 | -0.13 | -0.21 | -0.38 | m | -0.19 | -0.39 | -0.03 |
| Czech Republic | -0.02 | m | -0.14 | m | -0.45 | m | 0.27 | m | -0.18 | m | -0.32 | m |
| Denmark | -0.14 | m | -0.15 | m | -0.11 | m | 0.05 | m | 0.12 | m | 0.13 | m |
| Finland | -0.37 | m | -0.18 | m | 0.14 | m | 0.10 | m | m | m | -0.49 | m |
| Germany | 0.00 | m | 0.10 | m | -0.08 | m | -0.02 | m | 0.02 | m | -0.09 | m |
| Hungary | -0.62 | -0.36 | -0.56 | -0.29 | -0.31 | -0.27 | -0.11 | 0.05 | -0.36 | -0.39 | -0.13 | -0.31 |
| Ireland | -0.12 | m | -0.04 | m | -0.11 | m | -0.13 | m | m | m | -0.20 | m |
| Israel | m | -0.04 | m | -0.03 | m | -0.32 | m | 0.10 | m | -0.03 | m | -0.34 |
| Italy | -0.14 | 0.01 | 0.02 | -0.03 | 0.06 | 0.25 | -0.12 | 0.25 | -0.01 | 0.21 | -0.08 | 0.01 |
| Japan | 0.10 | 0.02 | -0.06 | 0.26 | -0.10 | 0.05 | -0.07 | 0.13 | 0.00 | 0.24 | -0.14 | -0.25 |
| Korea | -0.07 | -0.01 | -0.04 | 0.54 | -0.09 | 0.47 | 0.16 | 0.33 | m | 0.16 | 0.14 | 0.31 |
| Lithuania | -0.19 | -0.30 | -0.24 | -0.29 | 0.20 | -0.25 | 0.27 | -0.09 | 0.05 | -0.10 | 0.09 | -0.03 |
| Netherlands | -0.08 | m | -0.03 | m | 0.14 | m | -0.10 | m | 0.10 | m | -0.18 | m |
| New Zealand | 0.31 | -0.01 | 0.40 | -0.18 | 0.18 | -0.41 | 0.03 | 0.10 | -0.21 | -0.10 | -0.01 | -0.07 |
| Norway | 0.14 | -0.46 | 0.30 | -0.48 | -0.19 | -0.66 | -0.10 | -0.40 | 0.13 | -0.07 | 0.24 | 0.20 |
| Poland | 0.83 | m | 0.65 | m | 0.71 | m | 0.87 | m | m | m | -0.22 | m |
| Portugal | -0.27 | m | -0.39 | m | -0.43 | m | -0.23 | m | m | m | -0.65 | m |
| Slovak Republic | -0.30 | m | -0.79 | m | -0.37 | m | -0.12 | m | -0.16 | m | -0.42 | m |
| Slovenia | -0.81 | -0.21 | -0.92 | 0.34 | -0.30 | 0.13 | -0.04 | 0.44 | 0.02 | 0.28 | -0.64 | -0.54 |
| Spain | -0.06 | m | -0.04 | m | 0.06 | m | -0.10 | m | m | m | -0.25 | m |
| Sweden | 0.22 | -0.18 | 0.25 | 0.06 | 0.25 | 0.03 | 0.05 | 0.47 | -0.03 | 0.06 | 0.32 | -0.10 |
| Turkey | -0.26 | -0.85 | -0.19 | -0.87 | -0.12 | -1.29 | -0.02 | -0.14 | m | -0.21 | -0.15 | -0.34 |
| UK (England) | 0.12 | -0.19 | -0.19 | -0.25 | 0.26 | -0.18 | -0.29 | -0.22 | -0.20 | -0.12 | -0.15 | -0.19 |
| UK (Northern Ireland) | 0.02 | m | 0.07 | m | -0.08 | m | 0.04 | m | m | m | -0.17 | m |
| United States | -0.01 | -0.16 | 0.09 | 0.01 | -0.03 | -0.15 | 0.00 | -0.17 | 0.10 | -0.13 | -0.06 | -0.27 |
| US.(Massachusetts) | m | -0.24 | m | -0.05 | m | -0.03 | m | -0.08 | m | -0.14 | m | -0.15 |
| US (Minnesota) | m | -0.38 | m | -0.16 | m | -0.23 | m | 0.04 | m | -0.07 | m | -0.07 |
| **OECD (average)** | **-0.05** | **-0.20** | **-0.09** | **-0.05** | **-0.05** | **-0.17** | **-0.02** | **0.09** | **-0.04** | **0.00** | **-0.10** | **-0.20** |
| **OECD (av. absolute)** | **0.20** | **0.23** | **0.26** | **0.24** | **0.21** | **0.36** | **0.10** | **0.23** | **0.12** | **0.16** | **0.18** | **0.28** |
| Hong Kong, China | -0.23 | -0.22 | -0.07 | -0.19 | -0.04 | -0.26 | -0.01 | -0.09 | 0.15 | -0.44 | -0.13 | -0.32 |
| Indonesia | m | 0.26 | m | -0.31 | m | -0.13 | m | 0.39 | m | 0.14 | m | -0.01 |
| Russian Federation | -0.43 | 0.23 | -0.42 | 0.07 | 0.09 | 0.20 | 0.26 | 0.23 | 0.15 | 0.17 | 0.22 | 0.11 |
| Singapore | 0.07 | -0.19 | 0.23 | 0.15 | 0.21 | -0.25 | -0.02 | -0.05 | 0.08 | -0.11 | 0.25 | -0.10 |
| South Africa | m | 0.34 | m | 0.31 | m | 0.33 | m | 0.23 | m | 0.20 | m | 0.10 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015).

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**Table 13.3. Effect sizes for changes in teacher collaboration practices**

| | Discussing how to teach a particular topic | | | Collaborating in planning and preparing instructional material | | | Visiting another classroom to learn more about teaching | | | Assistance for teachers when students are conducting science experiments | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 4th Grade | 8th Grade Maths | 8th Grade Science | 4th Grade | 8th Grade Maths | 8th Grade Science | 4th Grade | 8th Grade Maths | 8th Grade Science | 4th Grade | 8th Grade |
| Australia | 0.44 | 0.64 | 0.36 | 0.31 | 0.47 | 0.46 | 0.33 | 0.41 | 0.60 | 0.00 | -0.31 |
| Austria | -0.12 | m | m | -0.08 | m | m | -0.10 | m | m | m | m |
| Belgium (Fl.) | 0.07 | m | m | -0.03 | m | m | 0.07 | m | m | m | m |
| Canada (Alberta) | -0.18 | m | m | -0.33 | m | m | 0.19 | m | m | m | m |
| Canada (Ontario) | 0.07 | 0.15 | 0.35 | -0.07 | 0.24 | 0.12 | 0.38 | 0.24 | 0.26 | -0.06 | 0.29 |
| Canada (Quebec) | 0.53 | 0.06 | 0.14 | 0.64 | 0.36 | 0.52 | 0.32 | 0.05 | 0.07 | -0.11 | 0.03 |
| Chile | -0.04 | 0.20 | 0.36 | -0.06 | 0.11 | 0.27 | 0.23 | -0.06 | 0.09 | m | 0.24 |
| Czech Republic | 0.31 | m | m | 0.48 | m | m | 0.58 | m | m | 0.22 | m |
| Denmark | 0.12 | m | m | 0.10 | m | m | -0.14 | m | m | 0.52 | m |
| Finland | 0.07 | m | m | 0.33 | m | m | 0.16 | m | m | m | m |
| Germany | 0.38 | m | m | 0.95 | m | m | 0.13 | m | m | 0.00 | m |
| Hungary | 0.33 | 0.59 | 0.49 | 0.15 | 0.24 | 0.00 | 0.69 | 0.66 | 0.56 | 0.48 | 0.52 |
| Ireland | 0.53 | m | m | 0.74 | m | m | 0.30 | m | m | m | m |
| Israel | m | 0.91 | 1.02 | m | 0.80 | 0.89 | m | 0.62 | 0.75 | m | 0.26 |
| Italy | 0.04 | 0.62 | 0.65 | -0.05 | 0.64 | 0.66 | -0.10 | 0.24 | 0.26 | 0.00 | 0.09 |
| Japan | 0.01 | 0.01 | 0.19 | 0.35 | -0.54 | 0.23 | 0.59 | 0.32 | 0.46 | 0.85 | 0.82 |
| Korea | 0.37 | 0.60 | 0.45 | 0.39 | 0.31 | 0.36 | 1.07 | 1.16 | 1.03 | m | -0.32 |
| Lithuania | 0.36 | 0.46 | 0.61 | 0.45 | 0.44 | 0.09 | 1.07 | 0.56 | 0.54 | -0.21 | 0.01 |
| Netherlands | 0.82 | m | m | 0.59 | m | m | 0.69 | m | m | 0.71 | m |
| New Zealand | 0.20 | 0.47 | 0.40 | 0.45 | 0.55 | 0.69 | 0.71 | 0.37 | 0.43 | -0.05 | 0.05 |
| Norway | -0.45 | 0.46 | 0.32 | -0.26 | 0.40 | 0.52 | -0.22 | -0.04 | 0.00 | -0.14 | 0.23 |
| Poland | 0.64 | m | m | 0.39 | m | m | 0.75 | m | m | m | m |
| Portugal | 0.20 | m | m | 1.06 | m | m | -0.19 | m | m | m | m |
| Slovak Republic | 0.50 | m | m | 0.13 | m | m | 0.61 | m | m | 0.28 | m |
| Slovenia | 0.57 | 0.43 | 0.70 | 0.33 | 0.19 | 0.47 | 0.52 | 0.30 | 0.49 | 0.30 | -0.15 |
| Spain | 0.34 | m | m | 0.53 | m | m | 0.25 | m | m | m | m |
| Sweden | 0.04 | 0.55 | 0.51 | -0.03 | 0.37 | 0.37 | 0.01 | 0.11 | 0.31 | 0.29 | 0.06 |
| Turkey | -0.03 | 0.26 | 0.08 | 0.12 | 0.42 | 0.20 | 0.09 | 1.05 | 1.00 | m | -0.01 |
| UK (England) | 0.51 | 0.26 | 0.38 | 0.47 | 0.35 | 0.30 | 1.06 | 0.61 | 0.59 | 0.26 | -0.13 |
| UK (Northern Ireland) | 0.47 | m | m | 0.49 | m | m | 0.69 | m | m | m | m |
| United States | 0.24 | 0.44 | 0.45 | 0.26 | 0.49 | 0.31 | 0.52 | 0.40 | 0.42 | 0.09 | 0.14 |
| US (Massachusetts) | m | 0.10 | 0.14 | m | 0.10 | 0.23 | m | -0.24 | 0.06 | m | 0.19 |
| US (Minnesota) | m | 0.15 | 0.08 | m | -0.02 | 0.03 | m | -0.08 | 0.00 | m | 0.38 |
| **OECD (average)** | **0.26** | **0.42** | **0.43** | **0.27** | **0.33** | **0.37** | **0.39** | **0.45** | **0.51** | **0.18** | **0.07** |
| **OECD (av. absolute)** | **0.33** | **0.43** | **0.44** | **0.33** | **0.42** | **0.39** | **0.45** | **0.45** | **0.51** | **0.26** | **0.24** |
| Hong Kong, China | 0.73 | 0.34 | 0.58 | 0.98 | 0.33 | 0.53 | 0.99 | 0.62 | 0.72 | -0.06 | 0.12 |
| Indonesia | m | 0.22 | 0.07 | m | -0.55 | -0.30 | m | 0.28 | 0.28 | m | 0.05 |
| Russian Federation | 0.62 | 0.64 | 0.71 | 0.45 | 0.49 | 0.41 | 1.23 | 0.89 | 0.79 | 0.51 | -0.65 |
| Singapore | 0.50 | 0.54 | 0.53 | 0.36 | 0.41 | 0.55 | 0.81 | 0.63 | 0.55 | 0.47 | 0.26 |
| South Africa | m | 0.43 | 0.38 | m | 0.45 | 0.46 | m | 0.54 | 0.46 | m | -0.13 |

Effect size from -0.5 to -0.2 and from 0.2 and 0.5

Effect size from -0.8 to -0.5 and from 0.5 and 0.8

Effect size equals or less than -0.8 and equals or greater than 0.8

*Source:* Authors' calculations based on TIMSS (2007, 2011 and 2015).

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# Part II.
# Innovation by level and category of practice and educational performance

# Chapter 14.
# Innovation by education level and broad category of practice

*This chapter synthesises the changes in individual practices by grouping in four categories: the level of education (primary and secondary), the discipline (science, mathematics, reading), the type of innovation (homework, etc.), and technology-related practices.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

# Innovation in primary and secondary education

## Innovation in primary and secondary education: moderate

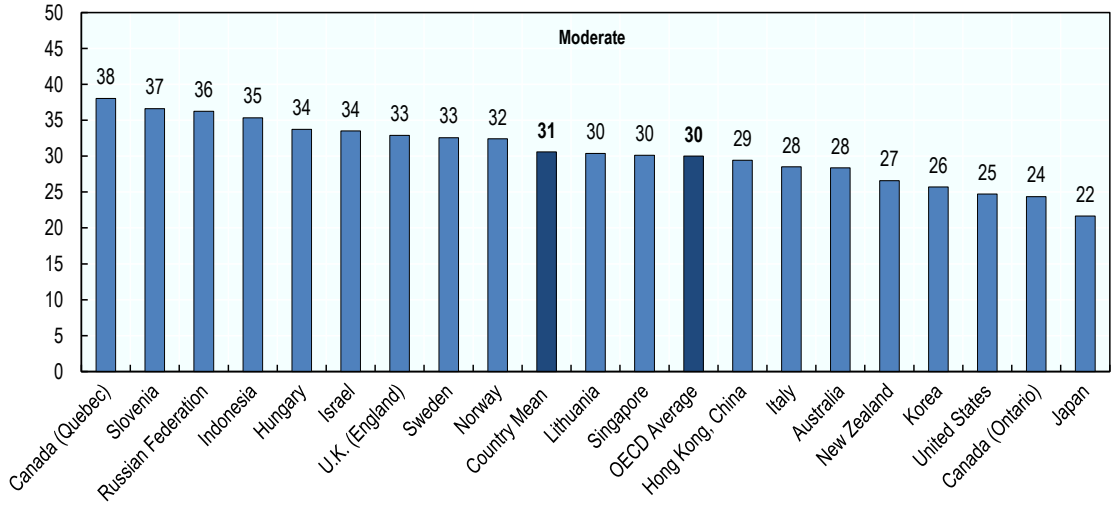
Over the past decade, all countries for which we could compute an innovation index for primary and secondary education had moderate levels of innovation. Students in Quebec (Canada), England (United Kingdom) and Slovenia have experienced the most change, whereas students in Ontario (Canada), Japan and the United States have had a more stable educational experience.

## Drivers of change

What has driven innovation (or stability) varies across countries. In Quebec (Canada), innovation mainly occurred in mathematics and science education practices, while in Slovenia, the Russian Federation and England (United Kingdom), it was spread across all fields. Japanese students experienced less change than their OECD counterparts because of lower change in ICT-based practices and in mathematics education. In Ontario (Canada), lower levels of innovation came from a greater stability in secondary education and, more generally, in science education.

At the OECD level, the change was primarily driven by innovation in mathematics education, with balanced levels of change in primary and in secondary education. Practices related to peer learning among teachers as well as computer availability in schools contributed the most to the average level of innovation.

**Figure 14.1. Innovation in primary and secondary education (2006-16)**




*Notes*: The innovation index synthesises educational innovation across all education levels and practices in the covered education systems. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 40 as moderate, and over 40 as large. See Annex B for more details. For Korea (2011-2015), New Zealand (2011-2015), Australia (2011-2016) and Indonesia (2006-2011), the index has been calculated for an interval shorter than and different from 2006-16 due to unavailability of data.
*Source*: Authors' calculations, based on TIMSS, PIRLS and PISA Databases.

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# Innovation in primary education

## Innovation in primary education: moderate

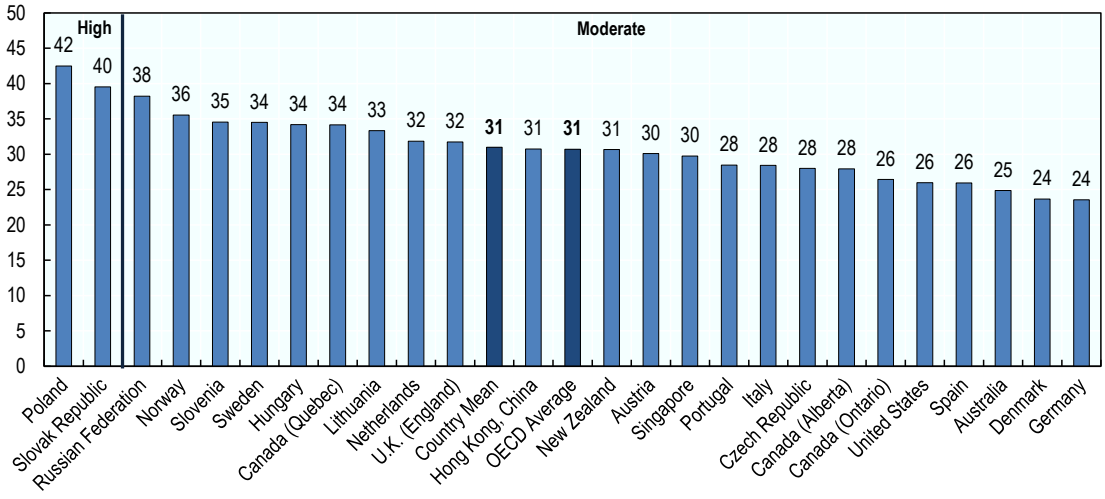
Over the past decades, almost all countries had moderate levels of innovation in primary education. In Germany, Denmark and Australia, students have experienced the least innovation in primary education practices. In Poland, the Slovak Republic and the Russian Federation, students were exposed to the greatest levels. (Poland is not fully comparable though, as innovation is measured over a shorter period for some indicators (2011-2015)).

## Drivers of change

The drivers of change differ among the countries with the most and least changes. In Poland, there was more innovation in science education practices than in mathematics, while the reverse is true in the Slovak Republic. In both countries, reading practices have remained more stable. At the lower other end of innovation, students in Denmark and Germany experienced little change across all disciplines. In fact, in primary education, change in mathematics and science education practices was similar, at a moderate level, while reading practices remained more stable.

At a more detailed level, students experienced the most change in the use of computers in maths, science and reading lessons. They were exposed to little change in reading pedagogical practices and in the formal training received by their teachers.

**Figure 14.2. Innovation in primary education (2006-16)**




*Note*: The index synthesises changes in all primary education practices. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. See Annex B for more details. For Poland (2011-2015), Slovak Republic (2011-2016), Austria (2011-2016), Czech Republic (2011-2016), Canada (Alberta) (2006-2011) and Spain (2011-2015), the index has been calculated for an interval shorter than and different from 2006-16 due to unavailability of data

*Source*: Authors' calculations based on TIMSS and PIRLS Databases.

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## Innovation in secondary education

### Innovation in secondary education: moderate

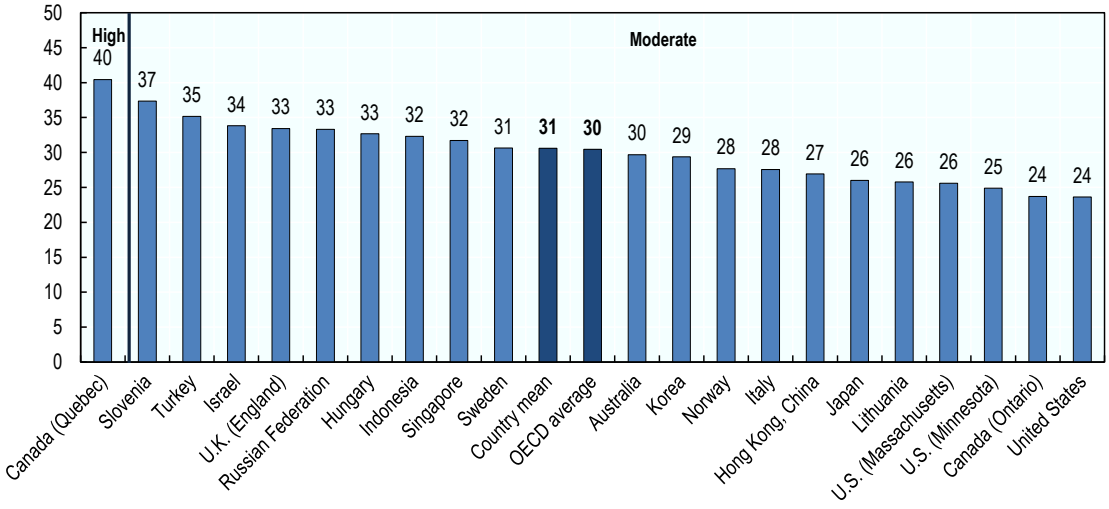
Innovation in educational practices in secondary education has been moderate. Students in Quebec (Canada) have experienced large levels of innovation in secondary education, followed by students Slovenia, Turkey and Israel. On the contrary, in the United States, students experienced a moderate-low level of innovation in secondary education, both at the country level and in the US states covered in the report. Students in Ontario (Canada) were also exposed to relatively little change in their educational practices in secondary education, a contrast to their peers in the neighbouring Quebec province.

### Drivers of change

Changes in mathematics education practices explain the high levels of innovation in Quebec and Slovenia. In Turkey, innovation was evenly distributed between maths and science education practices. In Quebec and Slovenia, the decrease in computer availability in school was a significant change for students. As for the more stable systems, the United States recorded only modest changes in maths and science education practices, with very little change in school level and non-disciplinary practices.

Overall, innovation in secondary education has mainly affected maths education practices. Teacher professional development through peer learning as well as homework practices have contributed the most to change, while the share of students with teachers having taken some formal teacher training remained very stable.

**Figure 14.3. Innovation in secondary education (2006-15)**




*Note*: The index synthesises changes in all secondary education practices. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. See Annex B for more details. For Massachusetts and Minnesota (United States) (2007-2011), the index has been calculated for an interval shorter than and different from 2006-15 due to unavailability of data

*Source*: Authors' calculations based on TIMSS and PISA Databases.

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# Innovation in reading education

## Innovation in reading education: moderate

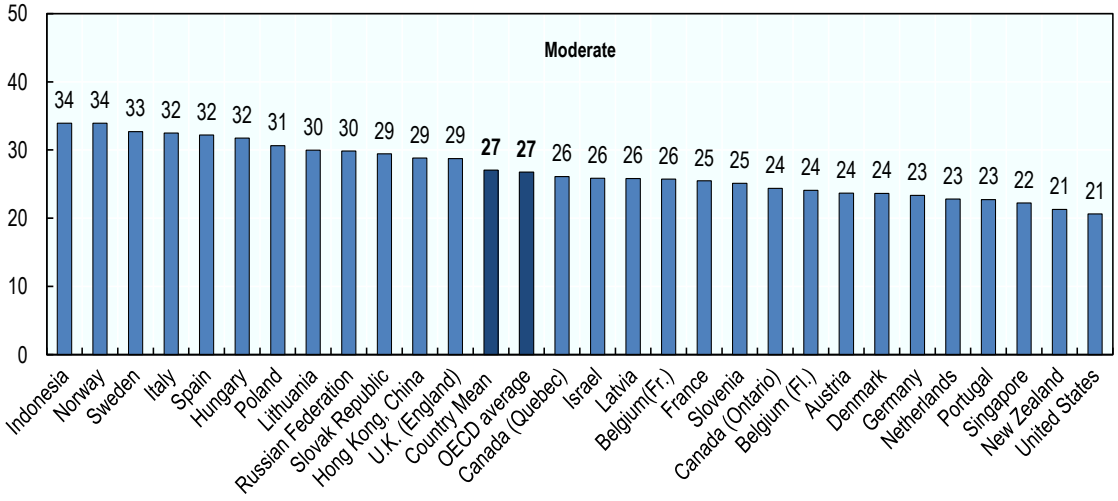
Innovation in reading practices in primary education has been moderate on average, and a bit lower than in maths and science. There was less variation and amplitude in innovation levels across countries compared to science and maths education. Students in Norway, Sweden and Indonesia (albeit over a shorter time period) have experienced the most innovation in their reading teaching and learning practices. In the United States, New Zealand and Singapore, pedagogical practices related to reading remained relatively stable.

## Drivers of change

A common driver of change in reading teaching and learning practices across education systems lay in a significant change in the use and availability of ICT in reading lessons. Otherwise, innovation in reading education practices can be traced back to system-specific changes rather than common international patterns. Changes in specific practices did not necessarily go in the same direction across systems.

In Indonesia, students were exposed to more innovation in assessment practices; in Sweden and Norway, what changed the most for students included a variety of other areas, from collaborative or personalised practices in reading to practices aiming to develop language art skills. In these three countries, reduced access to computers in reading lessons was a major common change for students at the system level.

**Figure 14.4. Innovation in reading education (2006-16)**




*Note*: The index synthesises changes in reading education practices in primary education. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. See Annex B for more details. For Indonesia (2006-2011), Slovak Republic (2011-2016) and Portugal (2011-2016), the index has been calculated for an interval shorter than and different from 2006-16 due to unavailability of data
*Source*: Authors' calculations. Based on PIRLS Databases.

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# Innovation in mathematics education

## Innovation in mathematics education: moderate

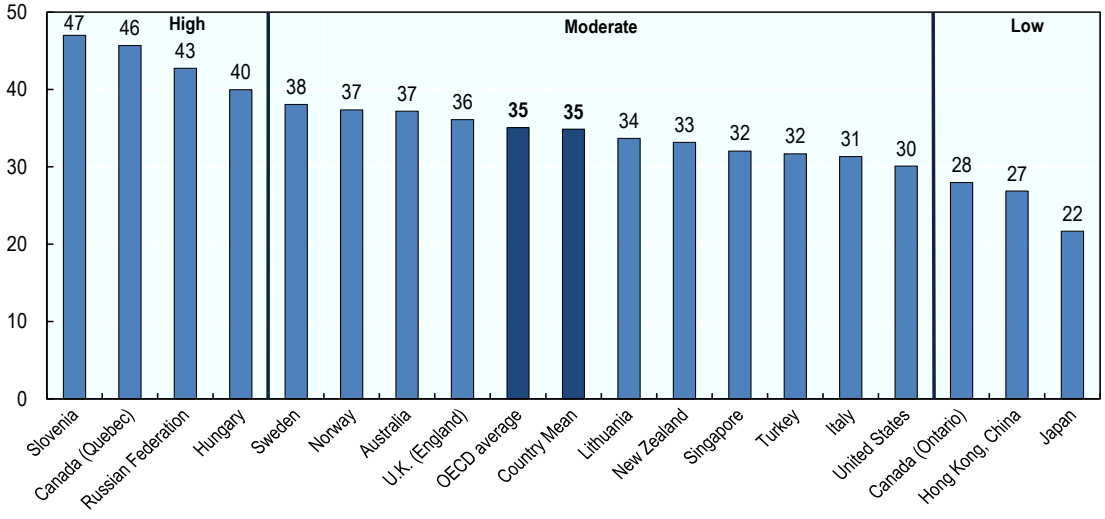
Innovation in maths education practices in primary and secondary education has been moderate on average, but larger than innovation levels in science or reading. This has been the field in which students have experienced the most change in their educational experience in the OECD area over the past decade. In Slovenia, Quebec (Canada), the Russian Federation and Hungary, students have experienced large levels of change between 2007 and 2015. At the other end, maths education in Japan has remained relatively stable compared to other countries. There were significant differences in the magnitude of change across countries: Slovenia recorded over twice as much innovation in maths education practices as Japan.

## Drivers of change

In most of the countries where maths education practices have seen large changes, it happened more in primary than in secondary education. Large changes occurred in computer availability and use during maths lessons. In Slovenia, students experienced large changes in the assessment practices in maths education. Across the board, professional development through peer learning among maths teachers also explains this relatively large level of innovation.

On average, innovation came from substantial changes in ICT use in maths lessons and in more students having teachers doing professional development through peer-learning activities.

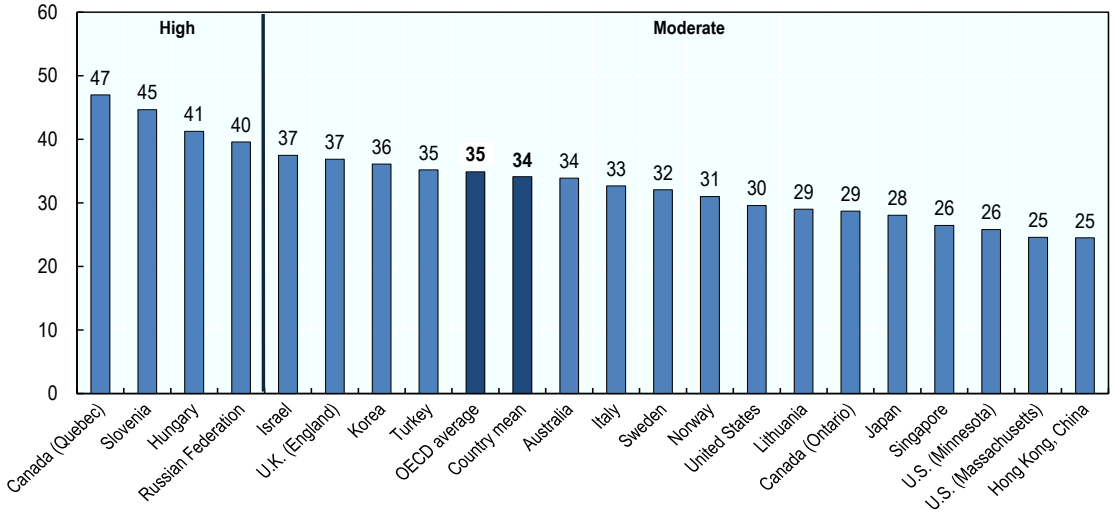
**Figure 14.5. Innovation in mathematics education (2007-15)**




*Note*: magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. See Annex B for more details. For Turkey (2011-2015) and New Zealand (2011-2015), the index has been calculated for an interval shorter than and different from 2007-15 due to unavailability of data.
*Source*: Authors' calculations Based on TIMSS Databases.

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**Figure 14.6. Innovation in secondary mathematics education (2007-15)**




*Note*: For U.S. (Minnesota) and U.S. (Massachusetts), the index has been calculated for 2007-11 instead of 2007-15 due to unavailability of data
*Source*: Authors' calculations based on TIMSS databases.

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# Innovation in science education

## Innovation in science education: moderate

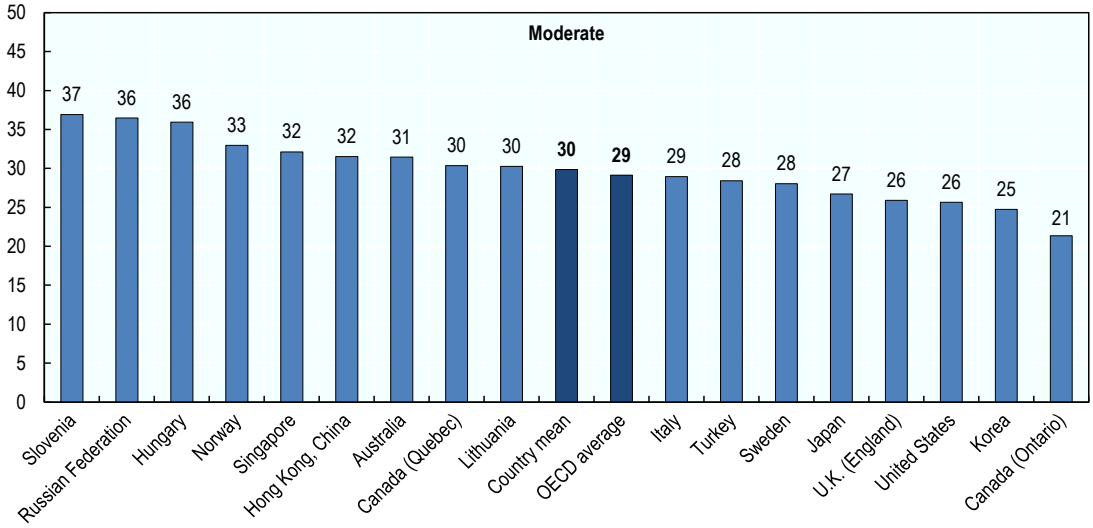
Innovation in science education practices in primary and secondary education has been moderate on average. Students in Slovenia experienced the largest change in science education practices, as was also the case for maths education. Innovation was also relatively large in the Russian Federation and Hungary. Students in Ontario (Canada) experienced only modest changes in science education practices, less than in other systems.

## Drivers of change

On average, changes in science practices across the OECD area have been equally distributed between primary and secondary education. The main areas of change were the use of ICT in science class, of teacher peer learning and of both active learning and direct transmission teaching practices.

Countries with the most innovation have often experienced more changes in primary than in secondary education. In education systems where innovation in science education has been smaller, innovation was more evenly balanced between primary and secondary education. The practices that have changed the most vary across countries. Slovenia experienced high levels of innovation in assessment practices, the Russian Federation, high levels of innovation in ICT-based practices, and Hungary, significant changes in independent knowledge acquisition practices. There was thus no common innovation pattern across countries.

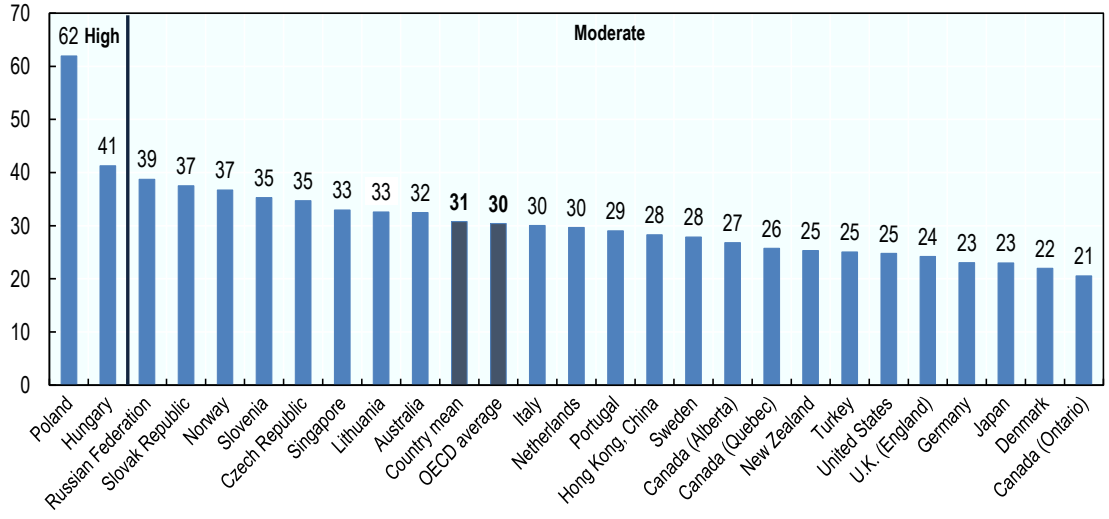
**Figure 14.7. Innovation in science education (2006-15)**




*Note*: The index synthesises changes in all science education practices in primary and secondary education. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. See Annex B for more details. For Turkey (2011-2015) and Korea (2011-2015), the index has been calculated for an interval shorter than and different from 2006-15 due to unavailability of data.
*Source*: Authors' calculations based on TIMSS and PISA Databases;

StatLink https://doi.org/10.1787/888933906652

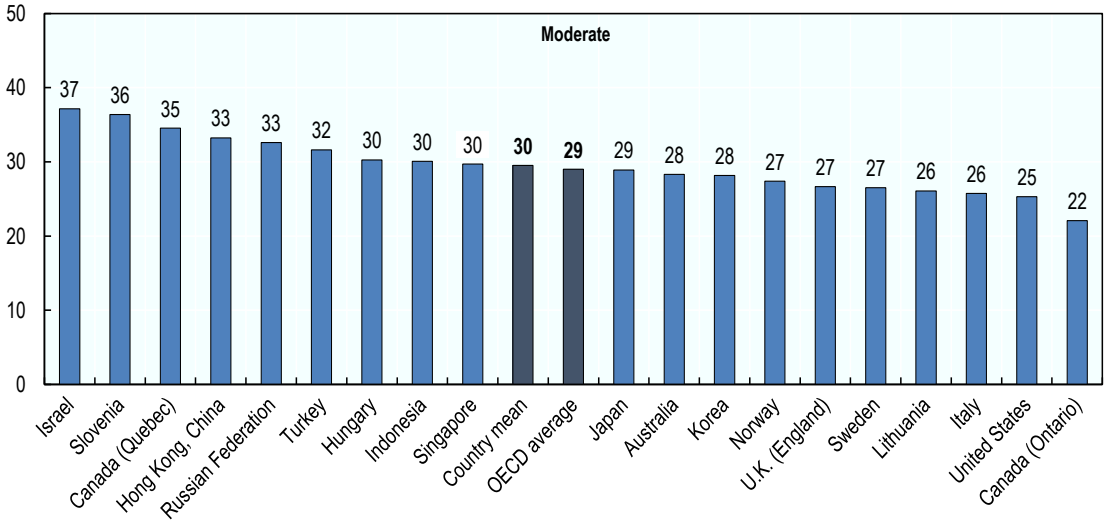
**Figure 14.8. Innovation in primary science education (2007-15)**




*Note*: For Turkey and Portugal, the index has been calculated for 2011-15 instead of 2007-15 due to unavailability of data
*Source*: Authors' calculations based on TIMSS Databases.

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**Figure 14.9. Innovation in secondary science education (2006-2015)**




*Note*: For Indonesia, the index has been calculated for 2007-11 instead of 2007-15 due to unavailability of data
*Source*: Authors' calculations based on TIMSS and PISA Databases.

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## Innovation in the availability of computers in schools

### Innovation in the availability of computers in schools: large

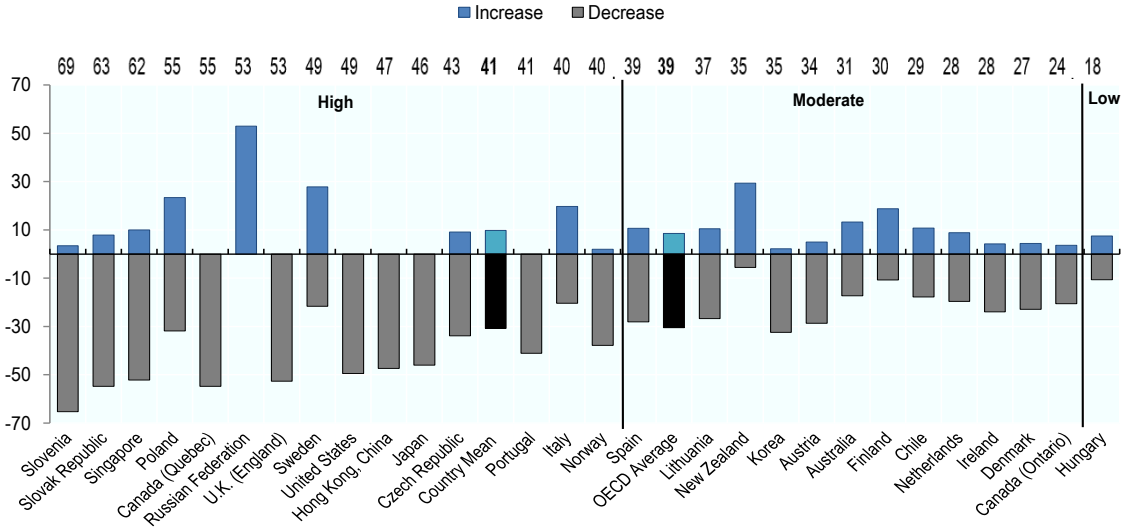
Students have experienced large innovation in the availability of computers (including tablets) for use in primary and secondary school lessons over the past decade. As digitalisation has made ICT ubiquitous, this may appear paradoxical. The levels of availability remain high (at about 80% of students having access on average for most indicators), but there was a consistent downward trend that correspond to a large effect size. This trend may be explained by a learning curve about the right amount and availability of devices in school. It is also possible that computer availability has taken new forms that are not captured by the international surveys used in this report, for example the use of students' personal devices or the use of computers outside of class.

In the Russian Federation, there was no decrease in any indicator of computer availability. New Zealand, Sweden and Finland experienced more increase than decrease. In all other countries, change mainly corresponded to a decrease in computer availability, with the largest decreases in Slovenia, Quebec (Canada) and the Slovak Republic.

### Drivers of change

In all countries, students were exposed to large decreases in the availability of computers in school and during maths, sciences and reading lessons. Portable computers have become more available (except in Japan and Portugal).

**Figure 14.10. Innovation in ICT availability in schools (2006-16)**




*Note*: The index synthesises innovation in computer availability in school and during lessons. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index for ICT availability computed by summing the absolute values of increases and decreases. See Annex B for more details. For Ireland (2011-2016), Chile (2011-2015), Finland (2011-2016) and Portugal (2011-2016) the index has been calculated for an interval different from 2006-16 due to unavailability of data.
*Source*: Authors' calculations based on TIMSS, PIRLS and PISA Databases.

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# Innovation in the use of ICT in schools

## Innovation in the use of ICT in schools: moderate

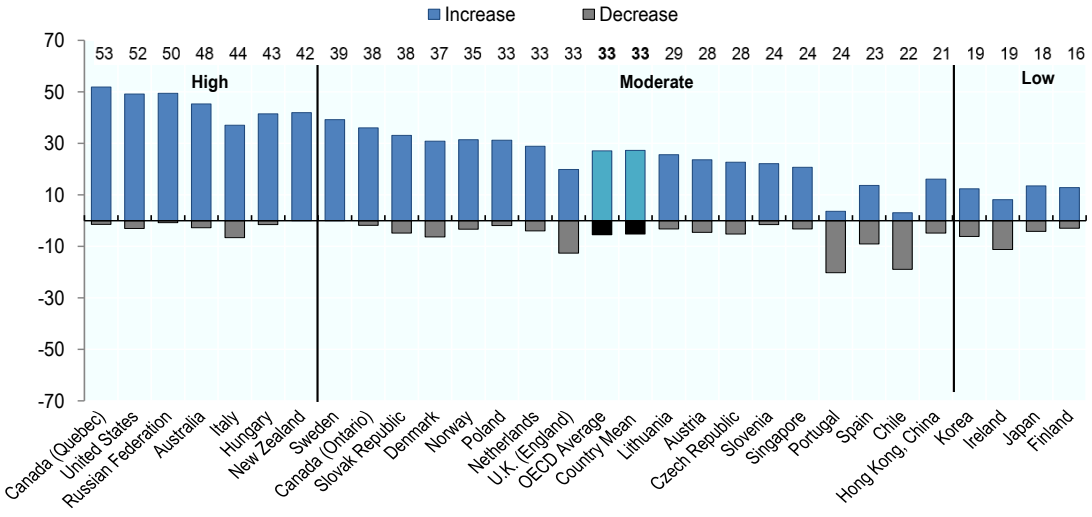
Where computers are available, more students have used them in their lesson or in schools over the past decades than in the past. Computers were used for multiple uses: practising maths, science or foreign languages, simulations, writing, or just looking for information. The use of ICT can enhance knowledge acquisition strategies, active learning pedagogies as well as the fostering of higher order skills.

On average, students have been exposed to moderate levels of innovation in the use of ICT in the last decade, with most pedagogical practices using ICT gaining rather than losing ground. Portugal, Chile and Ireland are the only countries where the use of ICT in schools has lost ground. Systems where these practices have increased significantly included Quebec (Canada), the Russian Federation, the United States, Australia, Italy and Hungary. In New Zealand and Sweden, all ICT-use related practices have increased.

## Drivers of change

In primary education, this increase is almost equally distributed across maths, science and reading education, with all three disciplines seeing large net increases. Major increases have concerned computer use to practice skills and procedures in both maths and science classes as well as to supplement reading lessons. In secondary education, decreasing ICT use occurred in maths education while increased ICT use was equally distributed between maths and science education. Similarly in secondary education, more students used computers to perform learning activities in maths and science. The share of students taught by teachers who received training on how to teach with ICT has decreased.

**Figure 14.11. Innovation in ICT use in schools (2006-16)**




*Note*: The index synthesises innovation in computer and ICT use in school and during lessons, conditioned to the availability of computers in schools or lessons. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in ICT use computed by summing the absolute values of increases and decreases. See Annex B for more details. For Finland (2011-2016), Ireland (2011-2016), Chile (2011-2015) and Portugal (2011-2016) the index has been calculated for an interval different from 2006-16 due to unavailability of data.
*Source*: Authors' calculations Based on TIMSS, PIRLS and PISA Databases.

StatLink https://doi.org/10.1787/888933906728

## Innovation in homework practices

### Innovation in homework practices: moderate

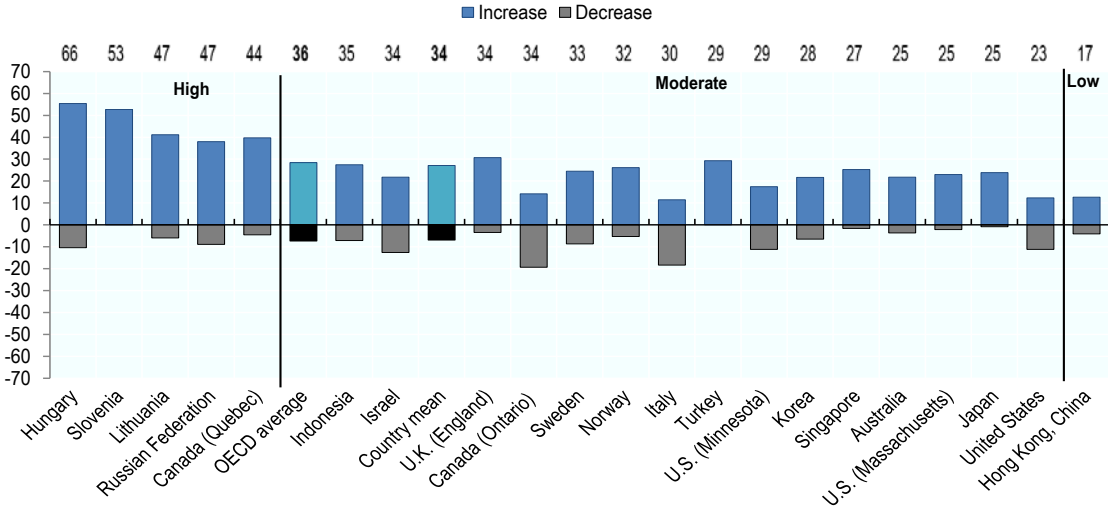
Innovation in the frequency, assessment and monitoring of homework in secondary education has been moderate in the past decade, but moderate-high. The practices covered include the frequency of homework, how homework is corrected, whether it is discussed in class, etc.

On average, students in the OECD area have seen the use of homework become more important in their science and maths education in the past decade. Students in Slovenia recorded no decreases in any homework practice covered, and alongside Hungary, Lithuania, Quebec (Canada) and the Russian Federation, experienced the largest levels of innovation in the use of homework practices. Apart from Ontario (Canada) and Italy, innovation was mainly driven by the spread of these practices. In fact, Italy and Ontario are the only places where homework has become less important to students' education, with considerable decreases in both homework frequency and the monitoring of their completion.

### Drivers of change

Most of the covered practices increased rather than decreased. In particular, discussion of maths and science homework in class has expanded significantly. While the frequency of homework has remained steady on average, it has increased significantly in a few countries and decreased moderately in most. On the other hand, monitoring homework completion has decreased in several countries: this is a worrisome innovation.

**Figure 14.12. Innovation in homework practices (2007-15)**




*Note*: The index synthesises innovation in homework practices. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in homework practices computed by summing the absolute values of increases and decreases. See Annex B for more details. For U.S. (Massachusetts), U.S. (Minnesota) and Indonesia the index has been calculated for the interval 2007-2011 instead of 2007-15 due to unavailability of data.
*Source*: Authors' calculations based on the TIMSS Databases.

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# Innovation in assessment practices

## Innovation in assessment practices: moderate

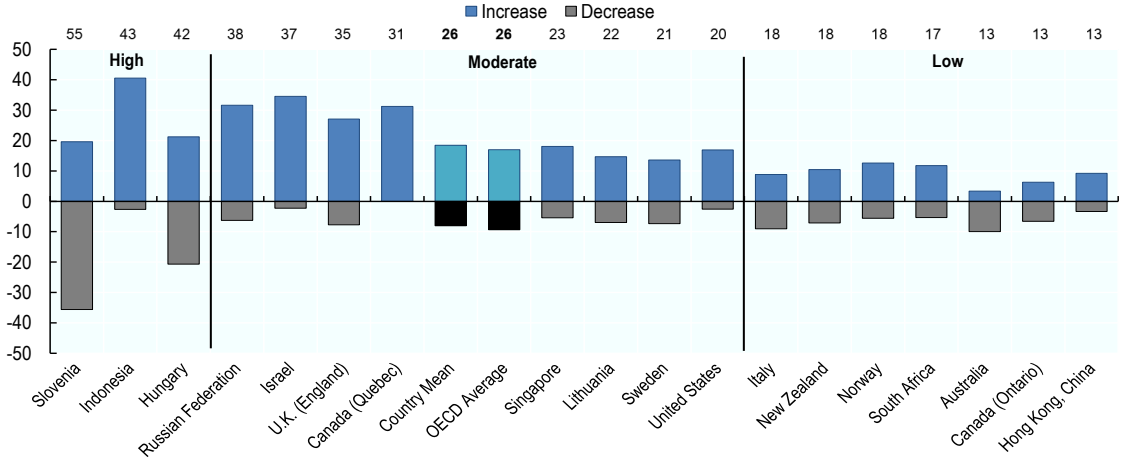
Assessment practices are an integral part of pedagogy, and increasingly of the monitoring of education systems. The assessment practices covered in this index include the frequency of feedback and correction of assignment, the importance of classroom tests, the emphasis on national or regional achievement tests.

On average, the use or emphasis on assessment has become more prevalent in students' education in the OECD area in the past decade. A majority of systems have placed more importance on assessment in their students' education. However, innovation in this area has taken two directions: the spread of some assessment practices has often been accompanied by a (smaller) decrease in others. Hungary and Slovenia registered large levels of innovation in this domain. In Slovenia, the emphasis on national and regional tests has decreased significantly, while classroom tests became less prevalent. In Hungary on the contrary, classroom tests have lost ground while the emphasis on regional and national achievement tests has increased. On the other hand, in Indonesia, Israel and Quebec (Canada), assessment has become more important in students' education. Students in Quebec have experienced an increase in all practices. In Quebec and Indonesia, tests in reading lessons have spread significantly, while in Israel assessment has mostly become more important in maths and science.

## Drivers of change

The diffusion of written and classroom tests in reading lessons has increased significantly in primary education. In secondary education, classroom tests increased more in science than in maths. The emphasis placed on national or regional or achievement tests increased in both science and maths.

**Figure 14.13. Innovation in assessment practices (2006-16)**




*Note*: The index synthesises innovation in assessment practices. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in assessment practices computed by summing the absolute values of increases and decreases. See Annex B for more details. For Australia (2006-2011), South Africa (2011-2015), New Zealand (2011-2015) and Indonesia (2007-2011).

*Source*: Authors' calculations based on the TIMSS and PIRLS Databases.

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## Innovation in active learning practices in science education

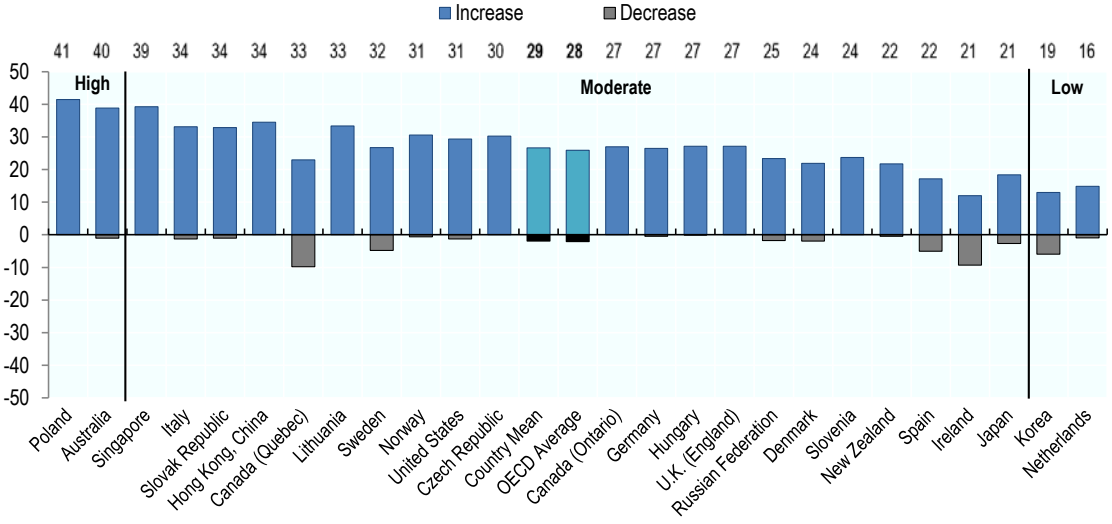
### Innovation in active learning in science education: moderate

Active learning practices are usually promoted as engaging and well suited for students to understand the nature of science. The covered active learning practices revolved around conducting, designing or simulating science experiments in primary and secondary education. On average, students have become more exposed to these practices over the past decade, which have corresponded to a moderate innovation. The direction of innovation has been relatively univocal, with only a few education systems experiencing small declines in some of these pedagogical activities. In Poland, Australia and Singapore, active learning in science has increased significantly. Conversely, in the Netherlands and Korea, they have remained pretty stable.

### Drivers of change

Active learning practices have particularly spread in primary science lessons, the main area of innovation in this area. For instance, more primary education students are given the opportunity to conduct or design experiments in science. Active learning pedagogies enhanced by ICT have also gained ground in both primary and secondary science education.

**Figure 14.14. Innovation in active learning practices in science education (2006-15)**




*Note*: The index synthesises innovation in active learning practices in science in primary and secondary education. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in active learning practices in science computed by summing the absolute values of increases and decreases. See Annex B for more details. For Ireland (2011-2015), Spain (2011-2015) and Poland (2011-2015) the index has been calculated for an interval different from 2006-15 due to unavailability of data

*Source*: Authors' calculations Based on the TIMSS and PIRLS databases.

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## Innovation in practices fostering higher order skills

### Innovation in practices fostering higher order skills: moderate

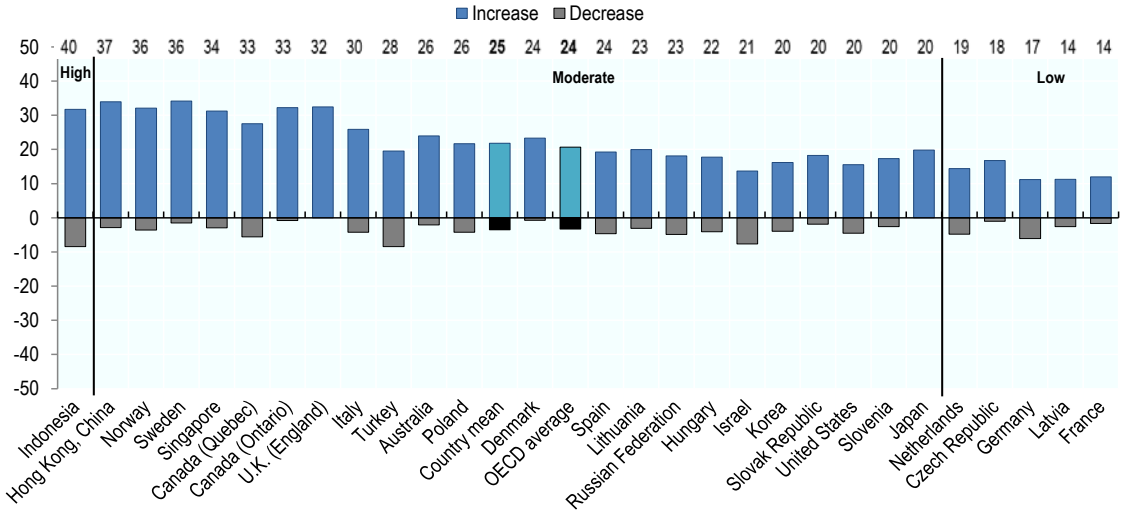
Many systems have put more emphasis in their curricula and policy discourse on the fostering of higher order skills, involving a deeper understanding of read texts or scientific phenomena, the development of critical thinking, the ability to draw inferences, to solve more complex problems, to be more observant and imaginative, etc.

On average, educational practices targeting the acquisition of higher order skills have spread across education systems, and have constituted a moderate-low innovation. Students in Indonesia and Honk Kong (China) have experienced larger innovation in this domain. These practices have also gained ground in Norway, Sweden, Singapore, Ontario (Canada) and England (United Kingdom). Reading lessons concentrated a large share of the innovation in this area in Indonesia, Honk Kong (China), Norway and Sweden: more students were often asked to predict what will happen after reading a text or to draw inferences from a reading. In France, Latvia, Germany and the Czech Republic, there was only very little innovation in this area.

### Drivers of change

At the OECD level, most of the innovation in this domain has taken place in science education. For instance, more students across the OECD were asked to observe and describe natural phenomena or design scientific experiments in primary and secondary education. At the same time, many other science practices remained very stable.

**Figure 14.15. Innovation in practices fostering higher order skills (2006-16)**




*Note*: The index synthesises innovation in practices fostering higher order skills. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in practices fostering high order skills computed by summing the absolute values of increases and decreases. See Annex B for more details. For the Czech Republic (2006-2011) and Indonesia (2006-2011) the index has been calculated for an interval different from 2006-16 due to unavailability of data
*Source*: Authors' calculations Based TIMSS, PISA and PIRLS Databases.

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# Innovation in rote learning practices

## Innovation in rote learning practices: moderate

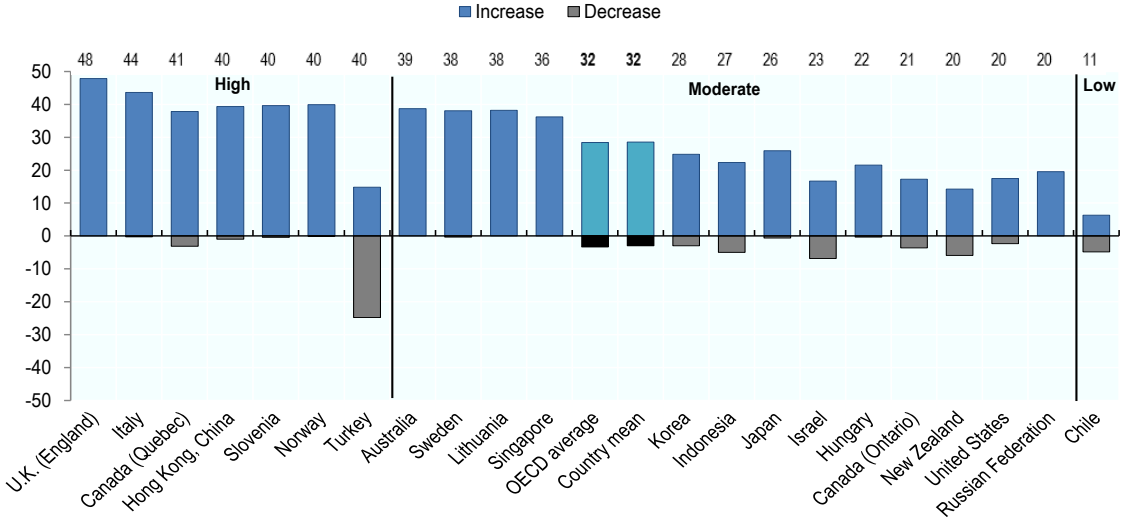
Rote learning has its strong critiques and promoters. While there should be some balance with other types of learning strategies, memorising rules, procedures and facts, reproducing procedures or learning new vocabulary systematically remain key learning practices.

In the last decade, more students have been exposed to rote learning practices, which constituted a moderate-high innovation. In England (United Kingdom), Italy, Quebec (Canada), Hong Kong (China), Slovenia or Norway, these practices have gained ground. In England, rote learning practices expanded in maths and to a lesser extent in science. In Italy, the use of memorisation in secondary education, in both maths and science lessons, has risen. In Quebec, innovation in this area mainly came from science. There was in fact no common pattern across countries with the most change. Turkey is the only country where students experienced high levels of innovation in this domain with a mix of decline and expansion of some of these pedagogical practices.

## Drivers of change

On average, the magnitude of change was similar between maths and science education, as well as between primary and secondary education.

**Figure 14.16. Innovation in rote learning practices (2006-16)**




*Note*: The index synthesises innovation in rote learning practices in maths and science in primary and secondary education, and to a lesser extent in reading. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in rote learning practices computed by summing the absolute values of increases and decreases. See Annex B for more details. For Chile (2011-2016) and New Zealand (2011-2016) the index has been calculated for an interval different from 2006-16 due to unavailability of data

*Source*: Authors' calculation Based on TIMSS, PIRLS and PISA Databases.

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## Innovation in independent knowledge acquisition practices

### Innovation in independent knowledge acquisition: large

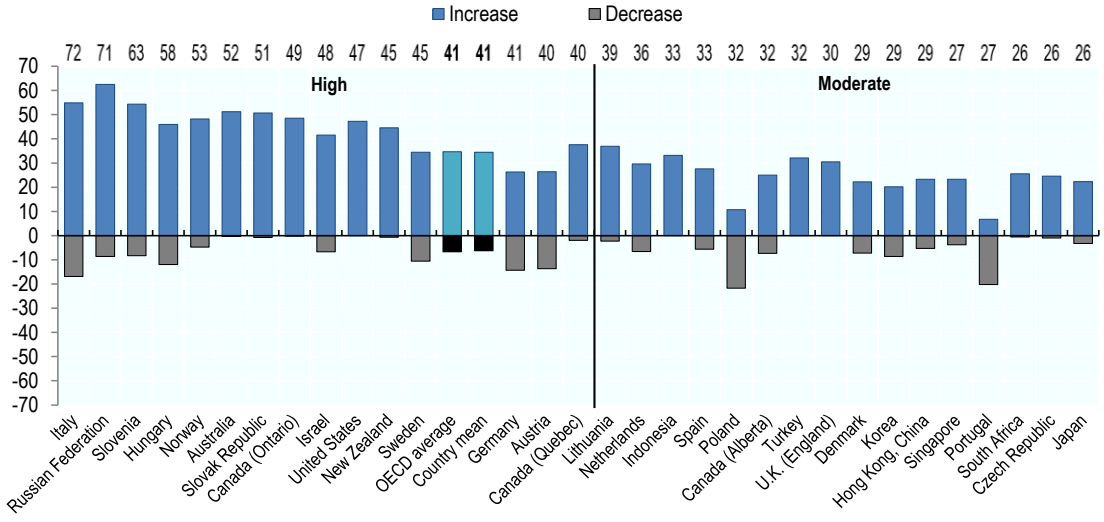
As part of the learning process, students are often asked to read books, textbooks and other resources or to look up for information and ideas on the Internet during class. This is what we call "independent knowledge acquisition".

On average, innovation in this area has been large in the past decade. In Italy, the Russian Federation, Slovenia, Hungary, Australia, the Slovak Republic, Ontario (Canada), Israel, the United States or New Zealand, students were exposed to large innovation in this area, with mainly an expansion of those covered practices. Japan experienced a moderate-low level of innovation in this area.

### Drivers of change

Innovation in this domain came from the spread of ICT-based practices to independently acquire knowledge in maths, science and reading: more primary and secondary students were regularly asked to use computer to look up for information and ideas during class in these three disciplines. This has particularly expanded in primary maths lessons. Very little change is observed concerning the reading of science textbooks. The main decrease recorded across countries corresponded to less students being asked to read non-fiction books in reading lessons.

**Figure 14.17. Innovation in independent knowledge acquisition practices (2006-16)**




*Note*: The index synthesises innovation in independent knowledge acquisition practices in science, maths and reading in primary and secondary education. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in independent knowledge acquisition practices computed by summing the absolute values of increases and decreases. See Annex B for more details. For South Africa (2006-2011), Portugal (2011-2016), Turkey (2011-2015), Poland (2011-2015), Spain (2011-2015) and Indonesia (2006-2011) the index has been calculated for an interval different from 2006-16 due to unavailability of data.
*Source*: Authors' calculations based on TIMSS and PIRLS Databases.

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## Innovation in the availability of school learning resources

### Innovation in the availability of school learning resources: moderate

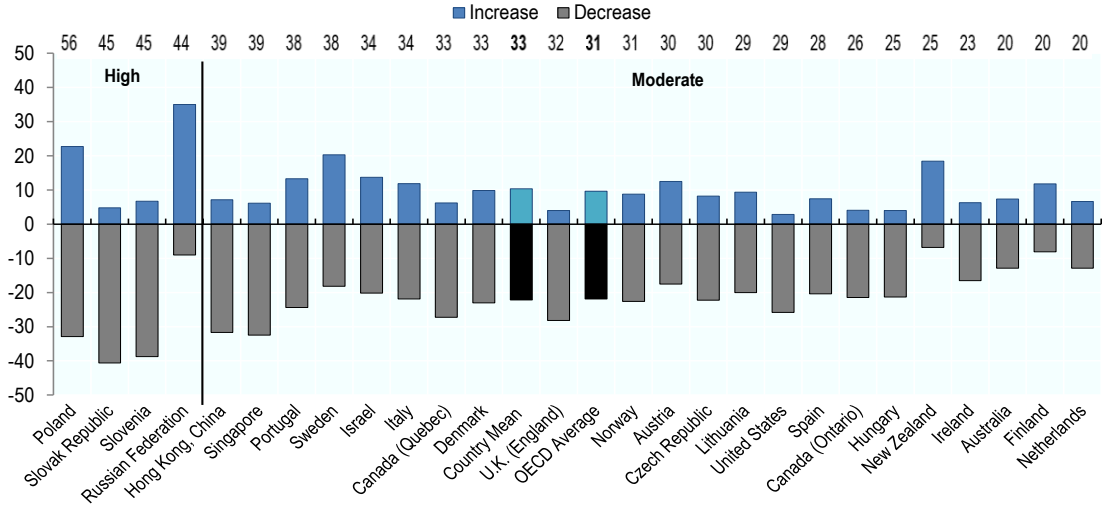
Learning resources available at school cover mainly two big areas in this report: the availability of reading resources (a library in the school or reading corners in classrooms) and the availability of computers in school or in class (including laptops or tablets). These learning resources available in school are of course supplemented by those available at home or in other public institutions (e.g. municipal library, if any).

Innovation in this domain has been moderate and has mainly taken the form of less students having access to the covered learning resources in their school or in their class. Students in Poland, the Slovak Republic, Slovenia and the Russian Federation have experienced big changes in the availability of learning resources at school. While this is driven by reduced availability in the first three systems, in the Russian Federation there has been a huge increase in learning resource availability. In the Netherlands, Australia, and Finland, availability remained largely stable.

### Drivers of the change

The decreasing availability of ICT resources, especially in the reading discipline, explains the change to a large extent. Less primary students also had access to a school library. Portable computers in schools are the only resource that has become consistently more available in schools, Portugal and Hong Kong (China) being the only two exceptions.

**Figure 14.18. Innovation in the availability of school learning resources (2006-16)**




*Note*: The index synthesises innovation in the availability of learning resources in school in science, maths and reading classes in primary and secondary education. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in the availability of school learning resources computed by summing the absolute values of increases and decreases. See Annex B for more details. For Finland (2011-2016), Ireland (2011-2016), the Czech Republic (2011-2016) and Portugal (2011-2016) the index has been calculated for an interval different from 2006-16 due to unavailability of data
*Source*: Authors' calculations based on TIMSS, PIRLS and PISA Databases.

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# Innovation in formal teacher training

## Innovation in teacher training: moderate

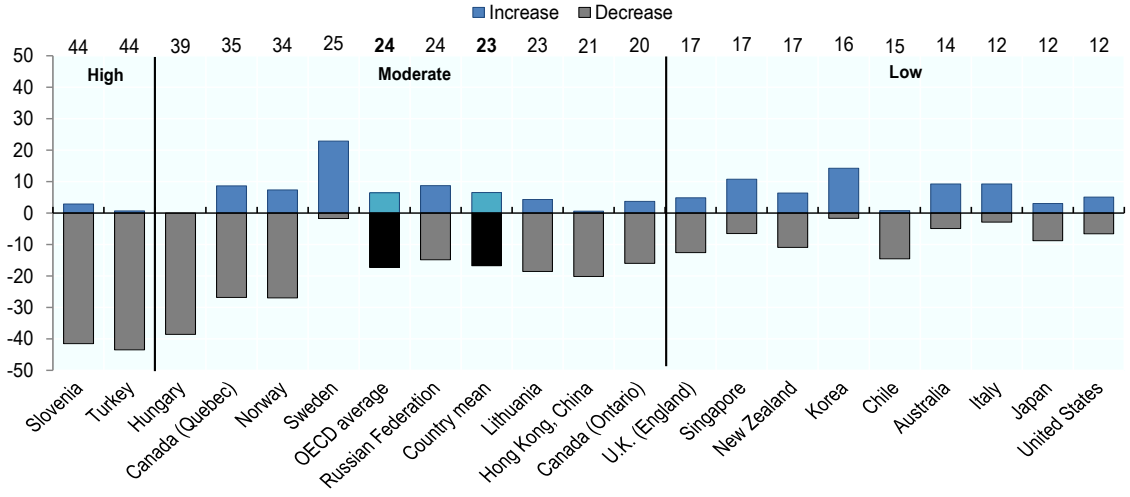
Innovation in upgrading and updating teachers' skills through formal training has been moderate over the past decade, in fact moderate-low: fewer students have been taught by teachers who had taken teacher training in their content area or in teaching their content in the past decade. Whether this is a "good" or "bad" innovation is difficult to say, as informal professional development can sometimes be as effective as formal training.

On average, the magnitude of the decreased teacher training practices overtook the increases. Only in Sweden and Korea were more students taught by teachers having taken formal teacher training. Sweden actually saw an increase in almost all practices of formal teacher training. At the other end of the spectrum, Hungary, Turkey and Slovenia witnessed large decreases, with Hungary recording increase in none of the teacher training practices covered. In Slovenia, the decrease was most pronounced in formal training for primary teachers while in Turkey, the fall was mostly due to less training by secondary teachers. In Hungary, teacher training decreased across disciplines and education levels. In many countries, teacher training remained stable over the period, with low levels of change – in fact lower than for most other areas of innovation we cover.

## Drivers of change

This negative decline of teacher training was common to both secondary and primary education, both maths and science, affecting mainly teacher training about maths or science content and curriculum.

**Figure 14.19. Innovation in formal teacher training (2007-15)**




*Note*: The index synthesises innovation in teacher training practices of students. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in formal teacher training computed by summing the absolute values of increases and decreases. See Annex B for more details. For Chile (2011-2015), Korea (2011-2015), New Zealand (2011-2015) and Turkey (2011-2015) the index has been calculated for an interval different from 2007-15 due to unavailability of data.
*Source*: Authors' calculations based on TIMSS Databases.

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# Innovation in teachers' peer learning

## Innovation in teachers' peer learning: large

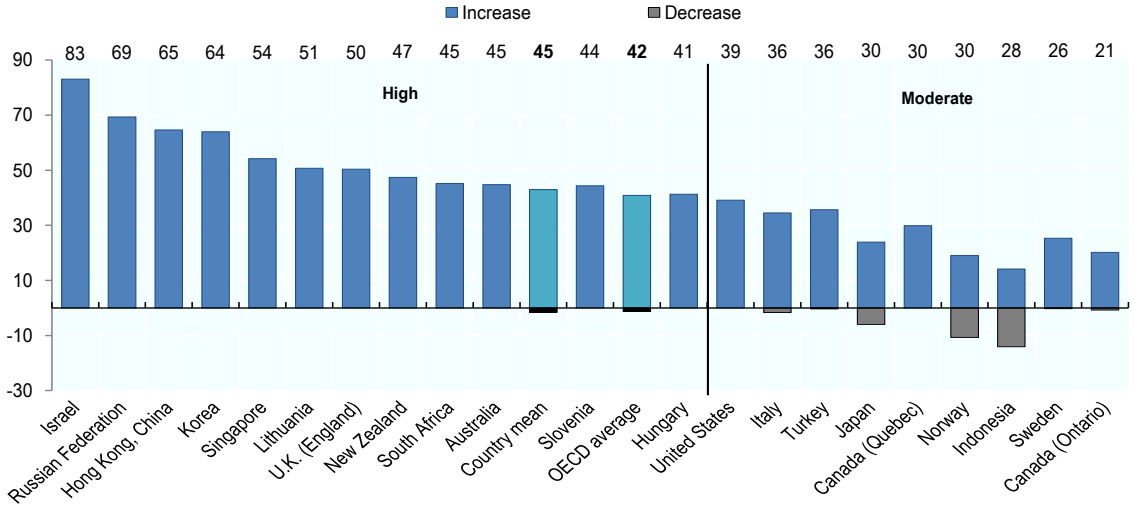
Peer learning is a strong form of professional development for teachers, often considered as more effective than formal training, partly because it is more strongly connected to teachers' needs. By coming together with their peers to discuss, collaborate or observe each other's practices, teachers develop professionally.

Contrary to formal training, which has mostly decreased, the rise of peer learning among teachers represents a large innovation on average, and at least a moderate one in all countries covered. Teachers engaged in peer learning activities taught a significantly higher share of students. In Israel, the Russian Federation, Hong Kong (China), Korea, innovation in this domain was very large, but it was also large in many other countries. In Israel, the practice skyrocketed in primary education, while in the other three most of the changes happened for secondary teachers. Indonesia and Norway are the only two countries to have seen some noticeable decrease in this practice, but all countries experienced a net increase in teacher peer learning.

## Drivers of change

Innovation in this domain has been large in both primary and secondary education, but changes in the latter have typically been greater than in the former. In secondary education, the practice has spread a little more for science than maths teachers. While all peer-learning practices have increased, collaborating with other teachers to prepare instructional material increased the most both in primary and secondary education.

**Figure 14.20. Innovation in teachers' peer learning (2007-15)**




*Note*: The index synthesises innovation in peer learning practices of teachers. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in teachers' peer learning computed by summing the absolute values of increases and decreases. See Annex B for more details. For Indonesia (2007-2011), Turkey (2011-2015), South Africa (2007-2011), New Zealand (2011-2015) and Korea 2011-2015).
*Source*: Authors' calculations based on TIMSS Databases.

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# Innovation in school external relations and human resource management (HRM)

## Innovation in school external relations and HRM: moderate

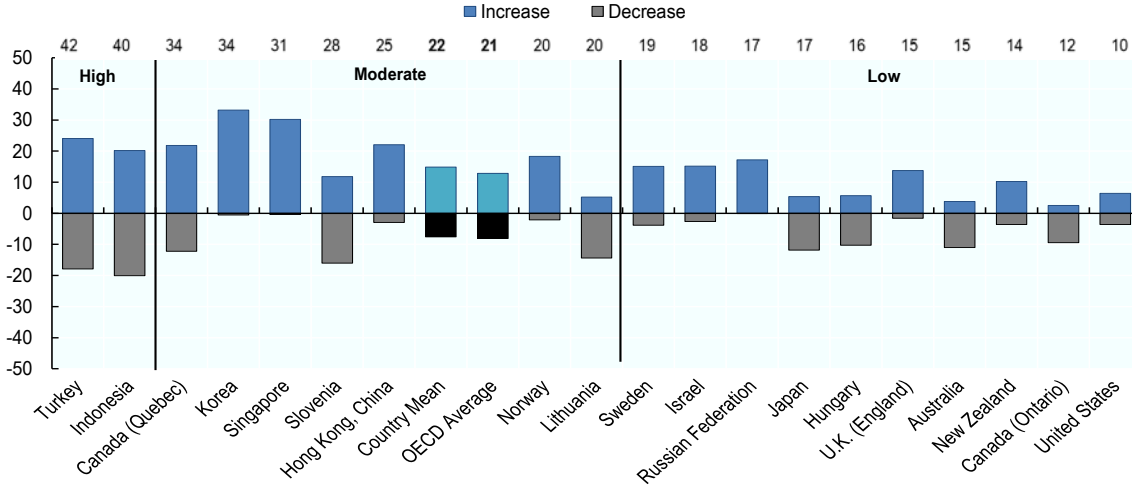
Innovation in education does not only concern pedagogical practices and resources, but also how schools relate to external stakeholders (such as parents) and their teachers. School external relations and HRM practices refer here to parental engagement (parental involvement in school activities, in helping in reading, public communication of school results) and to school practices to incentivise teachers to work and stay in the school.

Innovation in this area has been moderate in the past decade, in fact almost low. Turkey and Indonesia have experienced the most innovation in external relations and HRM practices, with positive and negative changes depending on the practices. Both countries have less used incentives to recruit or retain teachers in secondary education, while they increased the public posting and tracking of school achievement data. Parental involvement in school activities expanded in Québec (Canada), although parents were less mobilised to help in reading. Korea and Singapore have also experienced relatively large expansion of all these practices. In the United States, Ontario (Canada) and New Zealand, there was very little innovation in this area.

## Drivers of the change

Innovation has been low in the HRM practices covered, with very little change in the use of incentive policies for recruiting and retaining teachers in secondary schools. Parental involvement in school activities has increased, a bit more in secondary than in primary education. Public posting and tracking of school achievement data have met modest changes as well, with different trends across education systems.

**Figure 14.21. Innovation in external relations and HRM practices in schools (2006-16)**




*Note*: The index synthesises innovation in external relations and HRM practices in schools. The magnitude can be interpreted as an average effect size (multiplied by 100): levels below 20 can be considered as small, between 20 and 39 as moderate, and over 40 as large. The value on top is the composite index in external relations and HRM practices in schools computed by summing the absolute values of increases and decreases. See Annex B for more details. For New Zealand (2011-2016) the index has been calculated for an interval different from 2006-16 due to unavailability of data
*Source*: Authors' calculations based on TIMSS, PIRLS and PISA Databases.

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**Box 14.1. Construction of the composite indices in brief**

Composite indices synthesise the information of the individual practice indicators and correspond to systemic innovation in different broad areas in the covered education systems. A first set of indices proposes an aggregate measure of educational innovation in primary and secondary education altogether, and in primary and secondary separately. A second set captures innovation in the educational practices in mathematics, science, and reading. A third set of innovation indices focuses on computer availability and ICT use in schools. The fourth set of indices finally focuses on broad categories of practices related to education (pedagogical practices, teacher professional development, and school level practices). These indices are based on the same methodology, but could not be computed for all countries because of missing data. Some indices overlap, for example the technology-related indices and the indices by broad categories: they can thus not be compared directly.

A step-by-step construction of the indices followed the following process:

1. Practices were categorised under broad categories. For instance, the primary education innovation index groups all practices at that level; the homework practices index groups all practices related to homework; and so on.
2. Effect sizes were computed for every practice, quantifying the change in their use between the baseline and endline years. For every index, a weighted average of the effect sizes of its component practices was calculated. Equal weights were given to primary and secondary education while the weights for maths, science and reading reflect the relative time spent on them in terms of class hours. For instance, if maths, science and reading each are taught for 3, 4 and 3 hours a week respectively, their weights would be 0.3, 0.4 and 0.3 respectively.
3. The weighted average was multiply by a factor of 100 to reach the final composite index. By construction thus, the composite index is a positive number ranging from 0 to positive infinity. It can be interpreted as an average effect size (multiplied by 100). The higher the composite index, the higher the impact of the change in the use of the practices, and thus the innovation experienced by students in the educational system.
4. As a convention, and in line with the common interpretation of effect sizes, we refer to indices between 0 and 20 as small, between 20 and 40 as moderate, and over 40 as large. This is a continuum though.

For the indices by broad area of activity, the graphs show the final composite index as a number, while the bars highlight how much corresponded to an average expansion or contraction of the corresponding practices.

Annex B provides more about the details of the methodology adopted in the construction of the composite indices.

# Chapter 15.
# Innovation and educational outcomes

*This chapter examines the association between innovation and some educational outcomes at the country level: academic learning outcomes in primary and secondary education, the enjoyment of science, student satisfaction, equity, and educational expenditures. Beyond presenting some information about the past trends, the chapter aims to raise some questions that could be explored over time or with more granular data on innovation in education.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

## Linking innovation to educational outcomes

Innovation in education is not a goal in itself, but a means to achieve other educational objectives: improving learning outcomes, including students' wellbeing, improving cost-effectiveness and cost-efficiency, closing the achievement gap, improving teachers' learning and work satisfaction, etc. Measuring innovation in education is critical to see to what extent reforms (a top-down driver of innovation) and incentives for innovation are translating into actual change in classrooms and schools. This allows decision makers to assess whether their innovation policies and other policy reforms lead to the intended changes. It also allows them to get a better understanding of current practices and think about the mechanisms through which intended changes could actually occur.

Another key reason to measure innovation is to assess whether some innovations are good or bad. Ultimately, monitoring innovations, preferably at the micro level and with longitudinal data, should be a way to assess and identify what improves (or worsens) educational outcomes. This chapter aims to highlight this key objective in a heuristic way. While correlations at the macro-level of countries do not allow one to establish the direction of causality, they show whether there is an association between two variables and highlight the kind of questions one could better discuss and answer with more granular data.

This chapter looks at the links between pedagogical innovation and students' academic learning outcomes in primary and in secondary education, educational equity, students' satisfaction and enjoyment, but also the association between innovation and educational expenditures or teacher satisfaction. Some of the questions that one may want to be able to answer are as follows:

- Have past pedagogical innovations led to better learning outcomes? What are the drivers of positive change in education systems? Do some types of pedagogical innovation work better for some students than others and lead to close the achievement gap? Is innovation more likely in some contexts than others (for example where learning outcomes are lower or are declining)?
- How does innovation relate to educational expenditures? Most of the pedagogical innovation captured here does not require more expenditure. Some of it does though, for example teacher training or ICT devices. When or in which areas are increased or maintained educational expenditures a condition of educational innovation? When is it not the case? In some instances, one could imagine that innovation is a response to decreased educational expenditures. What are the links between available funds and practices within the classroom? Here is a second set of questions for policy makers.
- Innovation is a source of professional development for teachers. Is it also a source of satisfaction and wellbeing? How does it relate to their teaching efficacy and self-efficacy? When is it a source of stress? Is there a good level of innovation? While we can only glance at this issue, this is also an area to investigate.

## Innovation and academic outcomes in primary education

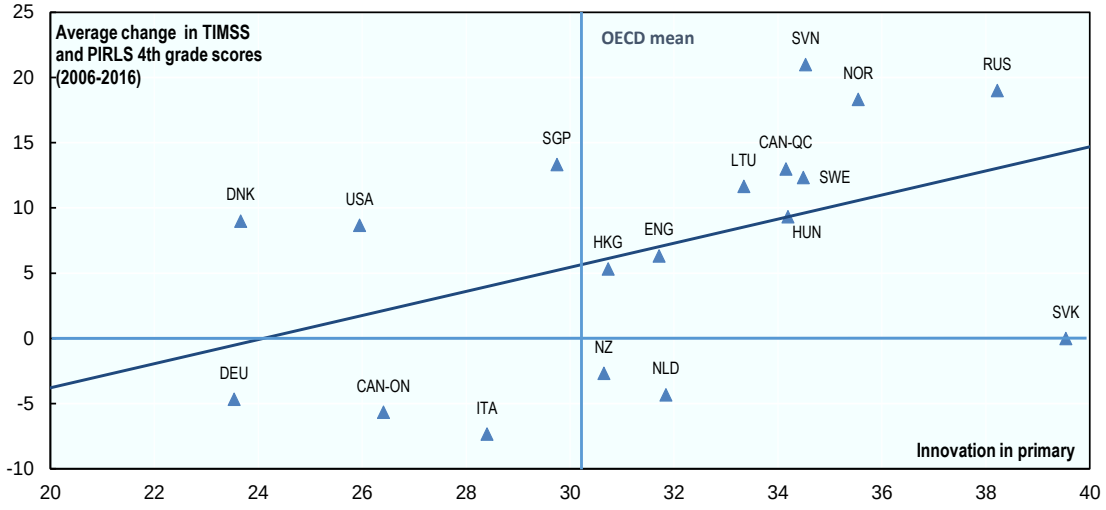
Is innovation in primary education associated with an improvement of academic learning outcomes? This is what one would hope. Although innovations may sometimes have other objectives (for example budget savings), one would expect innovation in mainly pedagogical practices to be associated with an improvement of students' academic learning outcomes. Of course, the expectation may not necessarily be met in reality.

In primary education the same teacher usually teaches all disciplines, so that innovation might have a cross-disciplinary effect and be linked to all learning outcomes. Innovation in all primary education practices and the average change in the learning outcomes for the three disciplines covered by the book are indeed positively associated. Innovation and improved learning outcomes have gone hand in hand.

At the disciplinary level, there was also a positive relationship between innovation in reading and positive change in reading scores, as well as between innovation in science education and positive change in science scores. (Due to a too small number of indicators on maths practices, we did not compute a separate maths innovation index for primary education.)

In most cases, higher levels of innovation are associated with stability or increases in students' learning outcomes, suggesting that innovation was not detrimental and sometimes beneficial to the systems where teachers innovated the most in their educational practices over the past decade. An alternative explanation may be that teachers in countries making the most progress in learning outcomes felt more secure to innovate and change their teaching and learning practices. That being said, in a few cases, above-average levels of innovation were associated with declining learning outcomes, reminding us that innovation might also be detrimental.

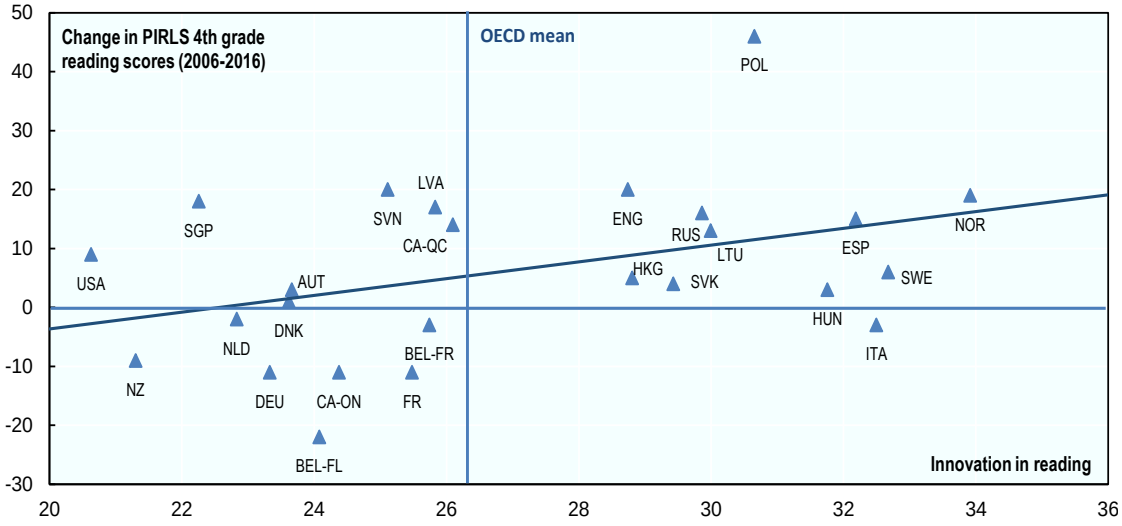
**Figure 15.1. Innovation in primary education and average change in primary science, maths and reading learning outcomes (2006-2016)**




*Note:* The correlation coefficient is equal to 0.47.
*Source*: Authors' calculations based on TIMSS and PIRLS Databases.

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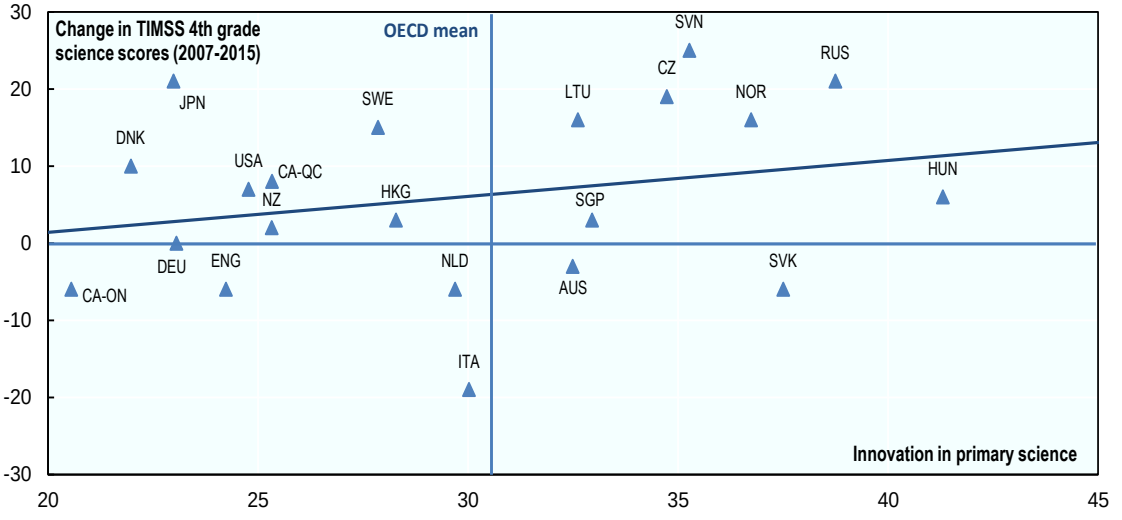
**Figure 15.2. Innovation in primary reading education and change in reading learning outcomes (2006-2016)**




*Note:* The correlation coefficient is equal to 0.40.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933906956

**Figure 15.3. Innovation in primary science education and change in science learning outcomes (2007-2015)**




*Note:* The correlation coefficient is equal to 0.25.
*Source*: Authors' calculations based on TIMSS databases.

StatLink https://doi.org/10.1787/888933906975

## Innovation and academic outcomes in secondary education

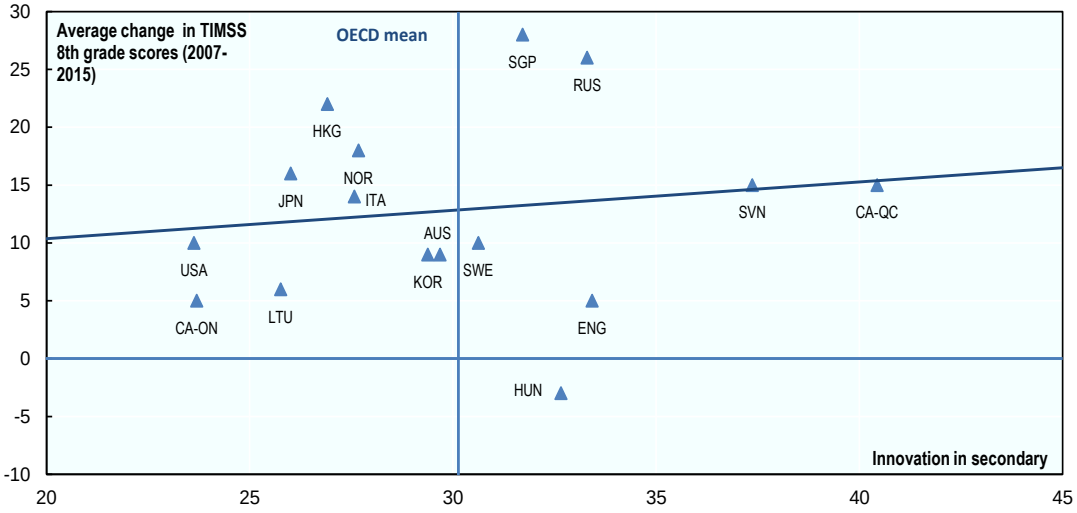
Is innovation in secondary education associated with improved academic learning outcomes? This is one what would hope, especially when innovation is mainly pedagogical. Innovation may sometimes have other objectives than the improvement of learning outcomes though, and even when it is their objective, past innovation may have just failed to achieve this goal.

There is a small positive association between innovation in our secondary education practices and the average change in the learning outcomes in maths and science. Given that in secondary education different teachers usually teach science and maths, there is less chances of cross-fertilisation between innovation in maths and science education. However, change in practices at the school or system level may have an impact.

Innovation in science education has been positively associated with the improvement of science learning outcomes in the last decade, whereas innovation in maths education has been negatively correlated with the improvement of maths outcomes. This reminds us that innovation does not necessarily lead to an improvement in the desired outcomes, exactly like policy reforms sometimes fail. This also raises the question of the lag time for innovation produce its effects, another question that the continuous study of innovation would allow one to answer.

The other direction of causality should also be taken seriously. In the case of mathematics, another possible interpretation could be that where teachers felt their students' learning outcomes decrease, they have changed their practices more, but perhaps not yet with observable success.

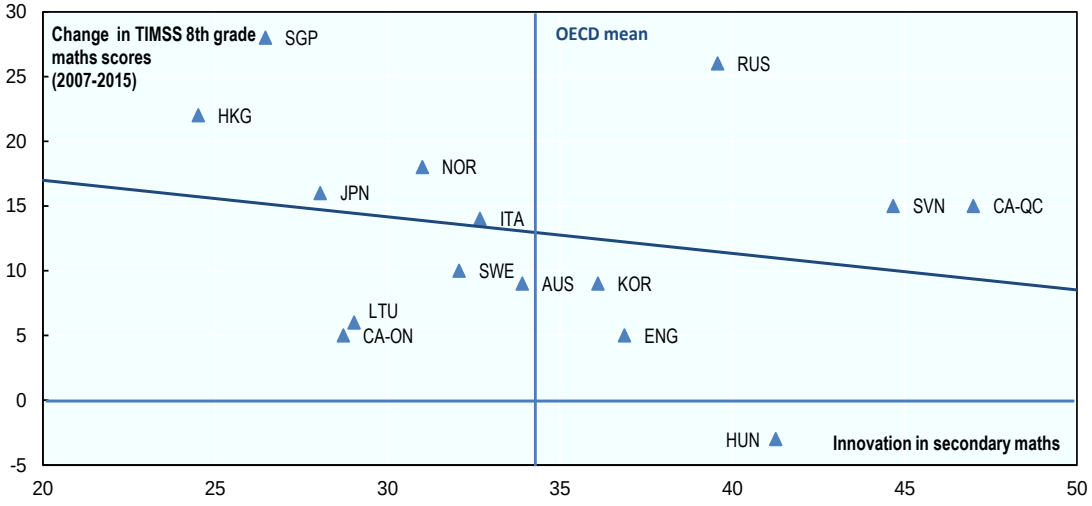
**Figure 15.4. Innovation in secondary education and average change in science and maths learning outcomes (2007-2015)**




*Note*: The correlation coefficient is equal to 0.22.
*Source*: Authors' calculations based on TIMSS Databases.

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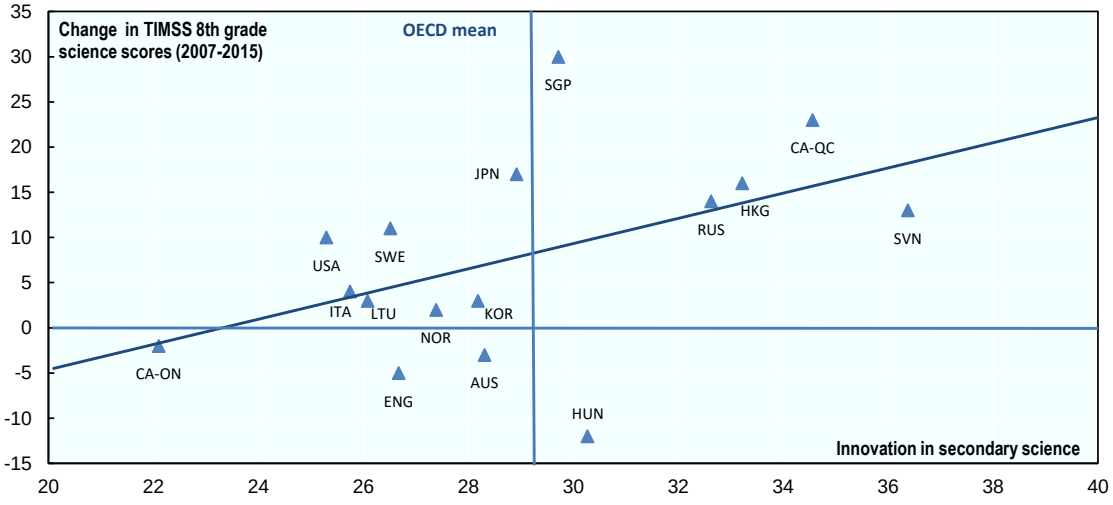
**Figure 15.5. Innovation in secondary maths education and change in maths learning outcomes (2007-2015)**




*Note:* The correlation coefficient is equal to 0.-0.22.
*Source*: Authors' calculations based on PISA and TIMSS Databases.

StatLink https://doi.org/10.1787/888933907013

**Figure 15.6. Innovation in secondary science education and change in science learning outcomes (2007-2015)**




*Note:* The correlation coefficient is equal to 0.48.
*Source*: Authors' calculations. Based on PISA and TIMSS databases.

StatLink https://doi.org/10.1787/888933907032

## Innovation and student enjoyment in science education

One of the strong pleas for innovation in education is that existing teaching and learning practices would often be irrelevant to students, who get bored in class and do not engage in their learning. Many feel that this is particularly true in science – and also particularly problematic given the (alleged) lack of interest of students for science careers and studies. Is there an association between innovation in science educational practices and students enjoyment of their science lessons?

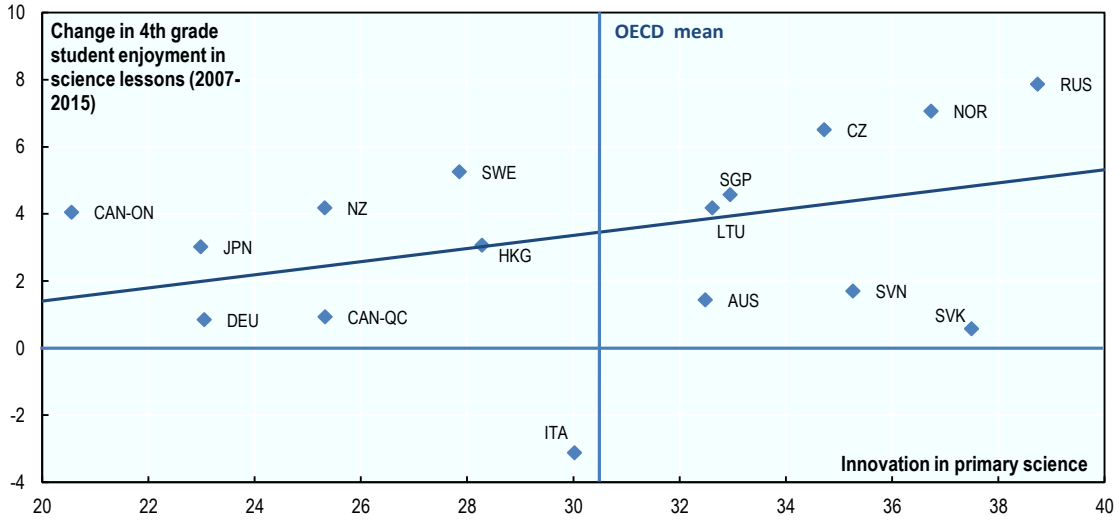
From another perspective, the emotional nature of learning has become more strongly acknowledged, and many teachers realise that the enjoyment of learning need not be an oxymoron. It also contributes to students' wellbeing. One would thus expect or hope that innovation in educational practices lead to enhanced student enjoyment of their learning in general, and in our case, in science in particular.

Both in primary and secondary education, there was a positive association between innovation in science education and the increase of students' enjoyment of their science lessons. We measure the enjoyment of science as the share of students in an education system reporting that they enjoy learning science at least a little. In primary education, all systems but Italy have had an increase in the enjoyment of science education, and this has been more often the case where innovation in science education practices has been more intense. Countries such as the Russian Federation or Norway have experienced both moderate-large innovation and greater enjoyment of science. The association is still positive, though not as strong in secondary education.

The direction of the causality may also run in the other direction. One could indeed imagine that, where a greater share of students start enjoying science (perhaps for reasons not captured in our book), it motivates teachers to change their teaching and learning practices. The (moderate) increase in active learning practices in science education could then be the outcome of a better learning climate as much as its cause.

While our aggregate data do not allow for any definitive conclusion, they show the kinds of questions that policy- and other decision-makers could answer with more systematic and refined data collections monitoring innovation and how education systems change over time. More granular data would make it possible to identify whether a mix of practices are associated to stronger increases in students' enjoyment of science and other disciplines. This could be true for a series of educational outcomes and skill acquisition.

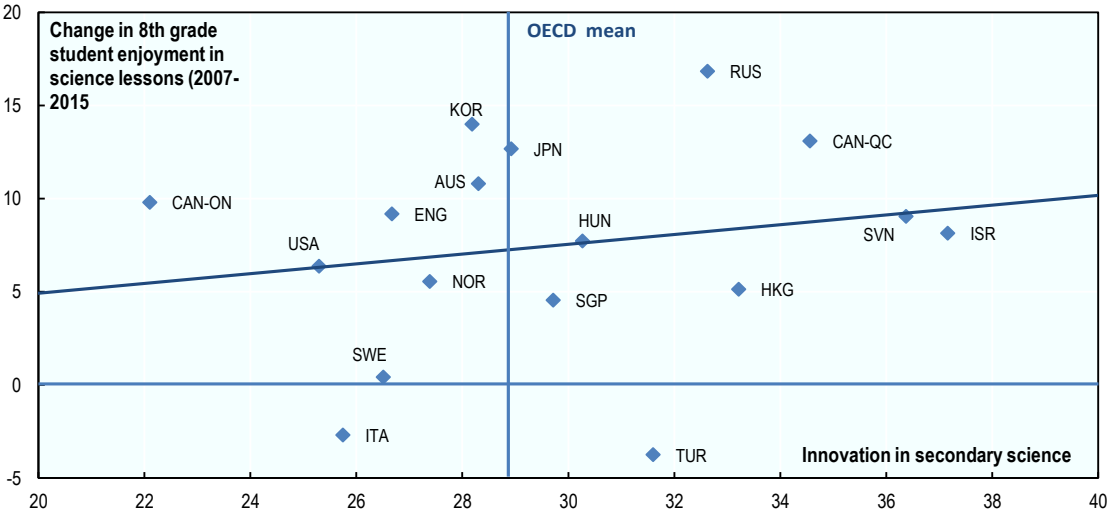
**Figure 15.7. Innovation in science education and change in student enjoyment of science lessons in primary education (2007-2015)**




*Note*: The correlation coefficient is equal to 0.40.
*Source*: Authors' calculations Based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933907051

**Figure 15.8. Innovation in science education and change in student enjoyment of science lessons in secondary education (2007-2015)**




*Note*: The correlation coefficient is equal to 0.19.
*Source*: Authors' calculations based on TIMSS and PISA Databases.

StatLink https://doi.org/10.1787/888933907070

## Innovation and student satisfaction

Wellbeing is both a skill that can be developed, and a function of the learning environment. Depending on their age, whatever they really think, students might find it not socially desirable to say that they like school. But sometimes they really do not like it... While this was seen as irrelevant in a not so distant past, and may still be seen as such in some schools or classes, most education systems now also aim to develop positive attitudes towards education and learning, both because this might lead to better academic outcomes but also just because it contributes to children's wellbeing (and possibly their likelihood to engage in lifelong learning). One can thus hope that past innovation has improved student satisfaction at school.

Perhaps because "innovation" is (usually) positively connoted, people often claim that innovation leads to greater student satisfaction. If nothing else, new pedagogical practices should make schooling more exciting and satisfactory. In fact, greater student satisfaction is a common finding of impact studies focusing on pedagogical interventions. Change itself may be an important element of satisfaction, and innovation may be useful for this sole reason: making people happier.

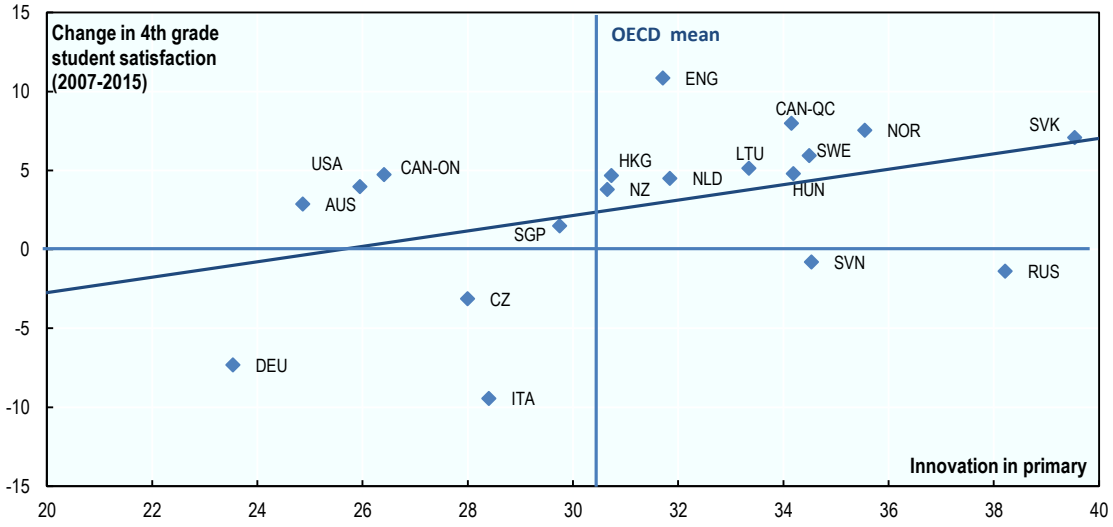
As innovation is not necessarily an improvement, it can also happen that learning conditions become worse than before, or that students enjoy less their learning environment. In that respect, policy makers and practitioners should be interested in how specific educational changes affect students' wellbeing in school – and to what extent certain levels of overall innovation have an impact on it.

In primary education, we find a positive association between educational innovation and student satisfaction, whereas in secondary education there is no association. We measure student satisfaction as the share of students reporting that they like being in school at least a little. The association in primary education supports the ideas that the change in the mix of educational practices has possibly gone in the right direction of improving student's liking of school, or even possibly driven this satisfaction given that, on average, greater levels of innovation were accompanied by greater increases of the share of satisfied students.

The lack of association in secondary education highlights that those assumptions are not self-evident and would require further investigation. The difference between secondary and primary education also lies in the fact that we only cover innovation in science and maths practices in secondary education, while our primary innovation index is more comprehensive and representative of what is learnt in primary education. More comprehensive measures may lead to different associations. Another possibility is that student satisfaction in secondary education depends on different factors than in primary education.

Longitudinal data concerning the same individuals and the mix of teaching and learning practices they experience would allow us to cast light on these issues.

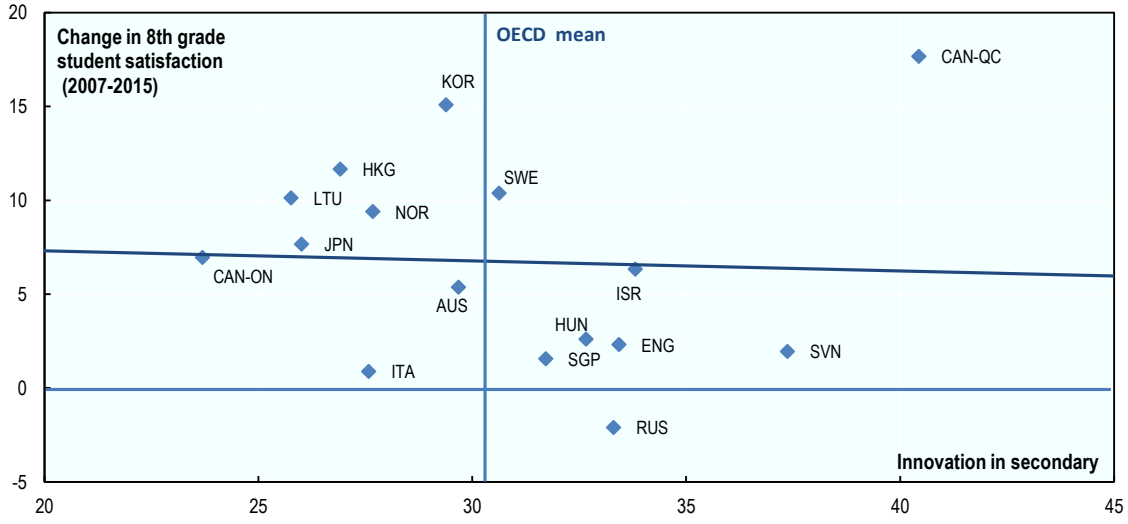
**Figure 15.9. Innovation in primary education and change in 4th grade student satisfaction (2007-2015)**




*Note*: The correlation coefficient is equal to 0.42.
*Source*: Authors' calculations based on TIMSS and PIRLS Databases.

StatLink https://doi.org/10.1787/888933907089

**Figure 15.10. Innovation in secondary education and change in 8th grade student satisfaction (2007-2015)**




*Note*: The correlation coefficient is equal to -0.04.
*Source*: Authors' calculations based on TIMSS and PISA Databases.

StatLink https://doi.org/10.1787/888933907108

## Innovation and equity in education

One concern with innovation is that it increases the achievement gap between students from different socio-economic backgrounds. Assuming innovation leads to an improvement of educational practices, this is indeed a very plausible outcome. This is for example why many observers worried about a "digital divide" when computers were just being first introduced in schools.

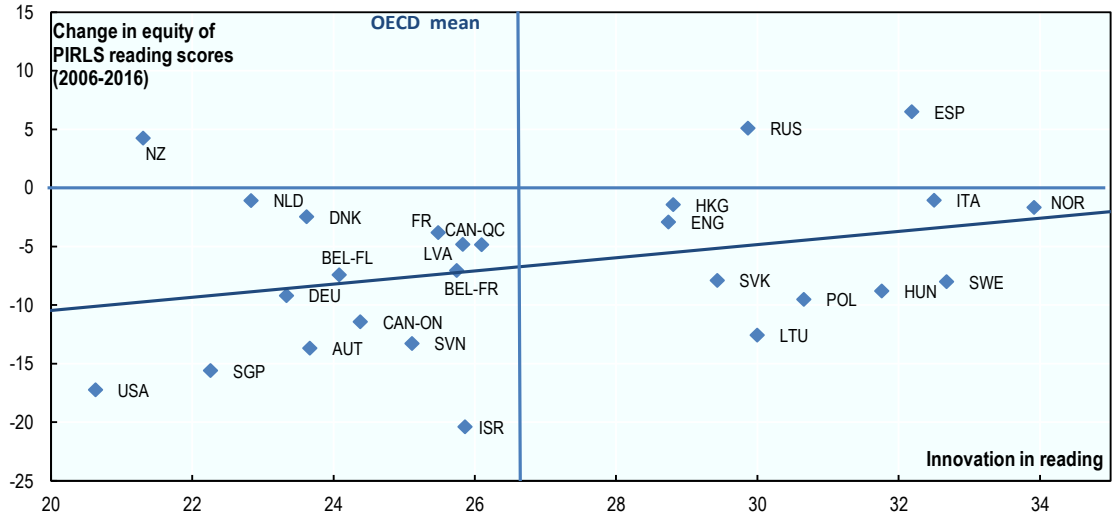
On the other hand, one can also hope that innovation will close the achievement gap and decrease inequity in education. In fact, this could only happen through innovation given that existing practices are still associated with relatively high levels of inequity (even though inequity has decreased in most countries over the past decades). Reducing inequity would come from a better dissemination of good and effective practices as much from a better tailoring of those practices to the learners. Some practices, such as mixed ability groups, are also believed to work particularly well for students from less advantaged backgrounds (while making little differences for the others).

In secondary education, we don't find any relationship between innovation levels in maths and science and the change in the score gap between students from higher and lower socio-economic backgrounds. (We do not show the corresponding graphs, but the coefficients of correlation are -0.07 and -0.14 for maths and science, respectively.)

In primary education, there was no consistent trend. In the past decade, inequity in the reading scores has increased in almost all countries covered. Countries that have experienced more innovation in teaching and learning practices in reading have also had less increase of educational inequity. In science education it was the opposite. Where there has been more innovation in science education practices, there has also been an increase in educational inequity.

Are there specific practices that explain more the association in one direction or in the other? While we cannot answer this question with aggregated data, this is again a question that needs to be investigated within country with more granular data.

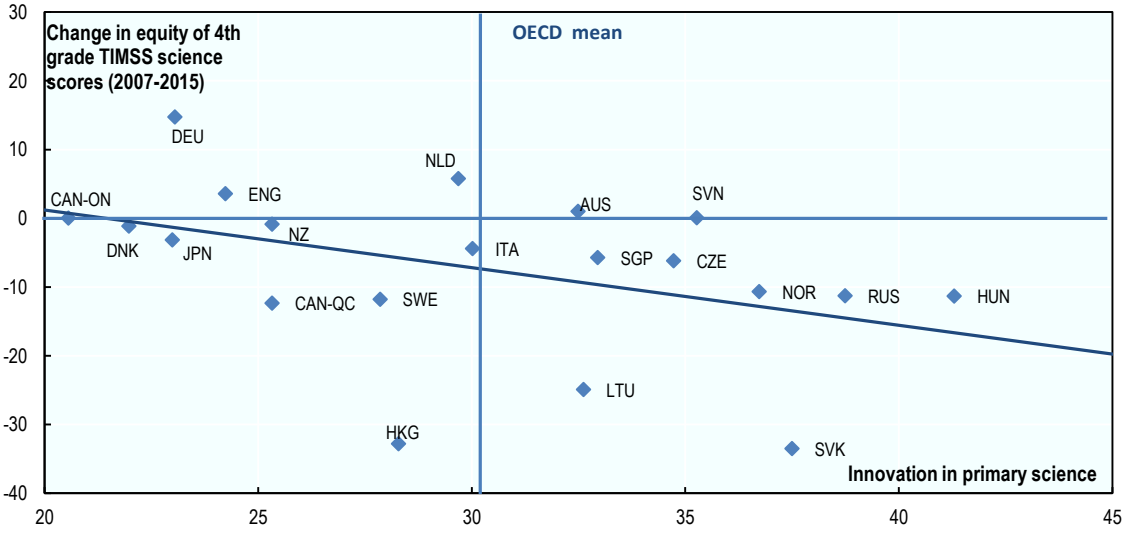
**Figure 15.11. Innovation in primary reading education and trends in equity of primary reading scores (2006-2016)**




*Note*: The correlation coefficient is equal to 0.32.
*Source*: Authors' calculations based on PIRLS Databases.

StatLink https://doi.org/10.1787/888933907127

**Figure 15.12. Innovation in primary science education and trends in equity of primary science scores (2007-2015)**




*Note*: The correlation coefficient is equal to -0.42.
*Source*: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933907146

## Innovation and teachers' collective self-efficacy

Innovation leads to and results from teacher professional development. Trying out new practices makes teachers pause and reflect about their teaching. Regardless of whether their attempts translate into success or not, this is an occasion to try to improve their teaching. Innovation also comes from the awareness that some changes in their pedagogical practices may be beneficial, either because they have acquired some new knowledge in a formal training, by discussing or observing colleagues or through any other way.

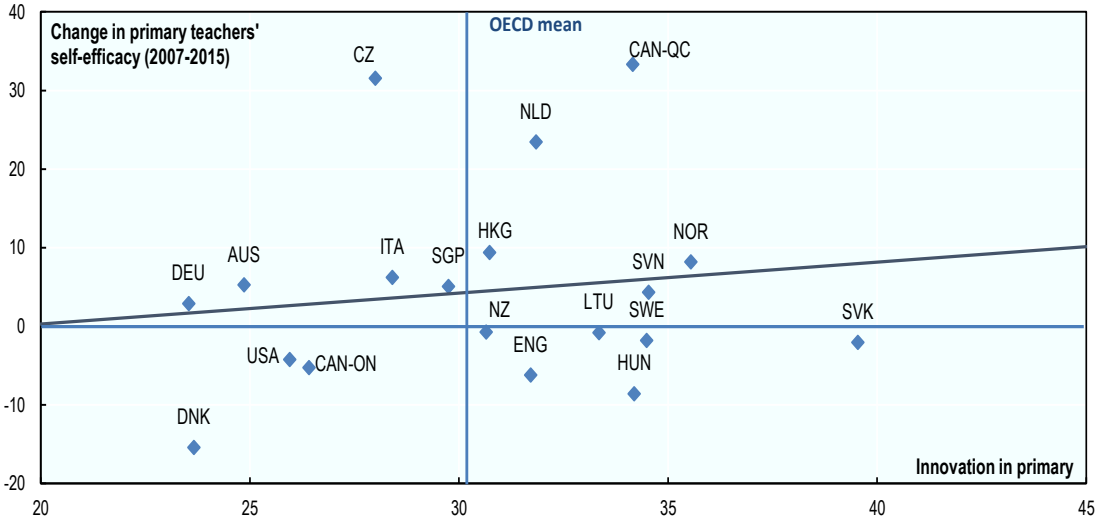
When it is implemented at scale, one should hope that, beyond individual learning, innovation leads to collective learning at the school level. Facing similar challenges at the same time conducts teachers to work collaboratively and reflectively with their peers. In that case, innovation both results from and induces the emergence of learning organisations as a form of work organisation.

One misconception about innovation and innovative teaching is that it may challenge the implementation of the national (or local) curriculum. This needs not be the case, and can actually be the contrary. If teachers develop professionally when they innovate, we can assume that they will be more successful in the delivery of the curriculum at some point, in spite of the possible decrease in efficacy for a while.

We approximate collective self-efficacy within school as the share of teachers who report that, within their school, teachers are highly or very highly successful in implementing the school's curriculum. Does this feeling of collective success in a defined community of practitioners increase when there is more innovation, or does it on the contrary disrupt it?

Overall, there is a small positive association in secondary education. The direction of causality could come from both directions. On the one hand, innovation may make teachers work collaboratively as they try to implement new pedagogies, which increases the collective belief that they are collectively successful within a school. On the other hand, the feeling of being successful in implementing the curriculum may contribute to the adoption of new pedagogical practices as teachers feel more self-confident, and also to greater levels of innovation as this could speed up the dissemination of the practices.

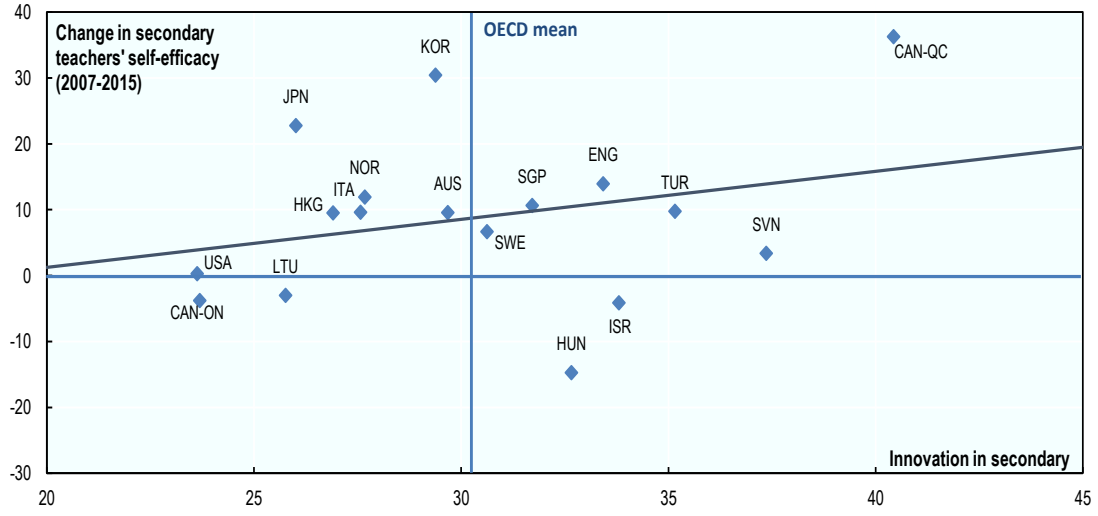
**Figure 15.13. Innovation and change in teachers' collective self-efficacy at the primary level (2007-2015)**




*Note*: The correlation coefficient is equal to 0.14.
*Source*: Authors' calculations based on TIMSS and PIRLS Databases.

StatLink https://doi.org/10.1787/888933907165

**Figure 15.14. Innovation and change in teachers' collective self-efficacy at the secondary level (2007-2015)**




*Note*: The correlation coefficient is equal to 0.27. The change in secondary teachers' collective self-efficacy averages the answer of maths and science teachers per country.
*Source*: Authors' calculations based on TIMSS and PISA Databases.

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## Innovation and teachers' collective ambition for their students

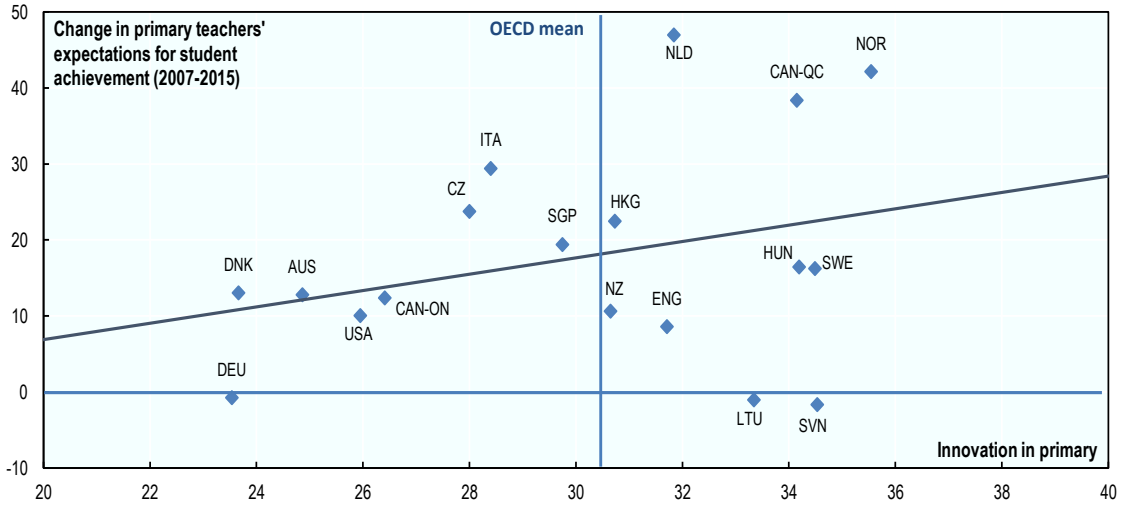
Innovation can be driven by many different objectives. A search for improving students' learning outcomes, a quest for reducing inequity or achieving collective wellbeing, a response to budget cuts (or increases), an adjustment to parental or social demand, an answer to individual or collective learning, or even a response to lower salaries, to worsening working conditions or social status, etc.

One would hope that innovation relates to teachers' and other actors' willingness to improve students' education and wellbeing. In some cases, limited educational improvement comes from teachers' lack of ambition for their students or from the belief that some of their students cannot make progress. Educational improvement can also come from the opposite belief. While there has recently been many discussion around the "growth" mindset of students, this should also apply to teachers.

Whether teachers report that teachers in their schools have high or very high expectations for student achievement is one measure of teachers' ambition for their students within a school.

Is innovation related to high expectations for achievement at the school level? This seems to be the case at the country level. In both primary and secondary education, teachers' collective expectations for their student achievement have increased. This is a trend that was witnessed in virtually all the covered countries. On average, the more innovation there has been in a country, the more teachers' expectations for their students' achievement have increased. While we cannot claim that there is a causal association, it is more plausible that innovation was driven by these high achievement expectations rather than the opposite.

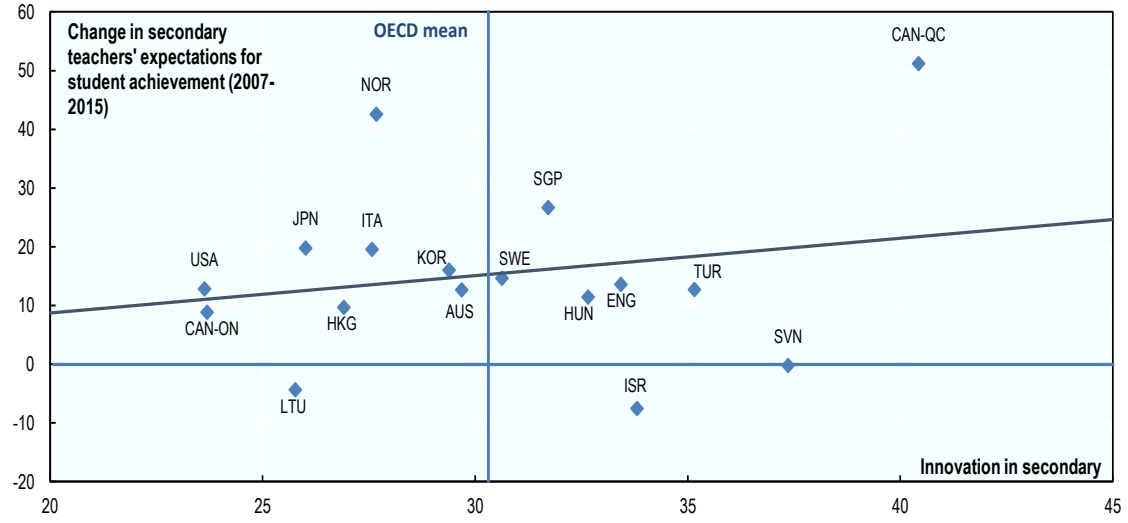
**Figure 15.15. Innovation and change in teachers' expectations for student achievement at the primary level (2007-2015)**




*Note*: The correlation coefficient is equal to 0.30.
*Source*: Authors' calculations based on TIMSS and PIRLS Databases.

StatLink https://doi.org/10.1787/888933907203

**Figure 15.16. Innovation and change in teachers' expectations for student achievement at the secondary level (2007-2015)**




*Note*: The correlation coefficient is equal to 0.21. The change in secondary teachers' expectations for student achievement averages the answer of maths and science teachers per country.
*Source*: Authors' calculations based on TIMSS and PISA Databases.

StatLink https://doi.org/10.1787/888933907222

## Innovation and change in educational expenditures

There are different assumptions as to how innovation relates to expenditure and budget. Innovation surveys in the business sector consistently show that the lack of funding within and outside a company is reported as the top hurdles to innovation. Depending on the type of innovation this could be true in the education sector as well. Typically, a lack of budget (or of investment capability) may lead to the slowing down or postponement of innovation activities. This is what happens during an economic downturn or a restrictive budgetary policy. On the other hand, some believe that innovation can be triggered by adversity, and that people will innovate more in difficult budgetary situations that force them to be more creative. "Frugal" or "inclusive" innovation is partly a response to the lack of financial resources.

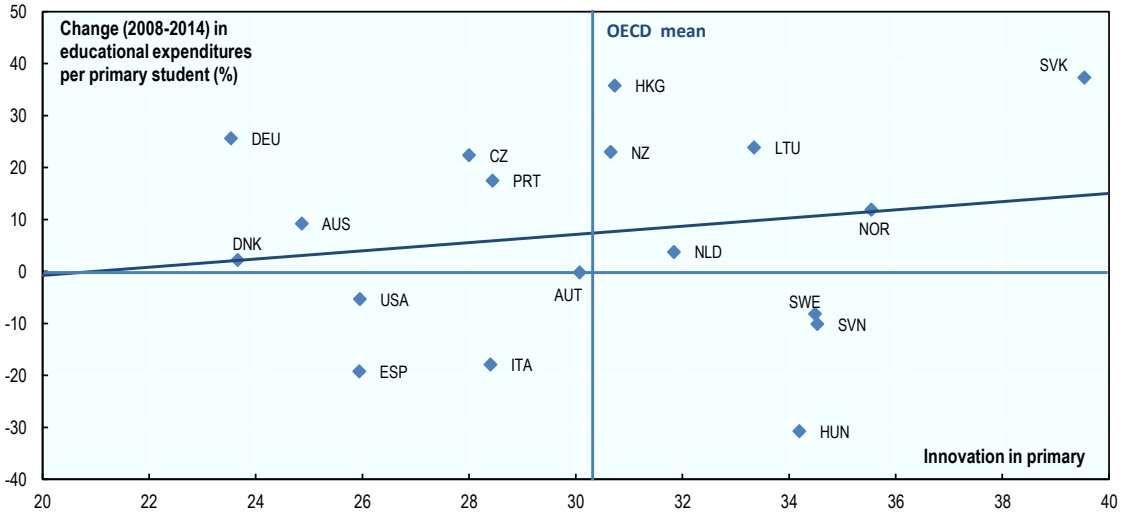
Innovation in education may be frugal or expensive. Some pedagogical innovations require budget. Enhanced access to ICT and sometimes proper use of ICT during class rely on a certain level of equipment and infrastructure. The mere maintenance of ICT has a cost; including the support of technical staff. Given the stability and even small decrease in access to ICT that we observed, one should not expect much expenditure on that front, except in very few countries. Some innovations may require some formal teacher training, but also the participation in more informal learning opportunities, which also involve some cost (such as staff time).

Innovation in the practices covered in the book does not require a specific budget in terms of implementation: most of those changes translate into a different use of students' and teachers' time. For example, discussing homework systematically in class implies that homework becomes a more integral part of students' instruction, but also that more class time will be devoted to it (as opposed to other practices). This should not change educational expenditure inasmuch as class time remains stable, but only how the existing budget is used.

Changing one's teaching and learning practices may require a change in knowledge, beliefs or attitudes that may have require some investment: new knowledge production, communication, facilitation of peer learning through a variety of means, from blog posts to systematic reviews of existing evidence, from internal school meetings to participation in conferences or visits abroad.

In the past decade, innovation in primary education has taken place in countries were educational expenditures per students were slightly on the rise. There was no association between educational expenditures and innovation in secondary education. (One caveat of this indicator is that expenditure per student can vary based on school demography, while the main educational expenditure (wages) typically remains more stable. It remains the most appropriate to use though.) One would learn more from studying the link between innovation and some sub-categories of budget, such as systems' innovation budget, training budget, etc. These educational expenditures are not available at the international level.

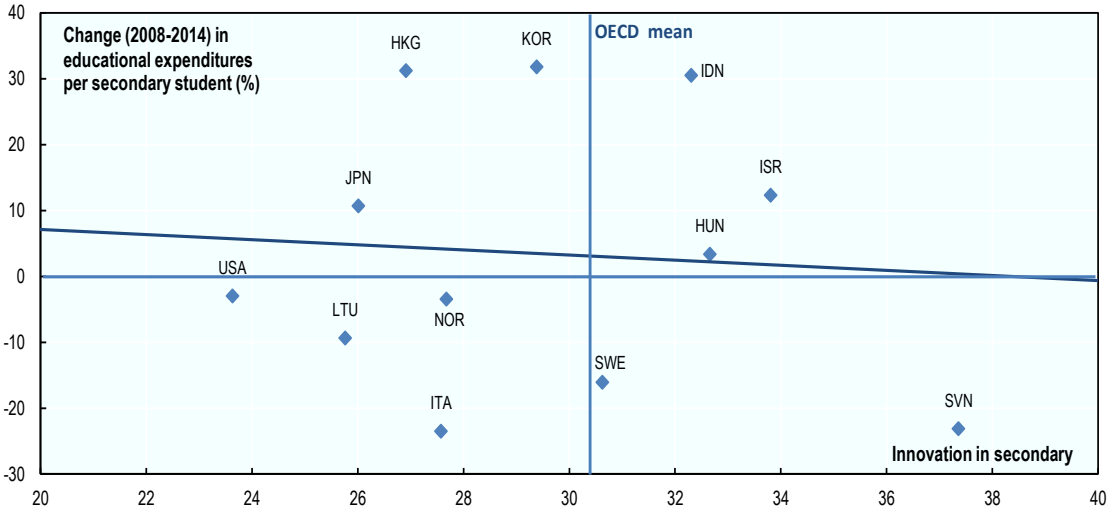
**Figure 15.17. Innovation and change in educational expenditures at the primary level (2008-2014)**




*Note*: The correlation coefficient is equal to 0.21. Educational expenditures were measured in constant PPP dollars. For Slovenia and the U.S., the change was computed between 2010 and 2014 instead of 2008 and 2014 due to data unavailability.
*Source*: Authors' calculations based on TIMSS, PIRLS and World Bank Databases.

StatLink https://doi.org/10.1787/888933907241

**Figure 15.18. Innovation and change in educational expenditures at the secondary level (2008-2014)**




*Note*: The correlation coefficient is equal to -0.08. Educational expenditures were measured in constant PPP dollars. For Slovenia and the U.S., the change was computed between 2010 and 2014 instead of 2008 and 2014 due to data unavailability.
*Source*: Authors' calculations based on TIMSS, PISA and World Bank Databases.

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# Part III.
# Country innovation indices

# Chapter 16.
# Countries' innovation dashboards

*This part presents a synthesis of educational innovation by broad category for countries for which there enough innovation indices could be computed. Depending on data availability, it shows the overall levels of innovation in primary and secondary education and by discipline, technology-related innovation as well as innovation by broad categories. It also highlights the three top innovations within countries. The synthesis for the OECD average is also presented.*

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

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# Education Innovation Index

Australia 28
OECD average 30

## Innovation in education by category




Primary 25 31



Secondary 30 30



Maths 37 35



Science 31 29

## Innovation in education by type of practice



Independent knowledge acquisition
52
-0,3 51,2
-6,7 34,6
41



Teachers' peer learning
45
0 44,7
-1,2 40,8
42



Active learning practices in science
40
-1 38,8
-2,1 25,9
28



Rote learning
39
0 38,6
-3,2 28,3
32



Fostering higher order skills
26
-2,1 23,9
-3,3 20,6
24



Homework
25
-3,6 21,8
-7,3 28,4
36



School external relations and HRM
15
-11 3,7
-8,1 12,8
21



Formal teacher training
14
-4,9 9,2
-17,2 6,4
24



Assessment
13
-10 3,3
-9,3 16,9
26

## ICT Innovation



Computer availability
31
-17,3 13,3
-30,5 8,5
39



Use of ICT in schools
48
-2,7 45,3
-5,4 27,1
33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016 . Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Australia

Between 2006 and 2016, the Australian education system experienced moderate educational innovation, a little less than the OECD average. While both mathematics and science practices changed more than average, innovation in mathematics practices significantly trumped innovation in science. Some of the difference with other OECD systems comes from lower innovation in primary education, as innovation in secondary was at the same level as other OECD systems. Whereas students have had less access to computers in school, they have used more technology in their education. Innovation mainly took place through the increase of independent knowledge acquisition in class, usually using ICT, as well as through more teacher peer learning.

## Practices that changed the most

### Primary

**65** more students in 100 frequently practised maths skills and procedures on computers, reaching a **75%** coverage

**49** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a 54% coverage

**38** more students in 100 frequently observed and described natural phenomena, reaching a **54%** coverage

### Secondary

**44** more students in 100 frequently practised maths skills and procedures on computers, reaching a **48%** coverage

**44** more students in 100 in science and **34** more in maths frequently used computers to look up for ideas and information, reaching a **60%** and **36%** coverage respectively

**26** more students in 100 frequently processed and analysed data on computers in maths, reaching a **26%** coverage

## Some trends in educational outcomes



Student satisfaction in secondary education

Student enjoyment in secondary science lessons

Teachers' collective ambition for their students in primary and secondary education



Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Student satisfaction in primary education

Student enjoyment in primary science lessons

Teachers' collective

self-efficacy in primary and secondary education

Equity of academic outcome in primary and secondary science

Equity of academic outcome in primary and secondary maths

# Ontario (CA) 24
# OECD average 30

# Education Innovation Index

## Innovation in education by category

| | | |
|---|---|---|
| Primary | 26 | 31 |
| Secondary | 24 | 30 |
| Maths | 28 | 35 |
| Science | 21 | 29 |
| Reading | 24 | 27 |

## Innovation in education by type of practice

| | | | |
|---|---|---|---|
| Independent knowledge acquisition | 49 | -0,6 / 48,5 | -6,7 / 34,6 | 41 |
| Fostering higher order skills | 33 | -0,8 / 32,2 | -3,3 / 20,6 | 24 |
| Active learning practices in science | 27 | 0 / 26,9 | -2,1 / 25,9 | 28 |
| School learning resources | 26 | -21,4 / 4 | -22,6 / 9,8 | 32 |
| Teachers' peer learning | 21 | -0,7 / 20,1 | -1,2 / 40,8 | 42 |
| Rote learning | 21 | -3,6 / 17,2 | -3,2 / 28,3 | 32 |
| Formal teacher training | 20 | -16 / 3,7 | -17,2 / 6,4 | 24 |
| Assessment | 13 | -6,5 / 6,2 | -9,3 / 16,9 | 26 |
| School external relations and HRM | 12 | -9,4 / 2,5 | -8,1 / 12,8 | 21 |

## ICT Innovation

| | | | |
|---|---|---|---|
| Computer availability | 24 | -20,5 / 3,6 | -30,5 / 8,5 | 39 |
| Use of ICT in schools | 38 | -1,7 / 36 | -5,4 / 27,1 | 33 |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Ontario (CA)

Between 2006 and 2016, educational innovation in Ontario (Canada) has been modest, and much lower than in other OECD education systems. The change in practices has been slightly larger in primary than in secondary education, but both remained markedly below the OECD average. Innovation in maths has been higher than in reading and science, though still below the OECD average. As in other OECD systems, technology education has taken the form of a decrease in computer availability, but a scale up of practices using computers in teaching and learning. Innovation has mainly taken place in three types of teaching and learning practices: independent knowledge acquisition in class, the fostering of higher order skills and active learning practices in science. The education system in Ontario remained relatively stable when compared to neighbouring Quebec.

## Practices that changed the most

### Primary

**54** more students in 100 frequently practised maths skills and procedures on computers, reaching a **59%** coverage

**28** more students in 100 had their teachers participating in a programme for improving students' critical thinking or problem solving skills in maths lessons, reaching an **81%** coverage

**21** less students in 100 had a science laboratory available for use at school, reaching a **7%** coverage

### Secondary

**35** more students in 100 systematically discussed maths homework in class, reaching an **82%** coverage

**28** more students in 100 frequently observed and described natural phenomena in science lessons, reaching a **47%** coverage

**25** more students in 100 frequently processed and analysed data on computers in maths, reaching a **27%** coverage

## Some trends in educational outcomes

**+**

Student satisfaction in primary and secondary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary education

**=**

Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Teachers' collective ambition for their students in secondary education

Teachers' collective self-efficacy in primary and secondary education

Equity of academic outcome in primary reading

Equity of academic outcome in primary and secondary science

Equity of academic outcome in primary and secondary maths

**−**

Academic outcome in primary reading

# Quebec (CA) 38
# OECD average 30

# Education Innovation Index

## Innovation in education by category

| | | |
|---|---|---|
| Primary | 26 | 31 |
| Secondary | 40 | 30 |
| Maths | 46 | 35 |
| Science | 30 | 29 |
| Reading | 26 | 27 |

## Innovation in education by type of practice

| | | | |
|---|---|---|---|
| Homework | 44 | -4,5 / 39,8 | -7,3 / 28,4 | 36 |
| Rote learning | 41 | -3,1 / 37,8 | -3,2 / 28,3 | 32 |
| Independent knowledge acquisition | 40 | -1,9 / 37,6 | -6,7 / 34,6 | 41 |
| Formal teacher training | 35 | -26,8 / 8,6 | -17,2 / 6,4 | 24 |
| School external relations and HRM | 34 | -12,8 / 21,8 | -8,1 / 12,8 | 21 |
| Fostering higher order skills | 33 | -5,6 / 27,5 | -3,3 / 20,6 | 24 |
| Active learning practices in science | 33 | -9,8 / 23 | -2,1 / 25,9 | 28 |
| School learning resources | 33 | -27,2 / 6,2 | -22,6 / 9,8 | 32 |
| Assessment | 31 | 0 / 31,2 | -9,3 / 16,9 | 26 |
| Teachers' peer learning | 30 | 0 / 29,8 | -1,2 / 40,8 | 42 |

## ICT Innovation

| | | | |
|---|---|---|---|
| Computer availability | 55 | -54,7 / 0 | -30,5 / 8,5 | 39 |
| Use of ICT in schools | 53 | -1,4 / 51,9 | -5,4 / 27 | 33 |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Quebec (CA)

Between 2006 and 2016, Quebec experienced a high level of innovation in education, much larger than other OECD education systems. Innovation in secondary education has been particularly large. Innovation in maths educational practices was outstanding and drove the high innovation levels in the province, as changes in science and reading were more or less on par with other OECD systems. As in other countries, students have had a bit less access to computers, but have used them more in class. Some of the big changes pertained to homework practices but also to an increase of both rote learning and practices fostering higher order skills. Quebec experienced much more change than its neighbouring province Ontario.

## Practices that changed the most

**Primary**

**50** more students in 100 frequently practised maths skills and procedures on computers, reaching a **53%** coverage

**47** less students in 100 had computers (including tablets) available for use during reading lessons, reaching a **45%** coverage

**31** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **36%** coverage

**Secondary**

**60** more students in 100 systematically discussed maths homework in class, reaching a **79%** coverage

**52** less students in 100 had their teachers participating in a program on maths curriculum, reaching a **25%** coverage

**39** more students in 100 frequently practised maths skills and procedures on computers, reaching a **44%** coverage

## Some trends in educational outcomes



Academic outcome in secondary science

Academic outcome in primary and secondary maths

Academic outcome in primary reading

Student satisfaction in primary and secondary education

Student enjoyment in secondary science lessons

Teachers' collective self-efficacy in primary and secondary education

Teachers' collective ambition for their students in primary and secondary education



Academic outcome in primary science

Student enjoyment in primary science lessons

Equity of academic outcomes in primary reading

Equity of academic outcome in primary and secondary science

Equity of academic outcome in primary and secondary maths



# Hungary 34
# OECD average 30

# Education Innovation Index

## Innovation in education by category

| | | |
|---|---|---|
| Primary | 34 | 31 |
| Secondary | 33 | 30 |
| Maths | 40 | 35 |
| Science | 36 | 29 |
| Reading | 32 | 27 |

## Innovation in education by type of practice

| | | | |
|---|---|---|---|
| Homework | 66 | -10,4 | 55,4 |
| | | -7,3 | 28,4 |
| | 36 | | |
| Independent knowledge acquisition | 58 | -11,9 | 45,9 |
| | | -6,7 | 34,6 |
| | 41 | | |
| Assessment | 42 | -20,6 | 21,2 |
| | | -9,3 | 16,9 |
| | 26 | | |
| Teachers' peer learning | 41 | 0 | 41,2 |
| | | -1,2 | 40,8 |
| | 42 | | |
| Formal teacher training | 39 | -38,6 | 0 |
| | | -17,2 | 6,4 |
| | 24 | | |
| Active learning practices in science | 27 | 0 | 27,1 |
| | | -2,1 | 25,9 |
| | 28 | | |
| School learning resources | 25 | -21,3 | 4 |
| | | -22,6 | 9,8 |
| | 32 | | |
| Rote learning | 22 | -0,3 | 21,5 |
| | | -3,2 | 28,3 |
| | 32 | | |
| Fostering higher order skills | 22 | -4,1 | 17,7 |
| | | -3,3 | 20,6 |
| | 24 | | |
| School external relations and HRM | 16 | -10,3 | 5,6 |
| | | -8,1 | 12,8 |
| | 21 | | |
| Other practices | 25 | -13,9 | 10,6 |
| | | -6,6 | 14,2 |
| | 21 | | |

## ICT Innovation

| | | | |
|---|---|---|---|
| Computer availability | 18 | -10,6 | 7,5 |
| | | -30,5 | 8,5 |
| | 39 | | |
| Use of ICT in schools | 43 | -1,6 | 41,4 |
| | | -5,4 | 27,1 |
| | 33 | | |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Hungary

Between 2006 and 2016, students in Hungary have experienced a relatively high level of innovation in teaching, learning and school practices, more than the average OECD country. Changes have been equally distributed across primary and secondary education. Mathematics education has been the main driving force of change, although innovation in science and reading were also higher than average. Access to computers remained more stable than elsewhere, but ICT was more often used in schools. The main changes lay in homework, assessment and independent knowledge acquisition practices. Teacher peer learning also gained significant ground. Perhaps driven by learning outcomes below the OECD average in international assessments, this high level of innovation points to a system-wide effort to change and improve educational practices in the classroom.

## Practices that changed the most

### Primary

**81** more students in 100 took written tests in reading lessons

**46** fewer students in 100 read nonfiction books at least once a week

**37** more students in 100 frequently practised maths skills and procedures on computers

### Secondary

**89** more students in 100 in maths and

**74** more in science systematically discussed homework in class

**41** more students in 100 frequently observed and described natural phenomena in science lessons

**38** more students in 100 frequently practised maths skills and procedures on computers

## Some trends in educational outcomes

Academic outcome in primary maths

Student satisfaction in primary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary and secondary education

Academic outcome in primary science

Academic outcome in primary reading

Academic outcome in secondary maths

Student satisfaction in secondary education

Teachers' collective self-efficacy in primary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary science

Equity of academic outcomes in primary maths

Academic outcome in secondary science

Teachers' collective self-efficacy in secondary education

Equity of academic outcomes in secondary science

Equity of academic outcomes in secondary maths

# Israel 34
# OECD average 30

# Education Innovation Index

## Innovation in education by category



Secondary

34

30



Reading

26

27

## Innovation in education by type of practice



Teachers' peer learning

83

0 83,1

-1,2 40,8

42



Independent knowledge acquisition

48

-6,7 41,5

-6,7 34,6

41



Assessment

37

-2,2 34,5

-9,3 16,9

26



Homework

34

-12,6 21,8

-7,3 28,4

36



School learning resources

34

-20,1 13,7

-22,6 9,8

32



Rote learning

23

-6,8 16,6

-3,2 28,3

32



Fostering higher order skills

21

-7,6 13,7

-3,3 20,6

24



School external relations and HRM

18

-2,6 15,1

-8,1 12,8

21



Other practices

16

-0,7 15

-6,6 14,2

21

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Israel

Between 2006 and 2016, students in Israel have experienced a relatively high level of innovation in education, more than the average in OECD systems. Innovation in secondary education practices has been exactly the same as in the overall system. A primary education innovation index could not be computed due to some data gaps. Innovation in reading practices has been modest in Israel, as was the case across OECD systems. The scale up of teacher peer learning practice represents an outstanding innovation in the system and compared to other OECD systems. Otherwise, most of the innovation lay in the expansion of independent knowledge acquisition practices in class, as well as assessment and homework practices.

## Practices that changed the most

### Primary

**36** more students in 100 had computers (including tablets) available during reading lessons, reaching a **62%** coverage

**35** more students in 100 had teachers putting major emphasis on national or regional tests in reading, reaching a **62%** coverage

**30** less students in 100 visited a library other than their classroom library at least once a month, reaching a **61%** coverage

### Secondary

**48** more students in 100 in science and **43** more in maths had their teachers discussing how to teach a particular topic, reaching an **83%** and **78%** coverage respectively.

**44** more students in 100 in science systematically discussed homework in class, reaching a **78%** coverage

**42** more students in 100 had their teachers collaborating in planning and preparing instructional material in science, reaching a **78%** coverage

## Some trends in educational outcomes

Academic outcome in primary reading

Academic outcome in secondary science

Academic outcome in secondary maths

Student satisfaction in secondary education

Student enjoyment in secondary science lessons

Teachers' collective ambition for their students in secondary education

Teachers' collective self-efficacy in secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in secondary science

Equity of academic outcomes in secondary maths

*The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.*

# Education Innovation Index

Italy 28
OECD average 30

## Innovation in education by category

| | | |
|---|---|---|
| Primary | 28 | 31 |
| Secondary | 28 | 30 |
| Maths | 31 | 35 |
| Science | 29 | 29 |
| Reading | 32 | 27 |

## Innovation in education by type of practice

| | | | |
|---|---|---|---|
| Independent knowledge acquisition | 72 | -16,9 54,8 | -6,7 34,6 | 41 |
| Rote learning | 44 | -0,2 43,6 | -3,2 28,3 | 32 |
| Teachers' peer learning | 36 | -1,6 34,5 | -1,2 40,8 | 42 |
| Active learning practices in science | 34,3 | -1,2 33 | -2,1 25,9 | 28 |
| School learning resources | 34 | -21,9 11,8 | -22,6 9,8 | 32 |
| Fostering higher order skills | 30 | -4,2 25,8 | -3,3 20,6 | 24 |
| Homework | 30 | 18,3 11,4 | -7,3 28,4 | 36 |
| Assessment | 18 | -9 8,8 | -9,3 16,9 | 26 |
| Formal teacher training | 12 | -2,8 9,2 | -17,2 6,4 | 24 |
| Other practices | 12 | -2,2 10,2 | -6,6 14,2 | 21 |

## ICT Innovation

| | | | |
|---|---|---|---|
| Computer availability | 40 | -20,3 19,6 | -30,5 8,5 | 39 |
| Use of ICT in schools | 44 | -6,6 37 | -5,4 27 | 33 |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Italy

Between 2006 and 2016, Italy has experienced a moderate level of innovation, slightly lower than in other OECD systems. Innovation has been equally distributed across primary and secondary education. Innovation in reading and maths have been higher than in science education, but Italian students have experienced much more change in reading than their OECD peers, and less in maths. As in other OECD systems, there was a large increase in the use of ICT in schools (and a different pattern than elsewhere in the access to computers). Innovation in independent knowledge acquisition in class was outstanding, but both rote learning practices and active learning practices spread over the last decade. Teacher peer learning has also scaled up significantly, though slightly less than in other OECD systems.

## Practices that changed the most

### Primary

**62** less students in 100 frequently read non-fiction in reading lessons, reaching a **23%** coverage

**59** less students in 100 frequently used computers to look up for ideas and information in reading lessons, reaching a **21%** coverage

**59** more students in 100 had computers (including tablets) available to use during reading lessons, reaching a **66%** coverage

### Secondary

**42** more students in 100 in science and

**41** more in maths had teachers frequently using memorisation of rules, procedures and facts as a pedagogical technique, reaching a **58%** and **74%** coverage respectively

**34** more students in 100 systematically discussed homework in maths class, reaching an **85%** coverage

**30** more students in 100 had science teachers collaborating in preparing instructional material, reaching a **51%** coverage

## Some trends in educational outcomes

**+**

Academic outcome in secondary maths

Teachers' collective ambition for their students in primary and secondary education

**=**

Academic outcome in primary maths

Academic outcome in primary reading

Academic outcome in secondary science

Student satisfaction in secondary education

Student enjoyment in secondary science lessons

Teachers' collective self-efficacy in primary and secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary science

**−**

Academic outcome in primary science

Student satisfaction in primary education

Student enjoyment in primary science lessons

Equity of academic outcomes in secondary science

Equity of academic outcomes in primary and secondary maths



# Education Innovation Index

Japan 22

OECD average 30

## Innovation in education by category



Secondary

26

30



Maths

22

35



Science

27

29

## Innovation in education by type of practice



Teachers' peer learning

30

-5,9 23,9

-1,2 40,8

42



Rote learning

26

-2,9 24,8

-3,2 28,3

32



Independent knowledge acquisition

26

-3,2 22,2

-6,7 34,6

41



Homework

25

-0,8 23,8

-7,3 28,4

36



Active learning practices in science

21

-2,6 18,3

-2,1 25,9

28



Fostering higher order skills

20

0 19,8

-3,3 20,6

24



School external relations and HRM

17

-11,8 5,3

-8,1 12,8

21



Formal teacher training

12

-8,8 3

-17,2 6,4

24

## ICT Innovation



Computer availability

46

-45,9 0

-30,5 8,5

39



Use of ICT in schools

18

-4,1 13,5

-5,4 27

33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Japan

Between 2006 and 2016, Japanese students have experienced little innovation in education, much less than their OECD peers. Innovation in secondary education was higher than at the system level. While data gaps prevented the calculation of a primary education innovation index, this suggests a much lower level of innovation at that level. In terms of discipline, pedagogical practices in science education changed roughly as much as in other countries. It is mainly in mathematics education that practices remained stable while they changed moderately elsewhere. Access to computers dropped a bit, more than in other systems, while the use of ICT in school remained much more stable. Given the good learning outcomes of Japan in international assessments, it is possible that teachers felt less pressure than elsewhere to change their pedagogical practices.

## Practices that changed the most

### Primary

**30** less students in 100 had computers (including tablets) available during maths lessons, reaching a **48%** coverage

**26** more students in 100 had teachers with assistance available while conducting experiments in science, reaching a **28%** coverage

**22** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **29%** coverage

### Secondary

**43** more students in 100 had teachers putting major emphasis on classroom tests in science, reaching a **94%** coverage

**26** more students in 100 had teachers with assistance available while conducting experiments in science, reaching a **28%** coverage

**22** more students in 100 had teachers systematically asking them to correct their own science homework, reaching a **69%** coverage

## Some trends in educational outcomes



Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Student satisfaction in secondary education

Student enjoyment in primary and secondary science lessons

Teachers' collective self-efficacy in primary and secondary education

Teachers' collective ambition for their students in primary and secondary education



Student satisfaction in primary education

Equity of academic outcomes in primary reading

Equity of academic outcome in primary and secondary science

Equity of academic outcome in primary maths



Equity of academic outcome in secondary maths

# Education Innovation Index

Korea 26

OECD average 30

## Innovation in education by category



Secondary

29

30



Science

25

29

## Innovation in education by type of practice



Teachers' peer learning

64

0 63,9

-1,2 40,8

42



School external relations and HRM

34

-0,5 33,2

-4.5 8

21



Independent knowledge acquisition

29

-8,5 20,1

-6,7 34,6

41



Homework

28

-6,5 21,6

-7,3 28,4

36



Rote learning

28

-2,9 24,8

-3,2 28,3

32



Fostering higher order skills

20

-3,9 16,1

-3,3 20,6

24



Active learning practices in science

19

-5,9 12,9

-2,1 25,9

28



Formal teacher training

16

-1,6 14,2

-17,2 6,4

24

## ICT Innovation



Computer availability

34

-32,3 2,1

-30,5 8,5

39



Use of ICT in schools

18,5

-6,1 12,4

-5,4 27,1

33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Korea

Between 2006 and 2016, Korea has experienced a modest level of innovation in its education system, below the OECD average. Innovation in secondary is almost on par with the OECD system average. While data gaps prevented the calculation of a primary education innovation index, this suggests a much smaller level of innovation in primary education. Science education practices have changed less than in the average OECD country. As in other OECD systems, access to computers has decreased, but the use of ICT in schools has remained much more stable than in other systems (where it typically spread). The main change lay in the diffusion of teacher peer learning practices, but also in the ways schools relate to their stakeholders. Having good performance in international assessments, Korean teachers possibly felt less of a need to change their teaching and learning practices.

## Some trends in educational outcomes

**+**

Academic outcome in secondary maths

Student satisfaction in secondary education

Student enjoyment in secondary science lessons

Teachers' collective ambition for their students in secondary education

Teachers' collective self-efficacy in secondary education

Equity of academic outcomes in secondary maths

**=**

Academic outcome in secondary science

Equity of academic outcomes in secondary science

## Practices that changed the most

### Primary

**45** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **52%** coverage

**33** more students in 100 frequently observed and described natural phenomena in science lessons, reaching a **67%** coverage

**18** less students in 100 frequently used computers to look up for ideas and information in maths, reaching a **13%** coverage

### Secondary

**40** more students in 100 had their maths teachers systematically correcting assignments and giving feedback, reaching a **53%** coverage

**38** more students in 100 in maths and **33** more in science had their teachers visiting another classroom to learn more about teaching, reaching a **39%** and **35%** coverage respectively

**37** more students in 100 went to schools which tracked achievement data over time by an administrative authority, reaching an **86%** coverage

# Lithuania 30
# OECD average 30

## Education Innovation Index

## Innovation in education by category




Primary: 33 / 31



Secondary: 26 / 30



Maths: 34 / 35



Science: 30 / 29



Reading: 30 / 27

## Innovation in education by type of practice



Teachers' peer learning: 51 (0 50,7 / -1,2 40,8) 42



Homework: 47 (-5,9 41,1 / -7,3 28,4) 36



Independent knowledge acquisition: 39 (-2,2 36,9 / -6,7 34,6) 41



Rote learning: 38 (0 38,1 / -3,2 28,3) 32



Active learning practices in science: 33 (0 33 / -2,1 25,9) 28



School learning resources: 29 (-20 9,3 / -22,6 9,8) 32



Fostering higher order skills: 23 (-3,1 19,9 / -3,3 20,6) 24



Formal teacher training: 23 (-18,5 4,3 / -17,2 6,4) 24



Assessment: 22 (-6,9 14,6 / -9,3 16,9) 26



School external relations and HRM: 20 (-14,3 5,1 / -8,1 12,8) 21



Other practices: 28 (-1 27,3 / -6,6 14,2) 21

## ICT Innovation



Computer availability: 37,2 (-26,7 10,4 / -30,5 8,5) 39



Use of ICT in schools: 29 (-3,2 25,6 / -5,4 27) 33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Lithuania

Between 2006 and 2016, Lithuania experienced a moderate level of innovation in education, on par with the average level in an OECD system. Primary educational practices changed much more than secondary practices. At the disciplinary level, there was a lot more change in mathematics education practices than in science and reading, but reading practices changed more than the OECD average (while maths practices changed less). Innovation related to technology followed the OECD pattern, with a drop in access to computers, and an increase in the use of ICT in class. Innovation in the system mainly lay in the diffusion of teacher peer learning practices and in changes in homework practices.

## Practices that changed the most

### Primary

**40** more students in 100 frequently practised maths skills and procedures on computers, reaching a **42%** coverage

**40** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **45%** coverage

**38** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **40%** coverage

### Secondary

**70** more students in 100 in maths and **57** more in science systematically discussed homework in class, reaching an **80%** and **68%** coverage respectively.

**30** more students in 100 had portable laptops or notebooks available for use at school, reaching a **48%** coverage

**28** more students in 100 had their teachers discussing how to teach a particular topic in science, reaching a **44%** coverage

## Some trends in educational outcomes

Academic outcome in primary science

Academic outcome in primary reading

Student satisfaction in primary and secondary education

Student enjoyment in primary and secondary science lessons

Academic outcome in secondary science

Academic outcome in primary and secondary maths

Teachers' collective ambition for their students in primary and secondary education

Teachers' collective self-efficacy in primary and secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in secondary maths

Equity of academic outcomes in primary maths

# New Zealand 27
# OECD average 30

# Education Innovation Index

## Innovation in education by category




Primary: 31 / 31



Maths: 33 / 35



Science: 36 / 29



Reading: 21 / 27

## Innovation in education by type of practice



Independent knowledge acquisition: 45 (-0,6 to 44,5; -6,7 to 34,6) / 41



Teachers' peer learning: 47 (0 to 47,3; -1,2 to 40,8) / 42



School learning resources: 25 (-6,7 to 18,4; -22,6 to 9,8) / 32



Active learning practices in science: 22 (-0,4 to 21,7; -2,1 to 25,9) / 28



Rote learning: 20 (-5,9 to 14,2; -3,2 to 28,3) / 32



Assessment: 18 (-7,1 to 10,4; -9,3 to 16,9) / 26



Formal teacher training: 17 (-10,9 to 6,3; -17,2 to 6,4) / 24



School external relations and HRM: 14 (-3,6 to 10,2; -8,1 to 12,8) / 21



Other practices: 22 (-5,1 to 16,6; -6,6 to 14,2) / 21

## ICT Innovation



Computer availability: 35 (-5,4 to 29,41; -30,5 to 8,5) / 39



Use of ICT in schools: 42 (0 to 41,9; -5,4 to 27,1) / 33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# New Zealand

Between 2006 and 2016, students in New Zealand have experienced a moderate level of innovation in education, a bit less than in an average OECD system. Changes in mathematics education practices have been close to the OECD average, but much lower for reading. Primary students in New Zealand experienced as much innovation as their OECD peers, suggesting that there was less change in secondary education practices. As the timeframe for secondary education was often just between 2011 and 2015, a secondary education innovation index was not computed (and this should be interpreted with caution). The use of technology in school has spread more than in other systems, but a big difference with other systems lay in an increased access to computers (while this typically decreased in other systems). Big changes occurred through the spread of teacher peer learning and independent knowledge acquisition in class.

## Practices that changed the most

### Primary

**50** more students in 100 in maths and **43** more in reading frequently used computers to look up for ideas and information, at least once a week, reaching a **54%** and **84%** coverage respectively

**74** more students in 100 frequently practised maths skills and procedures on computers, reaching an **87%** coverage

**25** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **29%** coverage

### Secondary

**34** more students in 100 had science teachers collaborating in preparing instructional material, reaching a **65%** coverage

**42** more students in 100 had portable laptops or notebooks available for use at school, reaching a **75%** coverage

**27** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **37%** coverage

## Some trends in educational outcomes



Student satisfaction in primary education

Student enjoyment in primary science lessons

Teachers' collective ambition for their students in primary education



Academic outcome in primary science

Academic outcome in primary maths

Teachers' collective self-efficacy in primary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary science

Equity of academic outcomes in primary maths



Academic outcome in primary reading

# Norway 32
# OECD average 30

# Education Innovation Index

## Innovation in education by category


Primary 36 31


Secondary 28 30


Maths 37 35


Science 33 29


Reading 34 27

## Innovation in education by type of practice


Independent knowledge acquisition
53 -4,7 48,2 -6,7 34,6 41


Rote learning
40 0 39,8 -3,2 28,3 32


Fostering higher order skills
36 -3,5 32 -3,3 20,6 24


Formal teacher training
34 -26,9 7,3 -17,2 6,4 24


Homework
32 -5,3 26,1 -7,3 28,4 36


School learning resources
31 -22,6 8,7 -22,6 9,8 32


Active learning practices in science
31 -0,6 30,5 -2,1 25,9 28


Teachers' peer learning
30 -10,7 19 -1,2 40,8 42


School external relations and HRM
20 -2,1 18,3 -8,1 12,8 21


Assessment
18 -5,5 12,6 -9,3 16,9 26

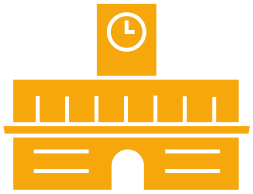

Other practices
18 -9,4 8,5 -6,5 14,1 21

## ICT Innovation


Computer availability
40 -37,8 2 -30,5 8,5 39


Use of ICT in schools
35 -3,3 31,4 -5,4 27 33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Norway

Between 2006 and 2016, Norway experienced a relatively high level of innovation in its education practices, slightly more than the OECD average. Innovation took place to a greater extent in primary education, where it has been relatively high, while that in secondary has been more modest. Innovation in maths practices has been large, considerably higher than in science and reading. Norway is nevertheless one of the few countries where innovation in reading lessons has been relatively large, and certainly much larger than in other OECD systems. As in other systems, access to computers has decreased overall, but the use of ICT in school has become more common. Innovation occurred through a significant spread of independent knowledge acquisition practices, rote learning practices, but also practices fostering students' higher order skills.

## Practices that changed the most

### Primary

**51** more students in 100 frequently practised maths skills and procedures on computers, reaching a **56%** coverage

**43** more students in 100 frequently discussed read text with peers at least once a week, reaching an **82%** coverage

**30** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **32%** coverage

### Secondary

**35** more students in 100 systematically discussed maths homework in class, reaching a **44%** coverage

**32** less students in 100 had their teachers participating in a program on maths curriculum, reaching an **11%** coverage

**32** more students in 100 went to schools which tracked achievement data over time by an administrative authority, reaching a **74%** coverage

## Some trends in educational outcomes



Academic outcome in primary science

Academic outcome in primary and secondary maths

Academic outcome in primary reading

Student satisfaction in primary and secondary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary and secondary education

Teachers' collective self-efficacy in secondary education



Academic outcome in secondary science

Teachers' collective self-efficacy in primary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in secondary maths



Equity of academic outcomes in primary maths

# Slovenia 37
# OECD average 30

# Education Innovation Index

## Innovation in education by category


Primary 35 31


Secondary 37 30


Maths 47 35


Science 37 29


Reading 25 27

## Innovation in education by type of practice


Independent knowledge acquisition
63
-8,3 54,4
-6,7 34,6
41


Assessment
55
-35,6 19,6
-9,3 17
26


Homework
53
0 52,6
-7,4 28,4
36


School learning resources
45
-38,7 6,7
-22,6 9,9
32


Teachers' peer learning
44
0 44,4
-1,2 40,8
42


Formal teacher training
44
-41,5 2,9
-17,3 6,5
24


Rote learning
40
-0,4 39,6
-3,2 28,4
32


School external relations and HRM
28
-16 11,8
-8,1 12,8
21


Active learning practices in science
24
0 23,7
-2,1 25,9
28


Fostering higher order skills
20
-2,6 17,3
-3,3 20,7
24

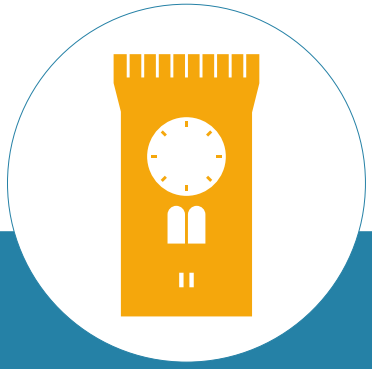

Other practices
17
-9,2 7,7
-6,6 14,1
21

## ICT Innovation


Computer availability
69
-65,3 3,4
-30,5 8,5
39


Use of ICT in schools
24
-1,5 22,2
-5,5 27,1
33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Slovenia

Between 2006 and 2016, Slovenia experienced a high level of innovation in education, much more than the OECD average. Innovation was larger in secondary than in primary education, though above the OECD average in both cases. Slovenia experienced the largest innovation among all the countries covered in both maths and science education, much above the OECD average. However, practices remained more stable, and below the OECD average in reading instruction. Access to computers in school dropped considerably, much more than in other OECD systems, while the use of ICT in school increased, but less than average. Innovation mostly lay in practices related to independent knowledge acquisition in class, assessment and homework. Formal teacher training contracted considerably, while teacher peer learning practices scaled up.

## Practices that changed the most

### Primary

**73** less students in 100 had computers (including tablets) available during reading lessons, reaching a **17%** coverage

**51** more students in 100 had maths teachers frequently using memorisation of rules, procedures and facts as a pedagogical technique, reaching a **79%** coverage

**45** more students in 100 in reading and **25** more in maths frequently used computers to look up for ideas and information, reaching a **62%** and **27%** coverage respectively

### Secondary

**69** less students in 100 in maths and **55** less in science had teachers put major emphasis on national or regional tests in science, reaching a **14%** and **16%** coverage respectively

**59** more students in 100 in maths and **47** more in science systematically discussed homework in class, reaching a **78%** and **79%** coverage respectively

**45** more students in 100 frequently read textbooks and resource materials in science, reaching a **60%** coverage

## Some trends in educational outcomes



Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Academic outcome in primary reading

Student enjoyment in secondary science lessons



Student satisfaction in primary and secondary education

Student enjoyment in primary science lessons

Teachers' collective ambition for their students in primary and secondary education

Teachers' collective self-efficacy in primary and secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in primary and secondary maths

# Sweden 33
# OECD average 30

# Education Innovation Index

## Innovation in education by category

| | Sweden | OECD average |
|---|---|---|
| Primary | 34 | 31 |
| Secondary | 31 | 30 |
| Maths | 38 | 35 |
| Science | 28 | 29 |
| Reading | 33 | 27 |

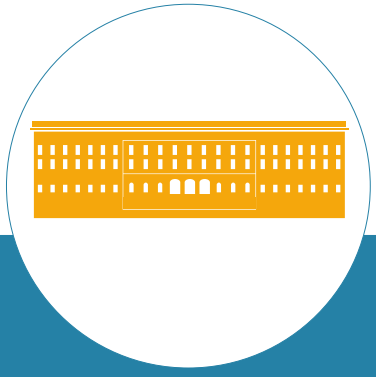
## Innovation in education by type of practice

| | Sweden | | | OECD average |
|---|---|---|---|---|
| Independent knowledge acquisition | 45 | -10,6 | 34,5 | 41 |
| | | -6,7 | 34,6 | |
| School learning resources | 38 | -18,1 | 20,3 | 32 |
| | | -22,6 | 9,8 | |
| Rote learning | 38 | -0,4 | 38 | 32 |
| | | -3,2 | 28,3 | |
| Fostering higher order skills | 36 | -1,5 | 34,2 | 24 |
| | | -3,3 | 20,6 | |
| Homework | 33 | -8,7 | 24,5 | 36 |
| | | -7,3 | 28,4 | |
| Active learning practices in science | 32 | -4,8 | 26,8 | 28 |
| | | -2,1 | 25,9 | |
| Teachers' peer learning | 26 | -0,3 | 25,3 | 42 |
| | | -1,2 | 40,8 | |
| Formal teacher training | 25 | -1,7 | 22,9 | 24 |
| | | -17,2 | 6,4 | |
| Assessment | 21 | -7,1 | 13,6 | 26 |
| | | -9,3 | 16,9 | |
| School external relations and HRM | 19 | -3,9 | 15,1 | 21 |
| | | -8,1 | 12,8 | |
| Other practices | 18 | -4,5 | 13,6 | 21 |
| | | -6,6 | 14,1 | |

## ICT Innovation

| | Sweden | | | OECD average |
|---|---|---|---|---|
| Computer availability | 49 | -21,6 | 27,1 | 39 |
| | | -30 | 8,5 | |
| Use of ICT in schools | 39 | 0 | 39,2 | 33 |
| | | -5,4 | 27 | |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Sweden

Between 2006 and 2016, Sweden experienced a relatively high level of innovation, slightly more than in the average OECD system. Practices in primary education changed more than average, and more than in secondary education. Innovation was much larger in maths than in science, as was the case in other OECD systems. Unlike most other OECD systems, practices in reading instruction changed significantly – and more than in science. Innovation related to technology took the form of a spread of the use of ICT in schools, but changes related to the access to computers took a different pattern than in other systems, with both a drop in some forms of access and an increase in others. Innovation mostly lay in the spread of practices related to independent knowledge acquisition in class, rote learning, and fostering of students' higher order skills.

## Practices that changed the most

### Primary

**49** more students in 100 frequently made predictions about what will happen next in read text, reaching a **68%** coverage

**42** more students in 100 frequently drew inferences and generalisations from text, reaching a **71%** coverage

**37** more students in 100 frequently practised maths skills and procedures on computers, reaching a **43%** coverage

### Secondary

**43** more students in 100 had portable laptops or notebooks available for use at school, reaching an **85%** coverage

**33** less students in 100 had desktop computers available for use at school, reaching a **63%** coverage

**31** more students in 100 frequently used computers to look up for ideas and information in science, reaching a **42%** coverage

## Some trends in educational outcomes



Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Student satisfaction in primary and secondary education

Student enjoyment in primary science lessons

Teachers' collective ambition for their students in primary and secondary education



Academic outcome in primary reading

Student enjoyment in secondary science lessons

Teachers' collective self-efficacy in primary and secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary science



Equity of academic outcomes in secondary science

Equity of academic outcomes in primary and secondary maths



# England (UK) 33
# OECD average 30

## Education Innovation Index

## Innovation in education by category



Primary 32 / 31



Secondary 33 / 30



Maths 36 / 35



Science 26 / 29



Reading 29 / 27

## Innovation in education by type of practice



Teachers' peer learning

50
0 50,3
-1,2 40,8
42



Rote learning

48
0 47,8
-3,2 28,3
32



Assessment

35
-7,7 27
-9,3 16,9
26



Homework

34
-3,4 30,6
-7,3 28,4
36



Fostering higher order skills

32
0 32,4
-3,3 20,6
24



School learning resources

32
-28,1 3,9
-22,6 9,8
32



Independent knowledge acquisition

30
0 30
-6,7 34,6
41



Active learning practices in science

27
0 27,1
-2,1 25,9
28



Formal teacher training

17
-12,5 4,8
-17,2 6,4
24



School external relations and HRM

15
-1,6 13,7
-8,1 12,8
21

## ICT Innovation



Computer availability

53
-52,6 0
-30,5 8,5
39



Use of ICT in schools

33
-12,6 19,9
-12,6 27,1
33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# England (UK)

Between 2006 and 2016, England experienced a moderate level of innovation, slightly above the OECD average. Innovation was almost equally distributed between primary and secondary education. There was much more innovation in mathematics practices compared to science and reading, even though only innovation in science was below the OECD average. The relatively high innovation in maths is mainly due to increases in the prevalence of ICT based practices and peer learning among maths teachers. While access to computers in school has dropped, the increased use of ICT was modest compared to other OECD systems. Innovation has mainly been driven by the diffusion of peer learning among teachers and the greater emphasis on rote learning, assessment and homework. Practices to foster higher order skills have also gained more ground than in other OECD systems.

## Practices that changed the most

### Primary

**43** less students in 100 had computers (including tablets) available for use during reading lessons, reaching a **55%** coverage

**43** more students in 100 had teachers with assistance available to work with students who have difficulty in reading, reaching a **62%** coverage

**34** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **35%** coverage

### Secondary

**38** more students in 100 frequently observed and described natural phenomena in science lessons, reaching a **61%** coverage

**33** more students in 100 in science and **31** more in maths systematically discussed homework in class, reaching a **46%** and **44%** coverage respectively

**24** more students in 100 frequently practised maths skills and procedures on computers, reaching a **31%** coverage

## Some trends in educational outcomes



Academic outcome in primary reading

Student satisfaction in primary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary and secondary education

Teachers' collective self-efficacy in secondary education



Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Student satisfaction in secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in primary and secondary maths



Teachers' collective self-efficacy in primary education



# United States 25
# OECD average 30

# Education Innovation Index

## Innovation in education by category

| | | |
|---|---|---|
| Primary | 26 | 31 |
| Secondary | 24 | 30 |
| Maths | 30 | 35 |
| Science | 26 | 29 |
| Reading | 21 | 27 |

## Innovation in education by type of practice

| | | | |
|---|---|---|---|
| Independent knowledge acquisition | 47 | 0 47,3 | -6,7 34,6 | 41 |
| Teachers' peer learning | 39 | 0 39,1 | -1,2 40,8 | 42 |
| Active learning practices in science | 31 | -1,2 29,3 | -2,1 25,9 | 28 |
| School learning resources | 29 | -25,7 2,8 | -22,6 9,8 | 32 |
| Homework | 23 | -11,1 12,2 | -7,3 28,4 | 36 |
| Fostering higher order skills | 20 | -4,4 15,5 | -3,3 20,7 | 24 |
| Assessment | 20 | -2,6 16,9 | -9,3 16,9 | 26 |
| Rote learning | 20 | -2,3 17,4 | -3,2 28,3 | 32 |
| Formal teacher training | 12 | -6,6 5 | -17,2 6,4 | 24 |
| School external relations and HRM | 10 | -3,6 6,4 | -8,1 12,8 | 21 |
| Other practices | 21 | 0 20,6 | -6,6 14,2 | 21 |

## ICT Innovation

| | | | |
|---|---|---|---|
| Computer availability | 49 | -49,4 0 | -30,5 8,5 | 39 |
| Use of ICT in schools | 52 | -2,9 49,1 | -5,4 27,1 | 33 |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# United States

Between 2006 and 2016, the United States experienced modest innovation in its education practices, much less than in other OECD systems. Innovation was almost equally distributed between primary and secondary education. Innovation at the disciplinary level followed the OECD pattern, with more innovation in maths, followed by science and then reading, in all cases markedly smaller than the OECD average. Innovation related to technology was large, taking the form of a higher than average drop in access to computers in schools but also higher than average expansion in the use of ICT in class. Independent knowledge acquisition practices in class, usually using computers, spread more than in other systems, while further innovation mainly lay in the scale up of teacher peer learning practices and of active learning practices in science education.

## Practices that changed the most

### Primary

**61** more students in 100 frequently practised maths skills and procedures on computers, reaching a **79%** coverage

**37** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **43%** coverage

**30** less students in 100 in science and **28** less in reading had computers (including tablets) available to use during lessons, reaching a **47%** and **70%** coverage respectively

### Secondary

**44** more students in 100 frequently practised maths skills and procedures on computers, reaching a **57%** coverage

**39** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **42%** coverage

**31** more students in 100 frequently processed and analysed data on computers in maths, reaching a **35%** coverage

## Some trends in educational outcomes



Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Academic outcome in primary reading

Student satisfaction in primary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary and secondary education



Student satisfaction in secondary education

Teachers' collective self-efficacy in primary and secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in primary and secondary maths



OECD average 30

# Education Innovation Index

## Innovation in education by category

| Primary | Secondary | Maths | Science | Reading |
|---|---|---|---|---|
| 31 | 30 | 35 | 29 | 27 |

## Innovation in education by type of practice

| | | | | | |
|---|---|---|---|---|---|
| Teachers' peer learning | -1,2 \| 40,8 | 42 | Independent knowledge acquisition | -6,7 \| 34,6 | 41 |
| Homework | -7,3 \| 28,4 | 36 | Rote learning | -3,2 \| 28,3 | 32 |
| School learning resources | -22,6 \| 9,8 | 32 | Active learning practices in science | -2,1 \| 25,9 | 28 |
| Assessment | -9,3 \| 16,9 | 26 | Formal teacher training | -17,2 \| 6,4 | 24 |
| Fostering higher order skills | -3,3 \| 20,6 | 24 | School external relations and HRM | -8,1 \| 12,8 | 21 |
| **Other practices** | -6,6 \| 14,2 | 21 | | | |

## ICT Innovation

| | | | | | |
|---|---|---|---|---|---|
| Computer availability | -30,5 \| 8,5 | 39 | Use of ICT in schools | -5,5 \| 27,1 | 33 |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# OECD

Between 2006 and 2016, on average OECD systems have experienced a moderate level of innovation in their teaching, learning and school level practices. Innovation has been equally distributed between primary and secondary education. Students in OECD systems have experienced a relatively high level of change in their maths education practices, moderate change in science and a more modest change in reading, a discipline where there has been stability in many OECD systems. Innovation related to technology took the form of a decrease in access to computers in schools, but more use of ICT in school or class. On average, innovation lay in the spread of teacher peer learning, a very promising change, but also in independent knowledge acquisition practices in class, and in homework practices.

## Some trends in educational outcomes



Academic outcome in primary maths

Student satisfaction in primary and secondary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary and secondary education

Teachers' collective self-efficacy in primary and secondary education



Academic outcome in primary and secondary science

Academic outcome in secondary maths

Academic outcome in primary reading

## Practices that changed the most

**Primary**

**42** more students in 100 frequently practised maths skills and procedures on computers, reaching a **51%** coverage

**32** less students in 100 had computers (including tablets) available during reading lessons, reaching a **51%** coverage

**27** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **31%** coverage

**Secondary**

**36** more students in 100 in maths and **30** more in science systematically discussed homework in class, reaching a **58%** and **55%** coverage respectively

**23** more students in 100 frequently practised maths skills and procedures on computers, reaching a **31%** coverage

**18** more students in 100 frequently used computers to look up for ideas and information in maths, reaching a **23%** coverage

# Hong Kong, China 29
OECD average 30

## Education Innovation Index

## Innovation in education by category

| | | |
|---|---|---|
| Primary | 31 | 31 |
| Secondary | 27 | 30 |
| Maths | 27 | 35 |
| Science | 32 | 29 |
| Reading | 29 | 27 |

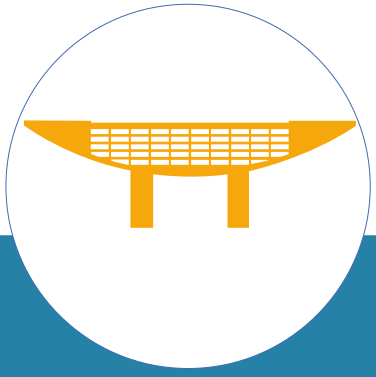
## Innovation in education by type of practice

| | | | |
|---|---|---|---|
| Teachers' peer learning | 65 | 0 / 64,6 | -1,2 / 40,8 | 42 |
| Rote learning | 40 | -0,9 / 39,3 | -3,2 / 28,3 | 32 |
| School learning resources | 39 | -31,6 / 7,1 | -22,6 / 9,8 | 32 |
| Fostering higher order skills | 37 | -2,8 / 33,9 | -3,3 / 20,6 | 24 |
| Active learning practices in science | 34 | 0 / 34,4 | -2,1 / 25,9 | 28 |
| Independent knowledge acquisition | 29 | -5,2 / 23,3 | -6,7 / 34,6 | 41 |
| School external relations and HRM | 25 | -2,9 / 22 | -8,1 / 12,8 | 21 |
| Formal teacher training | 21 | -20,1 / 0,6 | -17,2 / 6,4 | 24 |
| Homework | 17 | -4 / 12,6 | -7,3 / 28,4 | 36 |
| Assessment | 13 | -3,3 / 9,2 | -9,3 / 16,9 | 26 |
| Other practices | 23 | -1,9 / 20,6 | -6,6 / 14,2 | 21 |

## ICT Innovation

| | | | |
|---|---|---|---|
| Computer availability | 47 | 47,3 / 0 | -30,5 / 8,5 | 39 |
| Use of ICT in schools | 21 | -4,7 / 16,1 | -5,4 / 27,1 | 33 |

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Hong Kong, China

Between 2006 and 2016, Hong Kong, China, has experienced moderate innovation in education, with more change in primary than in secondary education practices. Innovation has been larger in science than in reading and maths, with a different pattern than in OECD systems where innovation typically came from changes in maths education practices. As in other systems, access to computers in schools and classes has dropped a bit, but mainly the use of ICT in class has not expanded as much in comparison to the average OECD system. The main areas of innovation were the expansion of teacher peer learning, the spread of rote learning practices and of practices that foster higher order skills. Succinctly put, most educational outcomes in Hong Kong have either improved or remained stable.

## Practices that changed the most

### Primary

**58** less students in 100 had computers (including tablets) available during reading lessons, reaching a **35%** coverage

47 more students in 100 had teachers collaborating in preparing instructional material, reaching a **70%** coverage

**32** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **33%** coverage

### Secondary

**42** more students in 100 frequently observed and described natural phenomena in science lessons, reaching a **62%** coverage

**32** more students in 100 regularly watched teachers demonstrate an experiment in science lessons, reaching a **51%** coverage

**22** more students in 100 in science had their teachers visiting another classroom to learn more about teaching, reaching a **25%** coverage

## Some trends in educational outcomes

**+**

Academic outcome in secondary science

Academic outcome in secondary maths

Student satisfaction in primary and secondary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary education

Teachers' collective self-efficacy in primary education

**=**

Academic outcome in primary science

Academic outcome in primary maths

Academic outcome in primary reading

Teachers' collective ambition for their students in secondary education

Teachers' collective self-efficacy in secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in secondary maths

**−**

Equity of academic outcomes in primary maths

# Indonesia 35
# OECD average 30

# Education Innovation Index

## Innovation in education by category



Secondary

34

30



Reading

32

27

## Innovation in education by type of practice



Assessment

43

-2,6 40,5

-9,3 16,9

26



Fostering higher order skills

40

-8,4 31,7

-3,3 20,6

24



School external relations and HRM

40

-20 20,2

-8,1 12,8

21



Homework

35

-7,1 27,5

-7,3 28,4

36



Independent knowledge acquisition

33

0 33,1

-6,7 34,6

41



Teachers' peer learning

28

-14,1 14,1

-1,2 40,8

42



Rote learning

27

-4,9 22,3

-3,2 28,3

32



Other practices

33

-18,7 14

-6,6 14,2

21

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Indonesia

Between 2006 and 2015, Indonesia has experienced a high level of innovation in education, exceeding the level of change in the average OECD system. Innovation in secondary education was slightly lower than at the overall system level, while still being above the OECD average, showing that, while a primary education innovation index could not be computed because of data gaps, existing data point to greater changes at that level. At the disciplinary level, only a reading education innovation index could be computed for the 2006-2011 period: Indonesia experienced significant innovation, much larger than in the average OECD system. Students experienced large changes in assessment practices and in how schools relate to their stakeholders. The use of practices to foster students' higher order skills has also spread considerably.

## Practices that changed the most

### Primary

**45** more students in 100 had teachers putting major emphasis on national or regional tests in reading, reaching a **76%** coverage

**38** more students in 100 frequently explained the style and structure of read text in reading lessons, reaching an **82%** coverage

**28** more students in 100 frequently discussed read text with peers, reaching a **97%** coverage

### Secondary

**46** more students in 100 in science and **35** more in maths systematically discussed homework in class, reaching a **67%** and **58%** coverage respectively

**38** more students in 100 went to schools which tracked achievement data over time by an administrative authority, reaching a **93%** coverage

**28** more students in 100 frequently studied natural phenomena through simulations on computers in science lessons, reaching a **32%** coverage

# Russian Federation 36
## OECD average 30

# Education Innovation Index

## Innovation in education by category




Primary 38 31



Secondary 33 30



Maths 43 35



Science 36 29



Reading 30 27

## Innovation in education by type of practice



Independent knowledge acquisition

71
-8,6 62,5
-6,7 34,6
41



Teachers' peer learning

69
0 69,3
-1,2 40,8
42



Homework

47
-8,8 38
-7,4 28,4
36



School learning resources

44
-9 35
-22,6 9,8
32



Assessment

38
-6,3 31,6
-9,3 16,9
26



Active learning practices in science

25
-1,7 23,3
-2,1 25,9
28



Formal teacher training

24
-14,9 8,7
-17,3 6,5
24



Fostering higher order skills

23
-4,9 18,1
-3,3 20,6
24



Rote learning

20
0 19,6
-3,2 28,4
32



School external relations and HRM

17
0 17,2
-8,1 12,8
21



Other practices

22
-6,3 15,7
-6,6 14.1
21

## ICT Innovation



Computer availability

49
0 52,9
-30,5 8,5
39



Use of ICT in schools

50
-0,7 49,5
-5,4 27,1
33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Russian Federation

Between 2006 and 2016, the Russian Federation has experienced a relatively high level of innovation in educational practices, more than the OECD average. There was more innovation in primary than secondary, although both sectors experienced more change than OECD systems. At the disciplinary level, innovation in the Russian Federation followed the OECD pattern, with more innovation in maths practices, followed by science and reading. Innovation related to technology took the form of much more access to computers in schools, a big difference compared to OECD systems where there was a decrease, and also a much greater use of ICT in school. The most significant changes lay in the spread of teacher peer learning practices, in the expansion of independent knowledge acquisition practices in class, and the change in homework practices.

## Practices that changed the most

### Primary

**62** more students in 100 frequently used computers to look up for ideas and information in reading, reaching a **75%** coverage

**56** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **70%** coverage

**50** more students in 100 in science and **48** more in maths had computers(including tablets) available for use during lessons, reaching a **66%** and **62%** coverage respectively

### Secondary

**60** more students in 100 in math and **48** more in science systematically discussed homework in class, reaching a **67%** and **62%** coverage respectively

**42** more students in 100 had teachers putting major emphasis on national or regional achievement tests in science, reaching a **91%** coverage

**39** more students in 100 had their teachers visiting another classroom to learn more about teaching, reaching a **52%** coverage

## Some trends in educational outcomes

**+**

Academic outcome in primary and secondary science

Academic outcome in primary and secondary maths

Academic outcome in primary reading

Student satisfaction in primary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary and secondary education

**=**

Student satisfaction in primary and secondary education

Teachers' collective ambition for their students in primary and secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in primary maths

**−**

Teachers' collective self-efficacy in primary and secondary education

# Singapore 30
# OECD average 30

# Education Innovation Index

## Innovation in education by category




Primary: 30 / 31



Secondary: 32 / 30



Maths: 32 / 35



Science: 32 / 29



Reading: 22 / 27

## Innovation in education by type of practice



Teachers' peer learning: 54 (0 to 54,2; -1,2 to 40,8) 42



Active learning practices in science: 39 (0 to 39,2; -2,1 to 25,9) 28



School learning resources: 39 (-32,5 to 6,1; -22,6 to 9,9) 32



Rote learning: 36 (0 to 36,2; -3,2 to 28,4) 32



Fostering higher order skills: 34 (-3 to 31,2; -3,3 to 20,7) 24



School external relations and HRM: 31 (-0,4 to 30,2; -8,1 to 12,8) 21



Independent knowledge acquisition: 27 (-3,8 to 23,3; -6,7 to 34,6) 41



Homework: 27 (-1,6 to 25,2; -7,3 to 28,4) 35



Assessment: 23 (-5,3 to 18; -9,3 to 16,9) 26



Formal teacher training: 17 (-6,5 to 10,8; -17,3 to 6,5) 24

## ICT Innovation



Computer availability: 62 (-52,1 to 10; -30,5 to 8,5) 39



Use of ICT in schools: 24 (-3,2 to 20,7; -5,4 to 27,1) 33

*The indices indicate innovation intensity from small (below 20) to large (over 40). When displayed, positive and negative values show how much of the index corresponds to a expansion and contraction of the covered practices between 2006 and 2016. Authors' calculations based on the PIRLS, PISA and TIMSS databases.*



# Singapore

Between 2006 and 2016, Singapore has experienced a moderate level of innovation in education, on par with the OECD average. Innovation has been almost equally distributed between primary and secondary education. Changes in maths and science practices were moderate (though below the OECD average in maths), and small in reading, an area where practices remained relatively stable. Access to computers in school decreased, to an even greater extent than in OECD systems, while the use of ICT spread a bit, though less than in the OECD area. Major areas of innovation lay in the spread of teacher peer learning practices and the scale up of active learning practices in science, rote learning practices, as well as practices fostering students' higher order skills.

## Practices that changed the most

### Primary

**44** more students in 100 frequently observed and described natural phenomena in science lessons, reaching a **59%** coverage

**44** fewer students in 100 in maths and

**38** less in reading had computers (including tablets) available to use during lessons, reaching a **37%** and **55%** coverage respectively

**31** more students in 100 had teachers with assistance available to work with students who have difficulty in reading, reaching a **32%** coverage

### Secondary

**38** more students in 100 in maths and **38** more in science systematically discussed homework in class, reaching a **68%** and **73%** coverage respectively

**36** more students in 100 frequently observed and described natural phenomena in science lessons, reaching a **54%** coverage

**33** more students in 100 had portable laptops or notebooks available for use at school, reaching a **79%** coverage

## Some trends in educational outcomes



Academic outcome in primary reading

Academic outcome in primary and secondary maths

Academic outcome in secondary science

Student satisfaction in primary education

Student enjoyment in primary and secondary science lessons

Teachers' collective ambition for their students in primary and secondary education

Equity of academic outcomes in secondary science

Equity of academic outcomes in secondary maths



Academic outcome in primary science

Student satisfaction in secondary education

Teachers' collective self-efficacy in primary and secondary education

Equity of academic outcomes in primary reading

Equity of academic outcomes in primary science

Equity of academic outcomes in primary maths

# Annex A.
# Data sources and methods

## Data sources: overview

This publication reports the results of secondary analyses of data from several sources collected in surveys of students, teachers and principals. These data are drawn from PISA (Programme on International Student Assessment), TIMSS (Trends in International Mathematics and Science Study) and PIRLS (Progress in International Reading Literacy Study). PISA, TIMSS and PIRLS have been created to look at student achievements in maths and science (PISA and TIMSS) and text understanding (PISA and PIRLS). Background questionnaires provide relevant information about classroom or school practices which have been used to identify the extent to which they have changed over time. All these surveys are cross-sectional.

## Coverage of the statistics

PISA is designed to assess learning outcomes of 15-year-old students and make comparisons over time. PISA focuses on the extent to which students can apply the knowledge and skills they have learnt and practised at school when confronted with situations and challenges for which that knowledge may be relevant.

PISA uses questionnaires to collect background information from students and data on various aspects of organisation and educational provision in schools from school principals.

The target population of PISA is 15-year-old students in grade 7 or higher who attend educational institutions, including those enrolled part-time and those in vocational training programmes. It is important to note that the sample is not designed to be representative of schools or classrooms and has not been reweighted. Results should be read as "the percentage of 15-year-old students who report ….."

TIMSS and PIRLS are designed to measure student achievement around the world and make comparisons over time. TIMSS has two target populations—all students enrolled at the 4th grade and all students enrolled at the 8th grade, although countries may choose to assess either or both student populations. Fourth and eighth grade represent four and eight years of schooling respectively, counting from the first year of ISCED Level 1, providing the mean age at the time of testing is at least 9.5 years/13.5 years.

The target population for PIRLS is all students enrolled at the 4th grade. All schools of all educational sub-systems that have students learning full-time in the target grade are part of the international target population, including schools that are not under the authority of the national Ministry of Education or its equivalent.

TIMSS and PIRLS are designed to pay particular attention to students' curricular and instructional experiences and therefore sample intact classes of students. However, as with PISA, TIMSS and PIRLS are not designed to be representative of schools or classrooms and data have not been reweighted. Results should be read as "the percentage of 4th /8th grade students who report….."

## Country coverage

This publication incorporates information from 47 education systems or countries within the OECD, and 6 partner countries.

- 36 education systems within the OECD participated in PISA 2015, 34 in 2009 and 32 in 2006.

- 29 education systems within the OECD participated in TIMSS 2015, 38 in 2011 and 27 in 2007.
- 31 education systems within the OECD participated in PIRLS 2016, 29 in 2011 and 27 in 2006.

## Sample sizes

**Table A.1. TIMSS sample sizes: Principals**

| | 4th grade | | | 8th grade | | |
|---|---|---|---|---|---|---|
| OECD countries | 2007 | 2011 | 2015 | 2007 | 2011 | 2015 |
| Australia | 229 | 280 | 287 | 228 | 277 | 285 |
| Austria | 196 | 158 | | | | |
| Belgium Flemish | | 142 | 153 | | | |
| Canada | | | 441 | | | 276 |
| Canada (Alberta) | 146 | 143 | | | 145 | |
| Canada (Quebec) | 186 | 190 | 121 | 170 | 189 | 122 |
| Canada (Ontario) | 188 | 146 | 151 | 176 | 143 | 138 |
| Chile | | 200 | 179 | | 193 | 171 |
| Colombia | 142 | | | 148 | | |
| Czech Republic | 144 | 177 | 159 | 147 | | |
| Denmark | 137 | 216 | 193 | | | |
| Finland | | 145 | 158 | | 145 | |
| France | | | 164 | | | |
| Germany | 246 | 197 | 204 | | | |
| Hungary | 144 | 149 | 144 | 144 | 146 | 144 |
| Ireland | | 150 | 149 | | | 149 |
| Israel | | | | 146 | 151 | 200 |
| Italy | 170 | 202 | 164 | 170 | 197 | 161 |
| Japan | 148 | 149 | 148 | 146 | 138 | 147 |
| Korea | | 150 | 149 | 150 | 150 | 150 |
| Lithuania | 156 | 154 | 225 | 145 | 141 | 208 |
| Netherlands | 141 | 128 | 129 | | | |
| New Zealand | 220 | 180 | 174 | | 158 | 145 |
| Norway | 145 | 119 | 140 | 139 | 134 | 143 |
| Poland | | 150 | 150 | | | |
| Portugal | | 147 | 217 | | | |
| Slovak Republic | 184 | 197 | 198 | | | |
| Slovenia | 148 | 195 | 148 | 148 | 186 | 148 |
| Spain | | 151 | 358 | | | |
| Sweden | 155 | 152 | 144 | 159 | 153 | 150 |
| Turkey | | 257 | 242 | 146 | 239 | 218 |
| U.K. (England) | 143 | 154 | 147 | 137 | 118 | 143 |
| U.K. (Northern Ireland) | | 136 | 118 | | | |
| United States | 257 | 369 | 250 | 239 | 501 | 246 |
| U.S. (Massachusetts) | 47 | | | 48 | 56 | |
| U.S. (Minnesota) | 50 | | | 49 | 55 | |
| Non OECD countries | | | | | | |
| Hong Kong | 126 | 136 | 132 | 120 | 117 | 133 |
| Indonesia | | | 230 | 149 | 153 | |
| Russian Federation | 206 | 202 | 208 | 210 | 210 | 204 |
| Singapore | 177 | 176 | 179 | 164 | 165 | 167 |
| South Africa | | | 297 | | 285 | 292 |

## Table A.2. TIMSS sample sizes: Teachers

| | 4th grade | | | 8th grade maths | | | 8th grade science | | |
|---|---|---|---|---|---|---|---|---|---|
| OECD countries | 2007 | 2011 | 2015 | 2007 | 2011 | 2015 | 2007 | 2011 | 2015 |
| Australia | 360 | 594 | 584 | 251 | 802 | 824 | 496 | 1049 | 909 |
| Austria | 356 | 296 | | | | | | | |
| Belgium Flemish | | 268 | 295 | | | | | | |
| Canada | | | 807 | | | 384 | | | 278 |
| Canada (Alberta) | 252 | 235 | | | 222 | | | 234 | |
| Canada (Quebec) | 308 | 300 | 195 | 226 | 265 | 165 | 192 | 323 | 167 |
| Canada (Ontario) | 279 | 362 | 309 | 214 | 244 | 202 | 219 | 245 | 96 |
| Colombia | 214 | | | 149 | | | 149 | | |
| Chile | | 200 | 261 | | 194 | 172 | | 194 | 191 |
| Czech Republic | 253 | 291 | 347 | 212 | | | 845 | | |
| Denmark | 246 | 341 | 305 | | | | | | |
| Finland | | 310 | 400 | | 264 | | | 827 | |
| France | | | 310 | | | | | | |
| Germany | 373 | 312 | 307 | | | | | | |
| Hungary | 255 | 324 | 307 | 289 | 280 | 232 | 987 | 1005 | 516 |
| Ireland | | 220 | 214 | | | 516 | | | 352 |
| Israel | | | | 394 | 514 | 596 | 270 | 282 | 347 |
| Italy | 323 | 314 | 328 | 287 | 205 | 21 | 287 | 205 | 228 |
| Japan | 250 | 265 | 292 | 216 | 181 | 231 | 178 | 151 | 169 |
| Korea | | 168 | 226 | 243 | 376 | 310 | 181 | 202 | 215 |
| Lithuania | 283 | 282 | 301 | 209 | 222 | 264 | 596 | 617 | 905 |
| Netherlands | 218 | 210 | 223 | | | | | | |
| New Zealand | 609 | 494 | 499 | | 354 | 435 | | 265 | 329 |
| Norway | | 280 | 280 | 270 | 175 | 220 | 264 | 171 | 80 |
| Poland | | 257 | 390 | | | | | | |
| Portugal | | 240 | 322 | | | | | | |
| Slovak Republic | 343 | 422 | 404 | | | | | | |
| Slovenia | 340 | 245 | 256 | 503 | 523 | 352 | 779 | 901 | 527 |
| Spain | | 200 | 517 | | | | | | |
| Sweden | 396 | 369 | 233 | 491 | 405 | 198 | 680 | 540 | 210 |
| Turkey | | 263 | 251 | 146 | 240 | 220 | 146 | 240 | 218 |
| U.K. (England) | 250 | 261 | 238 | 235 | 212 | 210 | 615 | 751 | 775 |
| U.K. (Northern Ireland) | | 187 | 154 | | | | | | |
| United States | 904 | 767 | 540 | 532 | 559 | 429 | 687 | 931 | 517 |
| U.S. (Massachusetts) | 156 | | | 103 | 105 | | 114 | 107 | |
| U.S. (Minnesota) | 168 | | | 104 | 110 | | 116 | 147 | |
| Non OECD countries | | | | | | | | | |
| Hong Kong | 282 | 267 | 279 | 145 | 148 | 173 | 123 | 124 | 145 |
| Indonesia | | | 378 | 149 | 170 | | 276 | 259 | |
| Russian Federation | 268 | 218 | 226 | 273 | 239 | 221 | 1083 | 916 | 748 |
| Singapore | 508 | 515 | 538 | 357 | 330 | 324 | 429 | 330 | 318 |
| South Africa | | | | | | 325 | | | 305 |

**Table A.3. TIMSS sample sizes: Students**

| | 4th grade | | | 8th grade | | |
|---|---|---|---|---|---|---|
| OECD countries | 2007 | 2011 | 2015 | 2007 | 2011 | 2015 |
| Australia | 4108 | 6146 | 10338 | 4069 | 7556 | 10338 |
| Austria | 4859 | 4668 | | | | |
| Belgium Flemish | | 4849 | | | | |
| Canada | | | 8757 | | | 8757 |
| Canada (Alberta) | 4037 | 3645 | | | | |
| Canada (Quebec) | 3885 | 4235 | 3950 | 3956 | 6149 | 3950 |
| Canada (Ontario) | 3496 | 4570 | 4520 | 3448 | 4756 | 4520 |
| Chile | | 5585 | 4849 | | 5835 | 4849 |
| Czech Republic | 4235 | 4578 | | 4845 | | |
| Denmark | 3519 | 3987 | | | | |
| Finland | | 4638 | | | 4266 | |
| France | | | | | | |
| Germany | 5200 | 3995 | | | | |
| Hungary | 4048 | 5204 | 4893 | 4111 | 5178 | 4893 |
| Ireland | | 4560 | 4704 | | | 4704 |
| Israel | | | 5512 | 3294 | 4699 | 5512 |
| Italy | 4470 | 4200 | 4481 | 4408 | 3979 | 4481 |
| Japan | 4487 | 4411 | 4745 | 4312 | 4414 | 4745 |
| Korea | | 4334 | 5309 | 4240 | 5166 | 5309 |
| Lithuania | 3980 | 4688 | 4347 | 3991 | 4747 | 4347 |
| Netherlands | 3349 | 3229 | | | | |
| New Zealand | 4940 | 5572 | 8142 | | 5336 | 8142 |
| Norway | 4108 | 3121 | 4697 | 4627 | 3862 | 4697 |
| Poland | | 5027 | | | | |
| Portugal | | 4042 | | | | |
| Slovak Republic | 4963 | 5616 | | | | |
| Slovenia | 4351 | 4492 | 4257 | 4043 | 4415 | 4257 |
| Spain | | 4183 | | | | |
| Sweden | 4676 | 4663 | 4090 | 5215 | 5573 | 4090 |
| Turkey | | 7479 | 6079 | 4498 | 6928 | 6079 |
| U.K. (England) | 4316 | 3397 | 4814 | 4025 | 3842 | 4814 |
| U.K. (Northern Ireland) | | 3571 | | | | |
| United States | 7896 | 12569 | 10221 | 7377 | 10477 | 10221 |
| U.S. (Massachusetts) | | | | 1897 | 2075 | |
| U.S. (Minnesota) | | | | 1777 | 2500 | |
| Non OECD countries | | | | | | |
| Colombia | 4801 | | | 4873 | | |
| Hong Kong | 3791 | 3957 | 4155 | 3470 | 4015 | 4155 |
| Indonesia | | | | 4203 | 5795 | |
| Russian Federation | 4464 | 4467 | 4780 | 4472 | 4893 | 4780 |
| Singapore | 5041 | 6368 | 6116 | 4599 | 5927 | 6116 |
| South Africa | | | 12514 | | 11969 | 12514 |

## Table A.4. PIRLS sample sizes: Principals, teachers and students

| | Principals | | | Teachers | | | Students | | |
|---|---|---|---|---|---|---|---|---|---|
| OECD countries | 2006 | 2011 | 2016 | 2006 | 2011 | 2016 | 2006 | 2011 | 2016 |
| Australia | | 280 | 286 | | 513 | 531 | | 6126 | 6341 |
| Austria | 158 | 158 | 150 | 263 | 284 | 259 | 5067 | 4670 | 4360 |
| Belgium Flemish | 137 | | 148 | 237 | | 277 | 4479 | | 5198 |
| Belgium French | 150 | 127 | 158 | 277 | 217 | 254 | 4552 | 3727 | 4623 |
| Canada | | 1111 | 926 | | 1393 | 1119 | | 23206 | 18245 |
| Canada (Alberta) | 150 | 145 | | 233 | 218 | | 4243 | 3789 | |
| Canada (Quebec) | 185 | 190 | 127 | 210 | 217 | 166 | 3748 | 4244 | 3179 |
| Canada (Ontario) | 180 | 189 | 188 | 200 | 275 | 251 | 3988 | 4561 | 4270 |
| Colombia | | 150 | | | 151 | | | 3966 | |
| Chile | | | 154 | | | 154 | | | 4294 |
| Czech Republic | 0 | 177 | 157 | | 235 | 270 | | 4556 | 5537 |
| Denmark | 145 | 232 | 185 | 216 | 236 | 186 | 4001 | 4594 | 3508 |
| Finland | 0 | 145 | 151 | | 285 | 295 | | 4640 | 4896 |
| France | 169 | 174 | 163 | 261 | 276 | 284 | 4404 | 4438 | 4767 |
| Germany | 405 | 197 | 208 | 418 | 222 | 227 | 7899 | 4000 | 3959 |
| Hungary | 149 | 149 | 149 | 194 | 245 | 206 | 4068 | 5204 | 4623 |
| Iceland | 128 | | | 239 | | | 3673 | | |
| Ireland | 0 | 151 | 148 | | 221 | 219 | | 4524 | 4607 |
| Israel | 149 | 152 | 159 | 149 | 165 | 159 | 3908 | 4186 | 4041 |
| Italy | 150 | 202 | 149 | 198 | 239 | 217 | 3581 | 4189 | 3940 |
| Latvia | 145 | | 150 | 213 | | 216 | 4162 | | 4157 |
| Lithuania | 144 | 154 | 195 | 270 | 277 | 243 | 4701 | 4661 | 4317 |
| Luxembourg | 178 | | | 363 | | | 5101 | | |
| Netherlands | 139 | 138 | 132 | 207 | 207 | 226 | 4156 | 3995 | 4206 |
| New Zealand | 243 | 192 | 188 | 509 | 434 | 411 | 6256 | 5644 | 5646 |
| Norway | 135 | 120 | 150 | 227 | 190 | 211 | 3837 | 3190 | 4232 |
| Poland | 148 | 150 | 148 | 250 | 257 | 214 | 4854 | 5005 | 4413 |
| Portugal | 0 | 148 | 218 | | 242 | 318 | | 4085 | 4642 |
| Slovak Republic | 167 | 197 | 220 | 263 | 314 | 333 | 5380 | 5630 | 5451 |
| Slovenia | 145 | 195 | 160 | 315 | 243 | 253 | 5337 | 4512 | 4499 |
| Spain | 152 | 312 | 629 | 193 | 402 | 678 | 4094 | 8580 | 14595 |
| Spain (Andalusia) | 0 | 149 | | 0 | 197 | 188 | 0 | 4333 | |
| Sweden | 147 | 152 | 154 | 255 | 254 | 214 | 4394 | 4622 | 4525 |
| U.K. (England) | 148 | 129 | 170 | 186 | 182 | 210 | 4036 | 3927 | 5095 |
| U.K. (Northern Ireland) | | 136 | 134 | | 184 | 161 | | 3586 | 3693 |
| United States | 183 | 370 | 158 | 253 | 606 | 208 | 5190 | 12726 | 4425 |
| Non OECD countries | | | | | | | | | |
| Hong Kong | 144 | 132 | 138 | 144 | 138 | 150 | 4712 | 3875 | 3349 |
| Indonesia | 168 | 158 | | 168 | 163 | | 4774 | 4791 | |
| Russian Federation | 232 | 202 | 206 | 232 | 209 | 213 | 4720 | 4461 | 4577 |
| Singapore | 178 | 176 | 177 | 356 | 355 | 354 | 6390 | 6367 | 6488 |
| South Africa | 397 | 341 | 293 | 403 | 111 | | 14657 | 3515 | 12810 |

## Table A.5. PISA sample sizes: Principals and students

| | Principals | | | Students | | |
|---|---|---|---|---|---|---|
| OECD countries | 2006 | 2009 | 2015 | 2006 | 2009 | 2015 |
| Australia | 350 | 345 | 758 | 14170 | 14251 | 14530 |
| Austria | 197 | 280 | 269 | 4927 | 6590 | 7007 |
| Belgium | 269 | 275 | 288 | 8857 | 8501 | 9651 |
| Canada | 861 | 908 | 759 | 22646 | 23207 | 20058 |
| Chile | 173 | 199 | 227 | 5233 | 5669 | 7053 |
| Colombia | 165 | 275 | 372 | 4478 | 7 921 | 11795 |
| Czech Republic | 244 | 260 | 344 | 5932 | 6064 | 6894 |
| Denmark | 209 | 285 | 333 | 4532 | 5924 | 7161 |
| Estonia | 169 | 175 | 206 | 4865 | 4727 | 5587 |
| Finland | 155 | 203 | 168 | 4714 | 5810 | 5882 |
| France | 179 | 166 | 252 | 4716 | 4298 | 6108 |
| Germany | 225 | 226 | 256 | 4891 | 4979 | 6522 |
| Greece | 189 | 183 | 211 | 4873 | 4969 | 5532 |
| Hungary | 189 | 187 | 245 | 4490 | 4605 | 5658 |
| Iceland | 135 | 129 | 124 | 3789 | 3646 | 3374 |
| Ireland | 164 | 141 | 167 | 4585 | 3937 | 5741 |
| Israel | 149 | 176 | 173 | 4584 | 5761 | 6598 |
| Italy | 796 | 1095 | 474 | 21773 | 30905 | 11583 |
| Japan | 181 | 185 | 198 | 5952 | 6088 | 6647 |
| Korea | 154 | 157 | 168 | 5176 | 4989 | 5581 |
| Latvia | 176 | 184 | 250 | 4719 | 4 502 | 4869 |
| Lithuania | 197 | 196 | 311 | 4744 | 4 528 | 6525 |
| Luxembourg | 31 | 39 | 44 | 4567 | 4622 | 5299 |
| Mexico | 1128 | 1531 | 275 | 30971 | 38250 | 7568 |
| Netherlands | 183 | 185 | 187 | 4871 | 4760 | 5385 |
| New Zealand | 170 | 161 | 183 | 4823 | 4643 | 4520 |
| Norway | 203 | 197 | 229 | 4692 | 4660 | 5456 |
| Poland | 221 | 179 | 169 | 5547 | 4917 | 4478 |
| Portugal | 172 | 212 | 246 | 5109 | 6298 | 7325 |
| Slovak Republic | 188 | 189 | 290 | 4731 | 4555 | 6350 |
| Slovenia | 356 | 337 | 333 | 6595 | 6155 | 6406 |
| Spain | 686 | 888 | 201 | 19604 | 25887 | 6736 |
| Sweden | 197 | 189 | 202 | 4443 | 4567 | 5458 |
| Switzerland | 509 | 425 | 227 | 12192 | 11812 | 5860 |
| Turkey | 160 | 170 | 187 | 4942 | 4996 | 5895 |
| United Kingdom | 494 | 481 | 550 | 13152 | 12179 | 14157 |
| United States | 166 | 160 | 177 | 5611 | 5233 | 5712 |
| Non OECD | | | | | | |
| Brazil | 625 | 947 | 841 | 9295 | 20 127 | 23141 |
| Hong Kong | 146 | 151 | 138 | 4645 | 4 837 | 5359 |
| Indonesia | 352 | 183 | 236 | 10647 | 5 136 | 6513 |
| Russian Federation | 209 | 213 | 210 | 5799 | 5 308 | 6036 |
| Singapore | | 171 | 177 | | 5 283 | 6115 |

## Year coverage

This publication focuses on change across time and therefore requires data from the same questions asked in different years. There are many such questions in the datasets employed, but it should be noted that the years in which they were answered varies.

Where possible, analysis focuses on change between 2006 and 2016, although data from TIMSS presents change between 2007 and 2015, and PISA data between 2006 and 2015 or 2009 and 2015. The years included in the analyses are indicated in the chapters.

In some cases, data are also available for an additional year between the two end points. In this case, the data from all three data collection exercises are represented in figures but only the end points are discussed in the text.

## Calculation of cross-country means and totals

Given the range of education systems covered in each chapter, cross-country means may not always incorporate the same countries or the same number of education systems. Where practical, the average cross-country statistics have been calculated using data for OECD countries (as in PISA, TIMSS, and PIRLS). In each indicator in TIMSS, PIRLS and PISA, the OECD average (unweighted) is computed taking into account the subset of OECD education systems with data available for all years concerned.

## Calculation of effect sizes

Effect sizes are presented for all analyses in addition to tests of statistical significance. Tests of significance allow the reader to determine whether the difference between the two percentages reported could have happened by chance if the actual difference is zero and thus consider the quality of the instrument used for measurement. However, statistical significance is dependent on the sample size (the larger the sample and the more confident the reader can be that even small differences wouldn't have happened by chance) and can, in principle, be improved simply by increasing the number of observations. Yet this does not tell the reader anything about how meaningful the observed effects are in real-world terms. For example, a change in classroom practice could be statistically significant but only amount to a few percentage points of relative change with no practical meaning.

The effect size provides important information about the size of the relationship between two statistics. The main difference between effect size and significance is that change is normalized by the standard deviation as opposed to standard error, which means that the result no longer depends on sample size. The precise form of calculation depends on the type of question asked, but is typically calculated as:

$$\mathrm{E} = \frac{\mathrm{X}_2 - \mathrm{X}_1}{\sigma_{21}}$$

i.e. as the change between a treatment and control group (or any two subgroups of a sample; or – as in our case - two different years), divided by a "pooled" standard deviation:

$$\sigma_{21} = \sqrt{\frac{{\sigma_1}^2 - {\sigma_2}^2}{2}}$$

Sometimes, the control group standard deviation or more complicated forms of pooled standard deviations are used instead of the one displayed. This book looks at effect sizes in

two ways. One approach is to calculate country level effect sizes. Here, means and standard deviations refer to the individual country samples. The effect size calculation provides information about how much, in terms of their own standard deviation, a country has moved up (or down) over time. For country level effect sizes, $\widehat{\sigma_1}$ and $\widehat{\sigma_2}$ are estimated via σ =SE*√n (with n being the sample sizes), which provides a conservative (lower) estimate for the effect size (as n could potentially be overestimated by including invalid observations).

A second way of looking at effect size is required for questions that evaluate proportions, i.e. those that deal with categorical variables and ask, for example, "How often do you do this activity in class? Daily? At least weekly? At least monthly? Rarely or never?". In this case, Cohen h is applied to carry out an arcsin-transformation, whereby h=2(arcsin √P1-arcsin √P2).

In accordance with common practices, effect sizes are assessed at three different levels. Effect sizes of less than 0.2 are considered negligible to very small, between 0.2 and 0.5 are come under small to modest, between 0.5 and 0.8, are large, and effect sizes above 0.8 are considered to be very large. While the usefulness of such cut-offs is debatable, this convention is followed by adding a colour coding in three different shades of blue when displaying effect sizes. The reader should interpret the colour coding with care as there is little practical difference between an effect size of 0.18 and 0.22, even if the colour coding is different.

## Further resources

The publication uses the OECD StatLinks service. Below each table and Figure is a URL that leads to a corresponding Excel workbook containing the underlying data for that indicator. These URLs are stable and will remain unchanged over time. In addition, readers of the electronic version of this publication (the e-book) will be able to click directly on the links and the relevant workbook will open in a separate window. The tables in the Excel files contain additional information and computations that could not be presented in the paper version.

# Annex B.
# Composite indices of innovation

The analyses reported throughout this book have shown considerable variation in the amount of change in educational practices and thus the potential extent of innovation. In order to provide an overview of change across school and classroom practices and to draw some conclusions about the level of innovation in each country, it may be considered helpful to combine some of this information and look at the extent and focus of innovation within education in different countries.

There may be important differences between practices at different education levels (primary or secondary) or across disciplines. For this reason, broader composite indices have been created to group together practices and represent innovation at the discipline level- maths, science and reading and at the education level- primary and secondary, besides and index for overall educational innovation. Additionally, composite indices for ICT practices and more specific educational practices have been computed. This allows readers and policy makers to identify which aspects of countries' education system(s) appear to have experienced relatively more innovation, and identifies countries that are innovating throughout the education system.

## Creating the indices

The indices draw from the analysis reported in this book. The approach used is broadly based on the guidance provided in the 2018 OECD handbook on constructing composite indicators. In particular, the indices are derived (as far as possible) from the definition of innovation discussed in the introduction and the process of creating them takes into account the need for appropriate data and imputing missing values.

The indices are based on the effect sizes of changes in responses to specific questions between baseline and endline years. Effect sizes reflect the size and direction of changes seen across two points in time, with a large positive effect size indicating a large increase over time and a large negative effect size indicating a large decrease. Effect sizes give a standardised measure of the change and can thus be easily added together.

**Table B.1. Data sources for indices**

| Study name | Questionnaire used | Grade/age covered |
|---|---|---|
| **TIMSS** | Principals<br>Teachers<br>Students | 4th grade<br>8th grade |
| **PIRLS** | Principals<br>Teachers<br>Students | 4th grade<br>8th grade |
| **PISA** | Principals<br>Students | 15-year-olds |

## Education level, discipline level, and overall indices of innovation

These indices are constructed in order to represent change in practices across different grades, disciplines or throughout the whole education system. Given that both increases and decreases indicate change which can be part of innovation, the absolute value of the effect size has been used to create these indicators. An index that kept the sign of the effect size would make countries that have large changes in both directions appear to have no change at all.

In order to have a fair representation of innovation, different disciplines have been given different weights at different levels. Primary and secondary levels were given equal weights, whereas maths, science, and reading were given different weights defined on the basis of the relative instruction time spent on each one of the disciplines in every respective grade (source: Education at a Glance 2011) For instance, as reading instruction time is roughly twice as large as science instruction time in primary education, change in reading practices was given twice as much weight as change in science practices for this particular level.

## ICT and thematic indices

These indices illustrate change in more specific educational practices. However, it is relevant in this case to not only analyse whether the use of certain practices has met significant change, but also whether the use has more often increased or decreased. Thus, besides the value of composite indices with absolute effect sizes, the graphs for ICT and thematic practices also demonstrate the decomposition of the change into increases and decreases.

The conceptual grouping of these indicators was done to maintain a more or less balanced representation of practices across both grades and across all the disciplines. This allowed us to go ahead with an unweighted average rather than weighting by grades or disciplines.

## Missing values

Variation in the coverage of PISA and TIMSS/PIRLS means that school and classroom change effect sizes are therefore not available for all education systems across all of the questions asked. Furthermore, data are missing when certain questions (or questionnaires) were omitted at the national level at certain points in time. This is not an issue when reporting responses to a single question, but it does pose a potential problem when seeking to combine information across questions. In order to analyse as many countries as possible whilst keeping a wide range of questions in the analysis, it has been necessary to manage the missing data through a combination of deletion and estimations processes.

An iterative process has been used to manage observations (education systems) and variables (questions) with missing data, and some systems/countries and questions have had to be omitted in the construction of an index:

1. Education systems that had effect size data for fewer than 20% of the potential question set were excluded.
2. Following this, questions with high proportions of missing data were dropped. Specifically, those questions with effect size missing for more than 50% of the remaining database were excluded.

3. Education systems with less than 60% valid data on the remaining questions were then excluded from the analysis.

Following the deletion process, some of the remaining education systems still had portions of missing data. Data was typically missing when education system had not participated in one of the surveys. As information for a whole dataset was missing, it was not possible to undertake an imputation at the indicator level. However, it was possible to estimate the effect of a missing dataset on the final index.

The estimation process uses information from countries having all the data points in order to estimate the impact of including a dataset on the index computation. We use this information to adjust the indices of countries missing one dataset. The process goes as follows:

- For education systems with all the information available, a subset of indices was computed, each one of them excluding one of the datasets from the index computation ($I_{-A}$). The index including all the data was also calculated ($I$). For instance if other countries missed PISA, countries with all the information available will have an index excluding PISA ( $I_{-A}$ ) and one with PISA (I).
- The ratios of complete index to sub-indices were calculated for each country ($I/I_{-A}$).
- The cross-country mean ratio of full index to every sub-index was computed, giving us a dataset factor effect for each potential missing data source. ($DF_A = Mean(I/I_{-A})$)
- Finally, countries missing data from one source (A) had their index computed with all their information available ($I_{m(A)}$). This index is then corrected by multiplying it by the dataset factor of the corresponding missing database, giving us the final composite index ($I = I_{m(A)} * DF_A$).

## Criteria for including questions in the indices

Highly correlated questions may unduly influence an index that seeks to explore the extent to which change occurs over different aspects of education, particularly given the existence of missing data. For this reason, where question effect sizes are highly correlated [0.6 or more using Person's r] and the wording of the questions is the same across different grades or subjects, only the question with the highest absolute effect size at the OECD level has been included in the classroom, school and overall indices. Where the effect sizes of different questions within a module are correlated, but the wording differs, both questions have been included as separate items within the indicator. Questions have also been retained for indices at subject and grade level where the possibility of correlation is not a problem.

**Table B.2. Number of available questions – Main indices**

| Countries and regions | Overall Index | Primary Index | Secondary Index | Maths Index | Science Index | Reading Index |
|---|---|---|---|---|---|---|
| Australia | 125 | 62 | 66 | 28 | 49 | - |
| Austria | - | 59 | - | - | - | 33 |
| Belgium (Fl.) | - | - | - | - | - | 33 |
| Canada (Alberta) | - | 59 | - | - | - | - |
| Canada (Ontario) | 110* | 62 | 51* | 28 | 43* | 33 |
| Canada (Quebec) | 110* | 62 | 51* | 28 | 43* | 33 |
| Czech Republic | - | 62 | - | - | - | - |
| Denmark | - | 62 | - | - | - | 33 |
| France | - | - | - | - | - | 33 |
| Germany | - | 62 | - | - | - | 33 |
| Hungary | 125 | 62 | 66 | 28 | 49 | 33 |
| Israel | 100*** | - | 66 | - | - | 33 |
| Italy | 125 | 62 | 63 | 28 | 49 | 33 |
| Japan | 91** | - | 66 | 28 | 49 | - |
| Korea | 91** | - | 66 | - | 48 | - |
| Latvia | - | - | - | - | - | 33 |
| Lithuania | 125 | 62 | 66 | 28 | 49 | 33 |
| Netherlands | - | 62 | - | - | - | 33 |
| New Zealand | 125 | 61 | - | 28 | 49 | 33 |
| Norway | 125 | 62 | 61 | 28 | 49 | 33 |
| Poland | - | 59 | - | - | - | 33 |
| Portugal | - | 59 | - | - | - | 33 |
| Slovak Republic | - | 62 | - | - | - | 33 |
| Slovenia | 125 | 62 | 66 | 28 | 49 | 33 |
| Spain | - | 59 | - | - | - | 33 |
| Sweden | 125 | 62 | 66 | 28 | 49 | 33 |
| Turkey | - | - | 61 | 28 | 48 | - |
| U.K. (England) | 110* | 62 | 51* | 28 | 43* | 33 |
| United States | 125 | 62 | 61 | 28 | 49 | 33 |
| U.S. (Massachusetts) | - | - | 51 | - | - | - |
| U.S. (Minnesota) | - | - | 51 | - | - | - |
| Hong Kong, China | 125 | 62 | 66 | 28 | 49 | 33 |
| Indonesia | 100*** | - | 61 | - | - | 33 |
| Russian Federation | 125 | 62 | 66 | 28 | 49 | 33 |
| Singapore | 125 | 62 | 56 | 28 | 43* | 33 |
| South Africa | - | - | 51* | - | - | 28 |

*Note*: * Missing PISA data- database effect estimation applied; ** Missing PIRLS data - database effect estimation applied; ***Missing TIMSS 4th grade data- database effect estimation applied.
*Source*: PISA, TIMSS and PIRLS databases.

**Table B.3. Number of available questions – ICT indices**

| Countries and regions | ICT availability | ICT use |
|---|---|---|
| Australia | 7 | 18 |
| Austria | 5 | 11 |
| Canada (Ontario) | 5 | 15 |
| Canada (Quebec) | 5 | 15 |
| Chile | 6 | 15 |
| Czech Republic | 5 | 11 |
| Denmark | 5 | 11 |
| Finland | 5 | 11 |
| Hungary | 7 | 18 |
| Ireland | 5 | 11 |
| Italy | 7 | 18 |
| Japan | 6 | 15 |
| Korea | 6 | 15 |
| Lithuania | 7 | 18 |
| Netherlands | 5 | 11 |
| New Zealand | 7 | 18 |
| Norway | 5 | 15 |
| Poland | 5 | 11 |
| Portugal | 5 | 11 |
| Slovak Republic | 5 | 11 |
| Slovenia | 7 | 18 |
| Spain | 5 | 11 |
| Sweden | 7 | 18 |
| Turkey | 4 | - |
| U.K. (England) | 5 | 15 |
| United States | 5 | 15 |
| Hong Kong, China | 7 | 18 |
| Russian Federation | 7 | 18 |
| Singapore | 7 | 18 |

*Source*: PISA, TIMSS and PIRLS databases.

**Table B.4. Number of available questions – Thematic indices**

| Countries and regions | Assessment Index | Homework Index | Active Learning in Science Index | High order skills index | Knowledge transmission and acquisition index | Learning resource availability index | Rote learning Index | Professional Development- Teacher training index | Professional Development- Peer learning index | External relations and HRM index | Other practices index |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Australia | 10 | 8 | 8 | 16 | 8 | - | 9 | 16 | 9 | 8 | - |
| Austria | - | - | - | - | 5 | 11 | - | - | - | - | 7 |
| Canada (Alberta) | - | - | - | - | 5 | - | - | - | - | - | - |
| Canada (Ontario) | 10 | - | 6 | 11 | 8 | 12 | 8 | 16 | 9 | 6 | - |
| Canada (Quebec) | 10 | 8 | 6 | 11 | 8 | 12 | 8 | 16 | 9 | 6 | - |
| Chile | - | - | - | - | - | - | 8 | 16 | - | - | - |
| Czech Republic | - | - | 5 | 13 | 5 | 11 | - | - | - | - | 7 |
| Denmark | - | - | 5 | 13 | 5 | 11 | - | - | - | - | 7 |
| Finland | - | - | - | - | - | 11 | - | - | - | - | 7 |
| France | - | - | - | 11 | - | - | - | - | - | - | - |
| Germany | - | - | 5 | 13 | 5 | - | - | - | - | - | 7 |
| Hungary | 10 | 7 | 8 | 16 | 8 | 14 | 9 | 16 | 9 | 8 | 7 |
| Ireland | - | - | 5 | - | - | - | - | - | - | - | - |
| Israel | 10 | 8 | - | 14 | 5 | 11 | 6 | - | 6 | 7 | 7 |
| Italy | 10 | 8 | 8 | 16 | 8 | 14 | 9 | 16 | 9 | - | 7 |
| Japan | - | 8 | 8 | 10 | 6 | - | 8 | 16 | 9 | 7 | - |
| Korea | - | 8 | 8 | 10 | 6 | - | 8 | 16 | 9 | 7 | - |
| Latvia | - | - | - | 11 | - | - | - | - | - | - | 7 |
| Lithuania | 10 | 7 | 8 | 16 | 8 | 14 | 9 | 16 | 9 | 8 | 7 |
| Netherlands | - | - | 5 | 13 | 5 | 11 | - | - | - | - | 7 |
| New Zealand | 9 | - | 8 | - | 8 | 14 | 9 | 16 | 9 | 8 | 7 |
| Norway | 10 | 8 | 8 | 16 | 8 | 12 | 9 | 16 | 9 | 8 | 6 |
| Poland | - | - | 5 | 13 | 5 | 11 | - | - | - | - | 7 |
| Portugal | - | - | - | - | 5 | 11 | - | - | - | - | 7 |
| Slovak Republic | - | - | 5 | 13 | 5 | 11 | - | - | - | - | 7 |
| Slovenia | 10 | 7 | 8 | 16 | 8 | 14 | 9 | 16 | 9 | 8 | 7 |
| Spain | - | - | 5 | 13 | 5 | 11 | - | - | - | - | 7 |
| Sweden | 10 | 7 | 8 | 16 | 8 | 14 | 9 | 16 | 9 | 8 | 7 |
| Turkey | - | 8 | - | 10 | 6 | - | 8 | 16 | 9 | 7 | - |
| U.K. (England) | 10 | 8 | 6 | 11 | 8 | 12 | 8 | 16 | 9 | 6 | - |
| United States | 10 | 8 | 8 | 16 | 8 | 12 | 9 | 16 | 9 | 8 | 6 |
| U.S. (Massachusetts) | - | 8 | - | - | - | - | - | - | - | - | - |
| U.S. (Minnesota) | - | 8 | - | - | - | - | - | - | - | - | - |
| Hong Kong, China | 10 | 8 | 8 | 16 | 8 | 14 | 9 | 16 | 9 | 8 | 7 |
| Indonesia | 10 | 7 | - | 14 | 5 | - | 6 | - | 6 | 7 | 6 |
| Russian Federation | 10 | 7 | 8 | 16 | 8 | 14 | 9 | 16 | 9 | 8 | 7 |
| Singapore | 10 | 8 | 6 | 11 | 8 | 14 | 8 | 16 | 9 | 6 | - |
| South Africa | 10 | - | - | - | 5 | - | - | - | 6 | - | - |

## Developing and reporting the indices

The indices developed are intended to show the extent of change or innovation in one country when compared with other countries. They can be used to rank countries according to their relative levels of innovation across levels, disciplines and in more specific educational practices.

Discipline, education level and overall innovation indices for each country =100 x (weighted average of absolute effect sizes)

ICT and thematic innovation indices do not accord any weight to values, therefore the composite indices for each country= 100 x (unweighted average of absolute effect sizes)

The number of questions included depends on whether data exist in PISA and/or TIMSS/PIRLS and therefore differs across education systems. It also clearly depends on the indicator itself: up to 33 questions are used in the reading innovation index compared to 49 in science for example. The number of questions included across ICT and thematic indices also varies considerably.

It is possible for the absolute effect sizes to take a value that is greater than one; however in practice they mostly range between 0 and 1; the indices can therefore take values from 0 to positive infinity but in practice they never cross 100 for the broad composite indices. For the ICT and specific composite indices the index itself has the same range as the broader ones but their decomposition shows the negative and positive contributions as well.

## Cautions

### Question inclusion

The indices combine information from a large and diverse pool of questions asked on different surveys. On the assumption that each question can provide additional information about the extent of change and innovation in an education system, the process employed to develop the indices has drawn on as many of the questions as possible and their inclusion has been determined by the availability of valid data. However, a more theoretical approach focusing on the most relevant questions, or a statistical approach to data reduction may provide different results.

### Education system coverage

The indices provide some information about a subset of the education systems discussed in the previous chapters. This subset has been determined by the availability of data. It may be the case that other systems sit at the extremes of the ranking. It should be noted that the inclusion or removal of education systems would also impact on the estimation of missing values. Although it gives a robust synthesis of change covered by our change indicators, the country ranking should not be over-interpreted.

### OECD average

The OECD average is computed for all the education systems for which data are available for all years concerned. In calculating the weights of regions that do not correspond to an entire OECD member the following procedure has been followed. Education systems that are part of a country for which the overall data is available are not considered – this being the case for the different states in the United States. Conversely, education systems that do

not have a figure for the whole country they belong to have been given weight equal to 1- this being the case, for example of Ontario and Flanders (Belgium) among others.

### Time periods

The effect size of the change in responses to a particular question is typically calculated across the same two points of time for each country but the two points in time may differ by question. The indices therefore show a tendency to change or innovate across slightly different time periods, rather than the extent of change over a specific time period.

### Interpreting the findings

The indices reported help the reader to consider the benefits of such a composite innovation indicator based on change measures, but may not provide a fully accurate representation of the level of change and innovation within a country. Whilst the indicator is based on many questions and observations, the missing data imputation and correction which were needed to construct the innovation indices invites the reader to be cautious. The innovation indices are mere indicators of innovation, and small differences in levels are almost certainly not meaningful.

A higher score on the indicator suggests that an education system is characterised by more change than other systems. However, there is currently no theory that could be applied to describe the different levels in terms of adequacy of innovation. Similarly, the scale does not provide information about what is necessary to move from one point to another. Additional work could be undertaken to develop qualitative descriptions of different points on the scale, but this should be preceded by improved data collection.

## Component indicators of the ICT based and thematic composite indices

**Table B.5. Indicators included in the composite index of innovation in computer availability in schools**

| Practice | Grade |
|---|---|
| Availability of computers (including tablets) to use during maths lessons | Primary and secondary |
| Availability of computers (including tablets) to use during science lessons | Primary and secondary |
| Availability of computers (including tablets) to use during reading lessons | Primary |
| Availability of desktop computers for use at school | Secondary |
| Availability of portable laptops or notebooks for use at school | Secondary |

**Table B.6. Indicators included in the composite index of innovation in ICT use in schools**

| Practice | Grade |
|---|---|
| Practising skills and procedures on computers in maths | Primary and secondary |
| Practising skills and procedures on computers in science | Primary and secondary |
| Study natural phenomena through simulations on computers in science | Primary and secondary |
| Processing and analysing data on computers in maths | Secondary |
| Processing and analysing data on computers in science | Secondary |
| Students using computers to write stories and texts in reading | Primary |
| Using computers to look for information in reading | Primary |
| Frequency of use of computer or a tablet at school | Primary |
| Use of digital devices for foreign language learning or mathematics | Secondary |
| Using digital devices for playing simulations at school | Secondary |
| Use of school computers for group work and communication with other students | Secondary |
| Teacher participation in a programme integrate information technology into mathematics | Primary and secondary |
| Teacher participation in a programme to integrate information technology into science | Primary and secondary |

**Table B.7. Indicators included in the composite index of innovation in active learning practices in science education**

| Practice | Grade |
|---|---|
| Students conducting scientific experiments and investigations in science | Primary and secondary |
| Study natural phenomena through simulations on computers in science | Primary and secondary |
| Students doing practical experiments in laboratories | Secondary |
| Students designing and planning science experiments | Primary and secondary |
| Scope for students to design their own experiments | Secondary |

**Table B.8. Indicators included in the composite index of innovation in homework practices**

| Practice | Grade |
|---|---|
| Frequency of homework in maths | Secondary |
| Frequency of homework in science | Secondary |
| Monitoring homework completion in maths | Secondary |
| Monitoring homework completion in science | Secondary |
| Students correcting their own homework in maths | Secondary |
| Students correcting their own homework in science | Secondary |
| Discussion of homework in class in maths | Secondary |
| Discussion of homework in class in science | Secondary |

**Table B.9. Indicators included in the composite index of innovation in assessment practices**

| Practice | Grade |
|---|---|
| Frequency of correction of assignment and feedback in maths | Secondary |
| Frequency of correction of assignment and feedback in science | Secondary |
| Importance of classroom tests in maths | Secondary |
| Importance of classroom tests in science | Secondary |
| Importance of national or regional achievement tests in maths | Secondary |
| Importance of national or regional achievement tests in science | Secondary |
| Written tests on reading | Primary |
| Emphasis on classroom test in reading | Primary |
| Emphasis on national or regional tests in reading | Primary |
| Oral examination and summarising of read text in reading | Primary |

**Table B.10. Indicators included in the composite index of innovation in fostering higher order skills**

| Practice | Grade |
|---|---|
| Students explaining their understanding of text in reading | Primary |
| Students explaining style and structure of text in reading | Primary |
| Students drawing inferences and generalisations from text in reading | Primary |
| Students identifying main ideas of text in reading | Primary |
| Students comparing read text with their own experiences in reading | Primary |
| Opportunities for students to explain their ideas in reading | Secondary |
| Making predictions about what will happen next in read text in reading | Primary |
| Observing and describing natural phenomena in Primary | Primary and secondary |
| Students designing and planning science experiments | Primary and secondary |
| Students drawing conclusions from an experiment in science | Secondary |
| Teacher explaining relevance of broad science topics | Secondary |
| Teacher explaining practical application of school science topics | Secondary |
| Scope for students to design their own experiments | Secondary |
| Solving problems with no obvious method of solution in maths | Secondary |

**Table B.11. Indicators included in the composite index of innovation in independent knowledge acquisition**

| Practice | Grade |
|---|---|
| Reading non-fiction books in reading | Primary |
| Reading textbooks and resource materials in science | Primary and secondary |
| Using computers to look for information in reading | Primary |
| Using computers to look up for ideas and information in maths | Primary and secondary |
| Using computers to look up for ideas and information in science | Primary and secondary |

**Table B.12. Indicators included in the composite index of innovation in rote learning practices**

| Practice | Grade |
|---|---|
| Memorising rules, procedures and facts as a pedagogical technique in maths | Primary and secondary |
| Memorising rules, procedures and facts as a pedagogical technique in science | Primary and secondary |
| Watching teachers demonstrate an experiment in science | Primary and secondary |
| Use scientific formulas and laws to solve routine problems | Secondary |
| Students doing practical experiments in laboratories | Secondary |
| Teaching new vocabulary systematically in reading | Primary |

**Table B.13. Indicators included in the composite index of innovation in formal teacher training**

| Practice | Grade |
|---|---|
| Teacher participation in mathematics content | Primary and secondary |
| Teacher participation in science content | Primary and secondary |
| Teacher participation in a program on maths pedagogy/instruction | Primary and secondary |
| Teacher participation in a program on science pedagogy/instruction | Primary and secondary |
| Teacher participation in a program on maths curriculum | Primary and secondary |
| Teacher participation in a program on science curriculum | Primary and secondary |
| Teacher participation in a program on mathematics assessments | Primary and secondary |
| Teacher participation in a program on science assessments | Primary and secondary |

**Table B.14. Indicators included in the composite index of innovation in teachers' peer learning**

| Practice | Grade |
|---|---|
| Collaborating in planning and preparing instructional material | Primary and secondary |
| Visiting another classroom to learn more about teaching | Primary and secondary |
| Discussing how to teach a particular topic | Primary and secondary |

*Note*: In secondary education, these questions were asked to both maths and science teachers; in primary education, no distinction was made on the basis of disciplines.

**Table B.15. Indicators included in the composite index of innovation in availability of school learning resources**

| Practice | Grade |
|---|---|
| Availability of a school library for students | Primary |
| Availability of a library or a reading corner in the classroom | Primary |
| Allowing students to borrow books from the classroom library | Primary |
| Students visiting a library other than their classroom library | Primary |
| Availability of desktop computers for use at school | Secondary |
| Availability of portable laptops or notebooks for use at school | Secondary |
| Frequency of use of computer or a tablet at school | Primary |
| Availability of computers (including tablets) to use during reading lessons | Primary |
| Availability of computers (including tablets) to use during maths lessons | Primary and secondary |
| Availability of computers (including tablets) to use during science lessons | Primary and secondary |
| Availability of a science laboratory for students | Primary and secondary |

**Table B.16. Indicators included in the composite index of innovation in school external relations and human resource management (HRM) practices**

| Practice | Grade |
|---|---|
| Parental help in reading | Primary |
| Incentives to recruit or retain maths teachers | Secondary |
| Incentives to recruit or retain science teachers | Secondary |
| Incentives to recruit or retain teachers other than maths and science | Secondary |
| Degree of parental involvement in school activities | Primary and secondary |
| Public posting of school achievement data (e.g. in the media) | Secondary |
| Tracking achievement data over time by an administrative authority | Secondary |

**Table B.17. Indicators included in the composite index of innovation in other miscellaneous educational practices**

| Practice | Grade |
|---|---|
| Teaching strategies for decoding sounds and words in reading | Primary |
| Same class-ability groups in reading classes | Primary |
| Mixed-ability groups in reading classes | Primary |
| Reading individually with students in reading | Primary |
| Use of school computers for group work and communication with other students | Secondary |
| Student grouping by ability into different classes | Secondary |
| Student grouping by ability within classes | Secondary |

# Annex C.
# List of tables available online

The following tables, available only in electronic format display the underlying data for the figures in Part I, organised by chapters. Data is presented for countries appearing both in the report and in the online version.

**Table C.1. Innovation in practices to develop technical skills in mathematics**

| Indicator no. | Figure no. | Indicator name |
|---|---|---|
| 1 | 2.1 | 4th grade students memorising rules, procedures and facts in maths |
| 1 | 2.2 | 8th grade students memorising rules, procedures and facts in maths |
| 2 | 2.3 | 4th grade students using computers to practice skills and procedures in maths |
| 2 | 2.4 | 8th grade students using computers to practice skills and procedures in maths |
| 3 | 2.5 | 15 year old students using digital devices for practising and drilling |
| 4 | 2.6 | 8th grade students solving problems without an immediately obvious method of solution in maths |
| 5 | 2.7 | 8th grade students using computers to process and analyse data in maths |

StatLink https://doi.org/10.1787/888933907279

**Table C.2. Innovation in practices to develop technical skills in science**

| Indicator No. | Figure No. | Indicator Name |
|---|---|---|
| 6 | 3.1 | 4th grade students memorising rules, procedures and facts in science |
| 6 | 3.2 | 8th grade students memorising rules, procedures and facts in science |
| 7 | 3.3 | 8th grade science students using formulas and laws to solve routine problems |
| 8 | 3.4 | 8th grade science students processing and analysing data on computers |
| 9 | 3.5 | 4th grade students using computers to practice skills and procedures in science |
| 9 | 3.6 | 8th grade students using computers to practice skills and procedures in science |
| 10 | 3.7 | 4th grade science students studying natural phenomena by computer simulations |
| 10 | 3.8 | 8th grade science students studying natural phenomena by computer simulations |
| 11 | 3.9 | 4th grade science students watching their teachers demonstrate an experiment |
| 11 | 3.10 | 8th grade science students watching their teachers demonstrate an experiment |
| 12 | 3.11 | 4th grade students conducting experiments and investigations in science |
| 12 | 3.12 | 8th grade students conducting experiments and investigations in science |
| 13 | 3.13 | 15 year old science students doing practical experiments in laboratories |

StatLink https://doi.org/10.1787/888933907298

**Table C.3. Innovation in practices to develop reading and language art skills**

| Indicator No. | Figure No. | Indicator Name |
|---|---|---|
| 14 | 4.1 | 4th grade students in reading being taught strategies to decode sounds and words |
| 15 | 4.2 | 4th grade students in reading being taught new vocabulary systematically |
| 16 | 4.3 | 4th grade students explaining their understanding of a text in reading lessons |
| 17 | 4.4 | 4th grade students explaining the style and structure of a text in reading lessons |
| 18 | 4.5 | 4th grade students in reading drawing inferences and generalisations from a text |
| 19 | 4.6 | 4th grade students identifying the main ideas of a text in reading lessons |
| 20 | 4.7 | 4th grade students using computers to write stories and texts in reading lessons |
| 21 | 4.8 | 4th grade students in reading orally examined about a text |

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### Table C.4. Innovation in practices to develop cross-disciplinary technical skills

| Indicator No. | Figure No. | Indicator Name |
|---|---|---|
| 22 | 5.1 | 4th grade students reading textbooks and resource materials in science |
| 22 | 5.2 | 8th grade students reading textbooks and resource materials in science |
| 23 | 5.3 | 4th grade students reading nonfiction work for reading lessons |
| 24 | 5.4 | 4th grade students using computers to look up for information in maths |
| 24 | 5.5 | 8th grade students using computers to look up for information in maths |
| 25 | 5.6 | 4th grade students using computers to look up for information in science |
| 25 | 5.7 | 8th grade students using computers to look up for information in science |
| 25 | 5.8 | 4th grade students using computers to look up for information in reading lessons |

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### Table C.5. Innovation in practices to develop higher order skills in science and reading

| Indicator no. | Figure no. | Indicator name |
|---|---|---|
| 27 | 6.1 | 4th grade students observing and describing natural phenomena in science lessons |
| 27 | 6.2 | 8th grade students observing and describing natural phenomena in science lessons |
| 28 | 6.3 | 4th grade students designing and planning experiments in science |
| 28 | 6.4 | 8th grade students designing and planning experiments in science |
| 29 | 6.5 | 15 year old students drawing conclusions from experiments in science |
| 30 | 6.6 | 15 year old students being explained the relevance of broad science topics |
| 31 | 6.7 | 15 year old students being explained practical applications of science topics |
| 32 | 6.8 | 4th grade students comparing read text with own experiences in reading lessons |
| 33 | 6.9 | 15 year old students explaining their ideas in science lessons |
| 34 | 6.10 | 4th grade students making predictions in a read text in reading lessons |
| 35 | 6.11 | 15 year old students using digital devices for playing simulations at school |
| 36 | 6.12 | 15 year old students designing their own experiments in science |

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### Table C.6. Innovation in personalised, collaborative and teacher-directed learning practices in reading

| Indicator no. | Figure no. | Indicator name |
|---|---|---|
| 37 | 7.1 | 4th grade students reading items of their own choice in reading lessons |
| 38 | 7.2 | 4th grade students given time to read books of their own choice for reading lessons |
| 39 | 7.3 | Individualized instruction in 4th grade reading lessons |
| 40 | 7.4 | Frequency of teaching reading as a whole-class activity in 4th grade |
| 41 | 7.5 | 4th grade students working independently on an assigned plan in reading |
| 42 | 7.6 | Frequency of teachers reading aloud to the class in 4th grade reading lessons |
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### Table C.7. Innovation in homework practices

| Indicator no. | Figure no. | Indicator name |
|---|---|---|
| 47 | 8.1 | Frequency of homework in 8th grade maths |
| 47 | 8.2 | Frequency of homework in 8th grade science |
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| 48 | 8.4 | 8th grade students being monitored for homework completion in science |
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| 49 | 8.6 | 8th grade students correcting their own homework in science |
| 50 | 8.7 | 8th grade students discussing homework in maths |
| 50 | 8.8 | 8th grade students discussing homework in science |

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### Table C.8. Innovation in assessment practices

| Indicator no. | Figure no. | Indicator name |
|---|---|---|
| 51 | 9.1 | Correction of assignments and feedback in 8th grade maths |
| 51 | 9.2 | Correction of assignments and feedback in 8th grade science |
| 52 | 9.3 | 8th grade students assessed through classroom tests in maths |
| 52 | 9.4 | 8th grade students assessed through classroom tests in science |
| 53 | 9.5 | 8th grade students assessed through regional or national tests in maths |
| 53 | 9.6 | 8th grade students assessed through regional or national tests in science |
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| 55 | 9.8 | 4th grade students assessed for reading through classroom tests |
| 56 | 9.9 | 4th grade students assessed for reading through regional or national tests |

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### Table C.9. Innovation in learning scaffolding practices in reading

| Indicator no. | Figure no. | Indicator name |
|---|---|---|
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| 59 | 10.3 | Spending more time on 4th grade students beginning to fall behind in reading |
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| 79 | 13.8 | 8th grade science teacher participation in programmes on pedagogy |
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Educational Research and Innovation

# Measuring Innovation in Education 2019

## WHAT HAS CHANGED IN THE CLASSROOM?

Measuring innovation in education and understanding how it works is essential to improve the quality of the education sector. Monitoring systematically how pedagogical practices evolve would considerably increase the international education knowledge base. We need to examine whether, and how, practices are changing within classrooms and educational organisations and how students use learning resources. We should know much more about how teachers change their professional development practices, how schools change their ways to relate to parents, and, more generally, to what extent change and innovation are linked to better educational outcomes. This would help policy makers to better target interventions and resources, and get quick feedback on whether reforms do change educational practices as expected. This would enable us to better understand the role of innovation in education.

This new edition of *Measuring Innovation in Education* examines what has (or has not) changed for students over the past decade in OECD education systems. It reviews no fewer than 150 educational practices. The report casts light on systemic innovation in primary and secondary education, with a focus on pedagogical innovation. Has the use of technology spread? Have assessments become more important in pedagogical practices? Are students given more agency in their learning? Are they still asked to memorise facts and procedures? Do teachers increasingly engage students in peer learning activities? These are some of the questions this book seeks to answer. This report also presents some preliminary findings about the links between innovation and educational performance.

This book will offer precious insights to policy makers, the education community and all those who seek to understand how educational practices are evolving.

The Centre for Educational Research and Innovation (CERI) provides and promotes international comparative research, innovation and key indicators, explores forward-looking and innovative approaches to education and learning, and facilitates bridges between educational research, innovation and policy development.

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