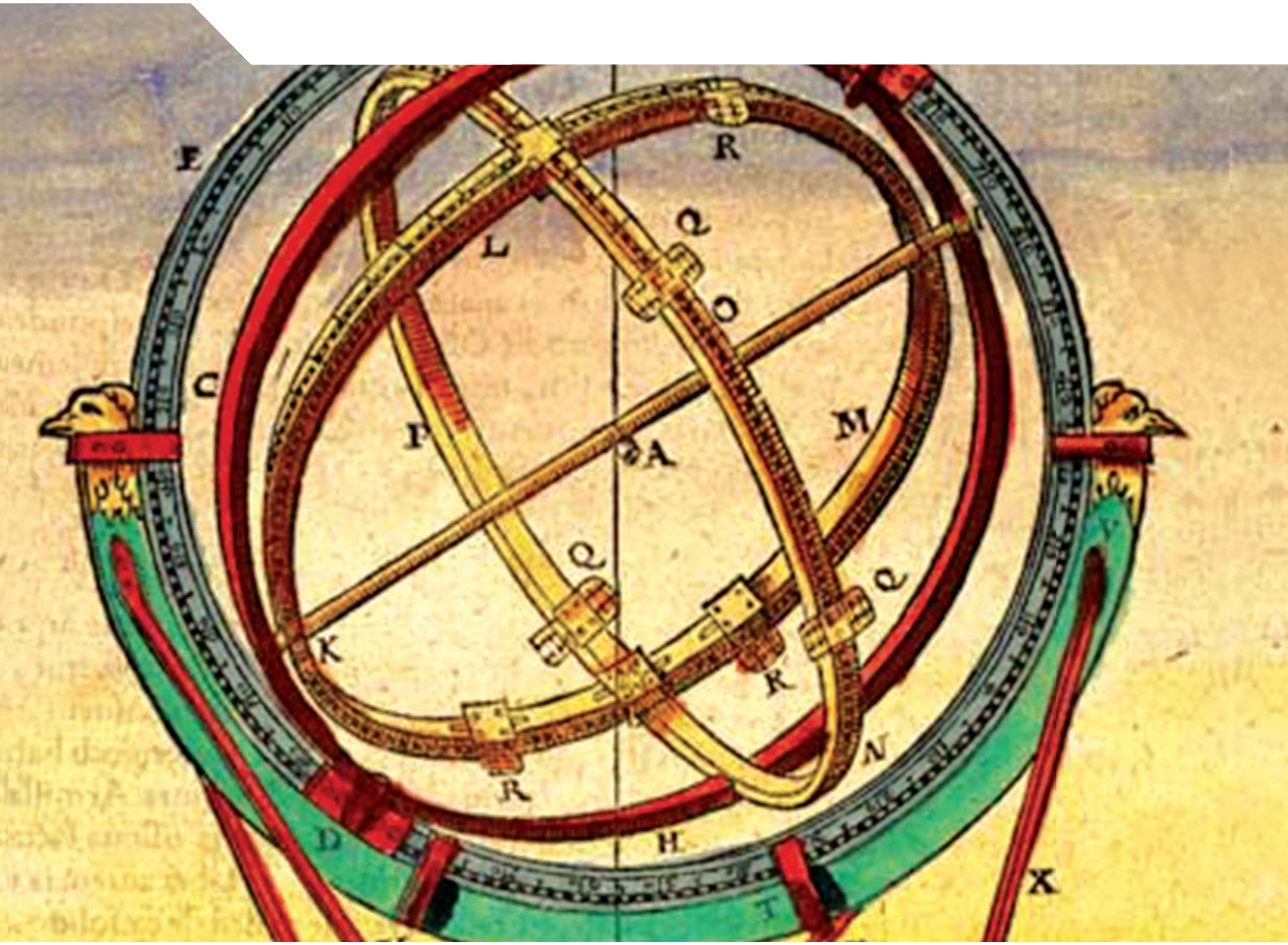
Educational Research and Innovation

Measuring Innovation in Education 2019

WHAT HAS CHANGED IN THE CLASSROOM?



OECD

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Stéphan Vincent-Lancrin, Joaquin Urgel,
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OECD
BETTER POLICIES FOR BETTER LIVES

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Please cite this publication as:
Vincent-Lancrin, S., et al. (2019), *Measuring Innovation in Education 2019: What Has Changed in the Classroom?*, Educational Research and Innovation, OECD Publishing, Paris.
https://doi.org/10.1787/9789264311671-en

ISBN 978-92-64-31166-4 (print)
ISBN 978-92-64-31167-1 (pdf)

Series: Educational Research and Innovation
ISSN 2076-9660 (print)
ISSN 2076-9679 (online)

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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

Acknowledgements

This book was authored by Stéphan Vincent-Lancrin, Senior Analyst, Joaquín Urgel, Consultant, Soumyajit Kar, Consultant, and Gwénaël Jacotin, Statistician, with the help of Anastasia Andreeva during her internship at the OECD. The project was led and conceptualised by Stéphan Vincent-Lancrin, and carried out as part of the work on Innovation in Education of the OECD Centre for Educational Research and Innovation (CERI) within the Directorate for Education and Skills.

Other OECD colleagues made valuable contributions to the project and the book: Carlos González-Sancho gave feedback throughout the process, from the inception to the final steps of the book; Judit Pál made a significant input to the design of the graphs; Federico De Luca gave useful feedback on the methodology. Other colleagues also contributed on various aspects of the project. Madeleine Gereke provided invaluable project assistance, Mathias Bouckaert and Quentin Vidal made helpful comments on the drafts, and Rachel Linden coordinated the publication process. Cassandra Davis and Anne-Lise Prigent supervised the publication and communication processes. Florence Guérinot gave useful advice regarding the production of the book. Finally, John Leo Tarver (Atriptyc Communications) prepared the infographics for the country notes.

Members of the CERI Governing Board are thankfully acknowledged for their input to the work, notably Gábor Hálasz, who gave detailed comments and advice on the concept of the report and its methodology, and Robert Rakocevic, who made helpful comments on the final version of the report. Fernando Galindo-Rueda, from the OECD Directorate for Science, Technology and Innovation, also made very insightful comments on the report and its methodology. Yves Punie and Riina Vuorikari, Joint Research Centre in Seville of the European Commission, contributed to the exploratory process of the project and notably the identification of possible data sources. Also, as the book builds on previous work, many other colleagues, at the OECD and outside, contributed to this edition through their work and comments on the 2014 edition: they cannot all be named, but know who they are.

The book would never have been possible without the co-funding and active support of the European Union. Geir Ottestad and Jan Pakulski, Policy Officer and Head of Unit at the Directorate-General for Education, Youth, Sport and Culture of the European Commission, respectively, are gratefully acknowledged for the confidence they placed in the project: without their commitment to the development of new indicators that can support countries' policies and their willingness to support and take innovation in education seriously, this project would not have seen the light.

Last but not least, the project benefited from the advice of Deborah Roseveare, Head of the Innovation and Measuring Progress division within the OECD Directorate for Education and Skills, Dirk Van Damme, former Head of the IMEP division, and Andreas Schleicher, Director for Education and Skills and Special Advisor on Education Policy to the Secretary General. Their enthusiastic support has made a big difference to the success of the project.

Table of contents

Tables

Figures

Boxes

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.

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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

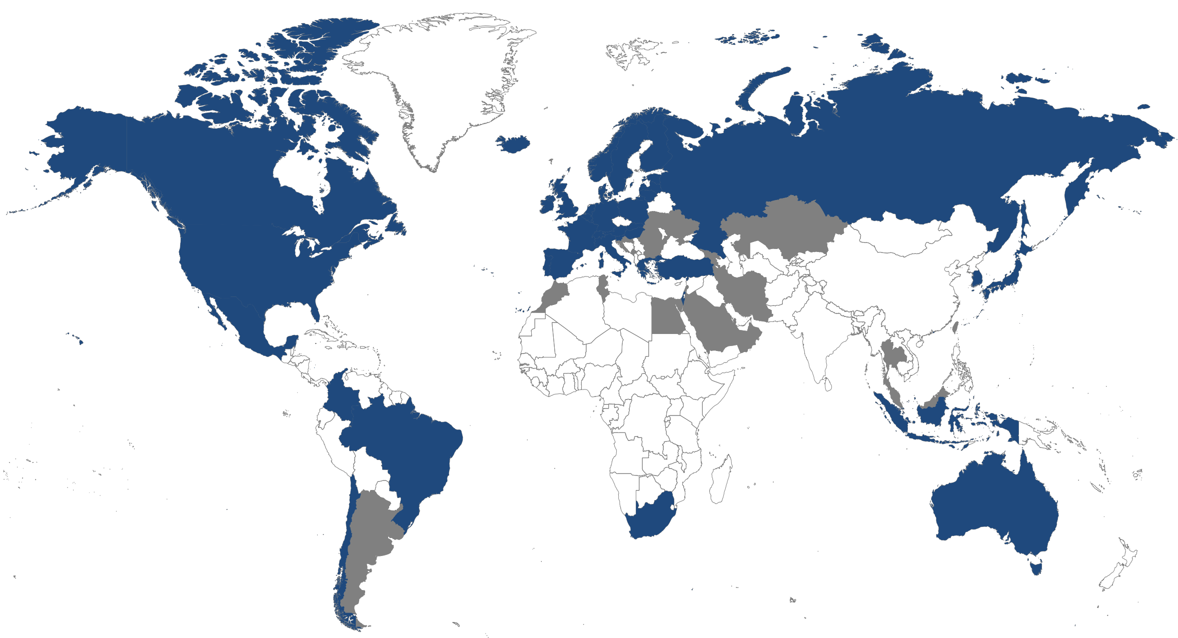
Education systems covered in this edition

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

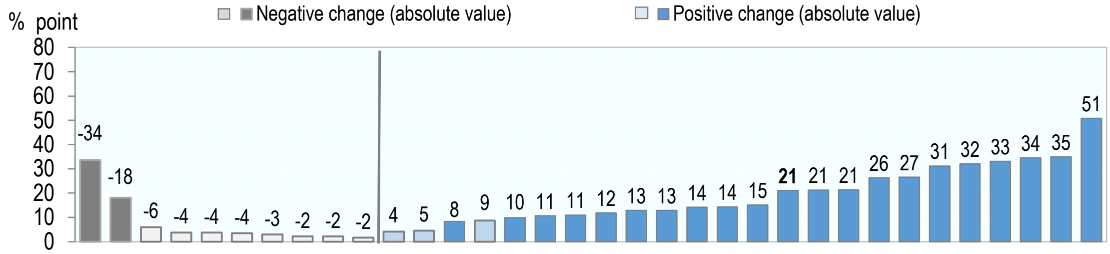
In secondary education, most OECD countries have experienced an expansion of this practice resulting in an average increase of 14 percentage points. The change, be it positive or negative, has amounted to 19 percentage points on average, corresponding to a large effect size of 0.4. In 8th grade mathematics, 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



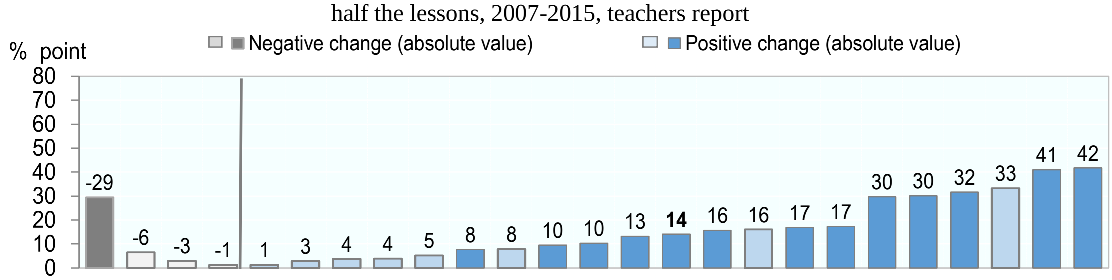
		Turkey*	Spain*	Northern Ireland (UK)*	Ireland*	Hong Kong, China	Chile*	Belgium (Fl.)*	Korea*	Japan	Finland*	Alberta (CAN)*	Austria*	Singapore	Portugal*	Denmark	United States	New Zealand	Ontario (CAN)	Hungary	Germany	Poland*	Italy	Russian Federation	**OECD average**	Czech Republic	Norway	Slovak Republic	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.

StatLink https://doi.org/10.1787/888933903631

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

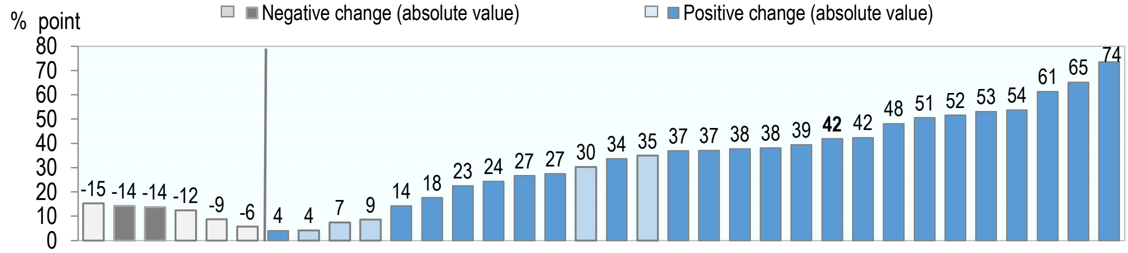
The share of students frequently using computers for practising skills and procedures during 8th grade mathematics lessons has expanded by 23 percentage points on average. Only Chilean students experienced a contraction in this domain (between 2011 and 2015). The average change between 2007 and 2015 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



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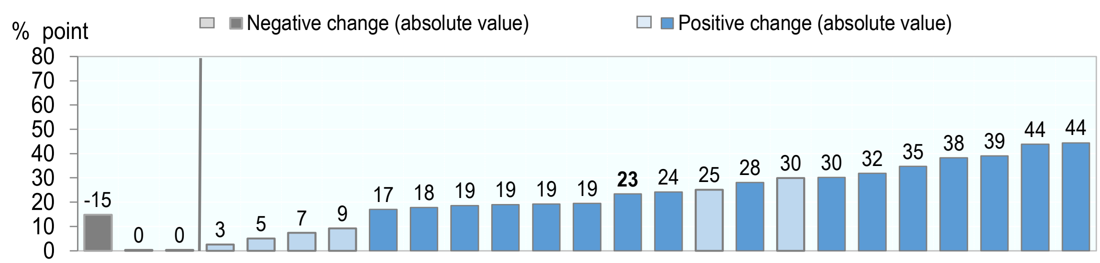
Figure 2.4. 8th grade students using computers to practice skills and procedures in maths

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



% of students	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
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.

StatLink https://doi.org/10.1787/888933903688

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

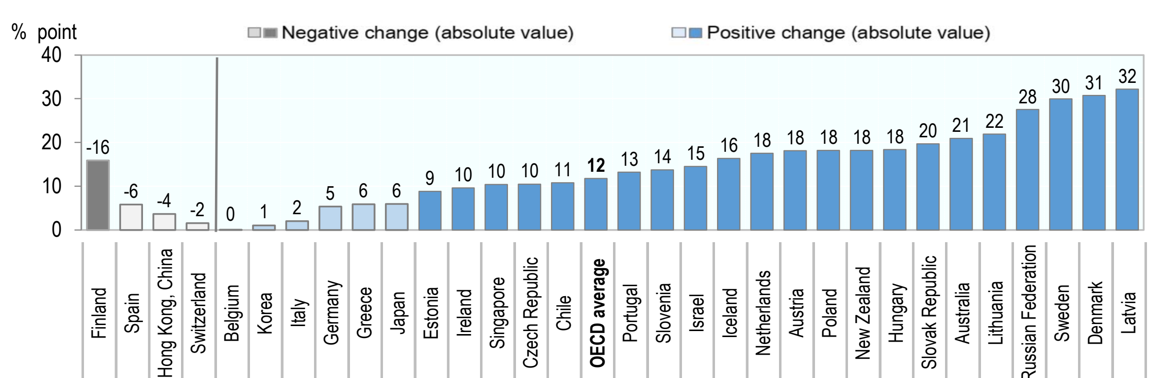
Students in most OECD countries have experienced an increase in the use of digital devices for practising and drilling. Between 2009 and 2015, the share of 15-year-old students using this learning practice at least once a month has increased by 12 percentage points on average. Only in Finland, Spain 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



% of students		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
	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

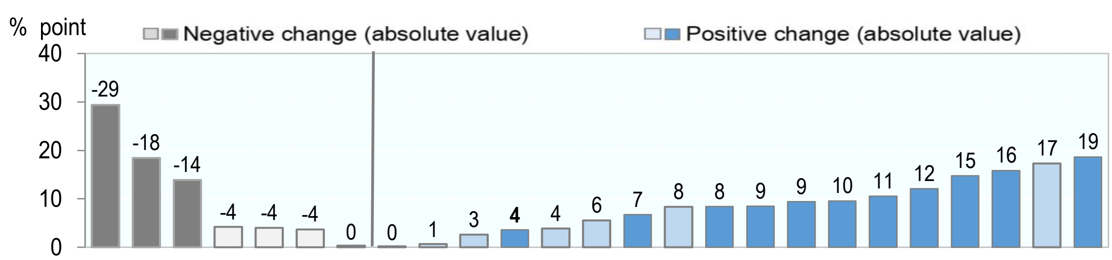
At the OECD level, the use of this practice increased on average by 4 percentage points between 2007 and 2015. With a modest effect size of 0.21, positive and negative changes led to an average absolute change of 9 percentage points. In 2015, this teaching and learning practice was not used in a systematic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



% of students	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
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

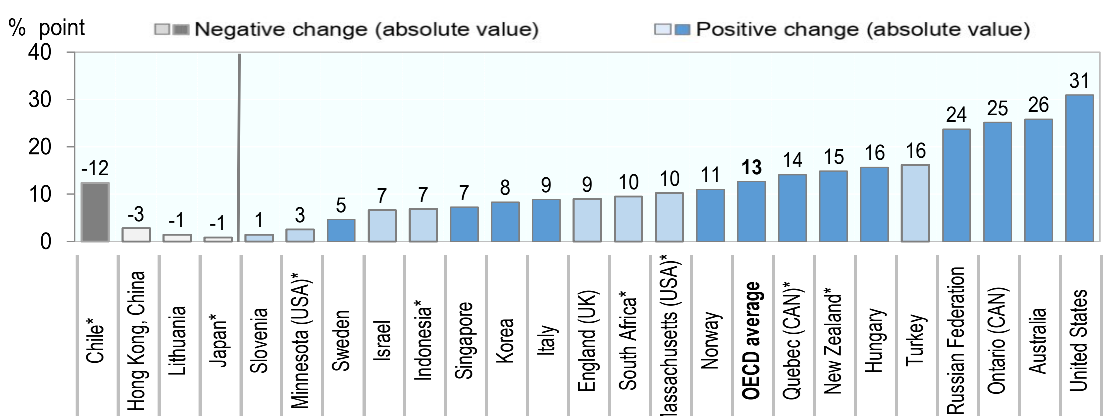
The share of students regularly using computers for processing and analysing data in 8th grade mathematics lessons increased by 13 percentage points on average. The positive and negative variations together amounted to a total absolute change of 13 percentage points, corresponding to a large effect size 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



% of students		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
	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

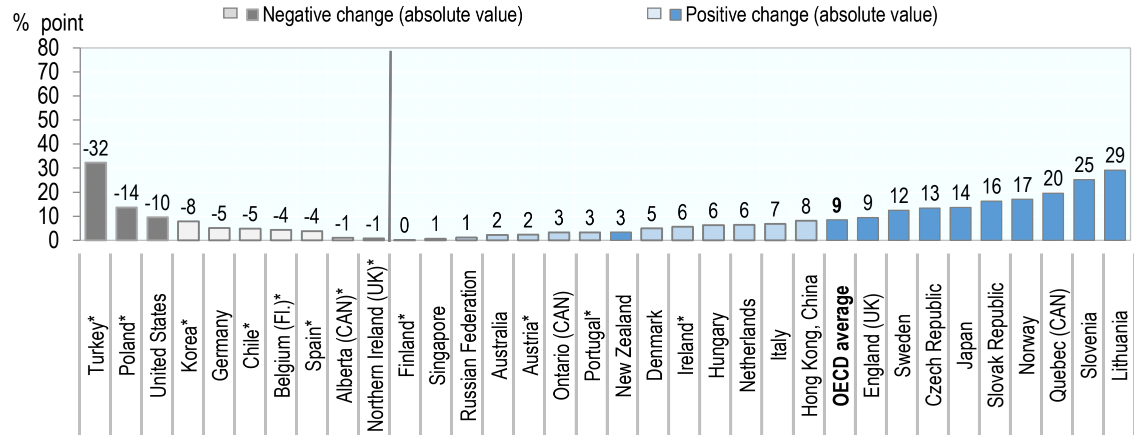
Most OECD education systems have seen greater use of memorisation of rules, procedures and facts during 8th grade science lessons, resulting on an average increase of 15 percentage points in the share of students regularly exposed to it between 2007 and 2015. Regardless of the direction of innovation, 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



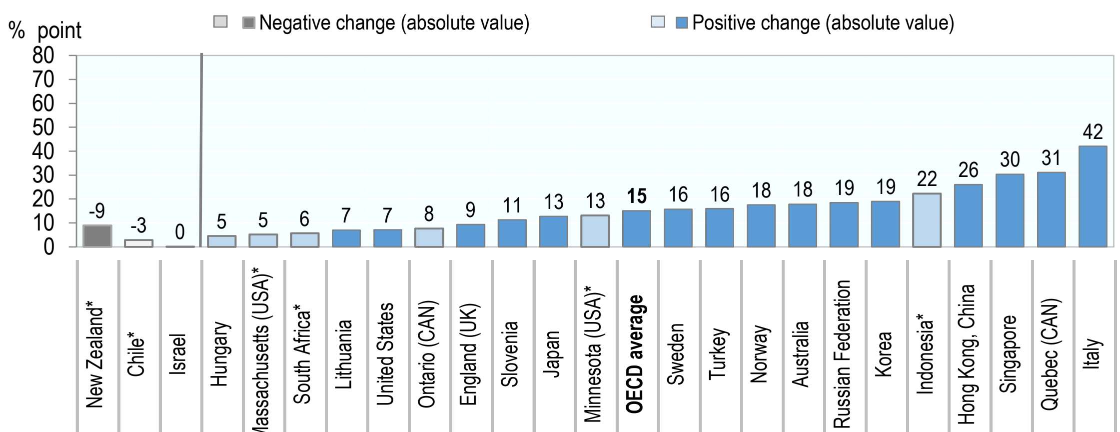
% of students	Turkey*	Poland*	United States	Korea*	Germany	Chile*	Belgium (Fl.)*	Spain*	Alberta (CAN)*	Northern Ireland (UK)*	Finland*	Singapore	Russian Federation	Australia	Austria*	Ontario (CAN)	Portugal*	New Zealand	Denmark	Ireland*	Hungary	Netherlands	Italy	Hong Kong, China	**OECD average**	England (UK)	Sweden	Czech Republic	Japan	Slovak Republic	Norway	Quebec (CAN)	Slovenia	Lithuania
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



% of students	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
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

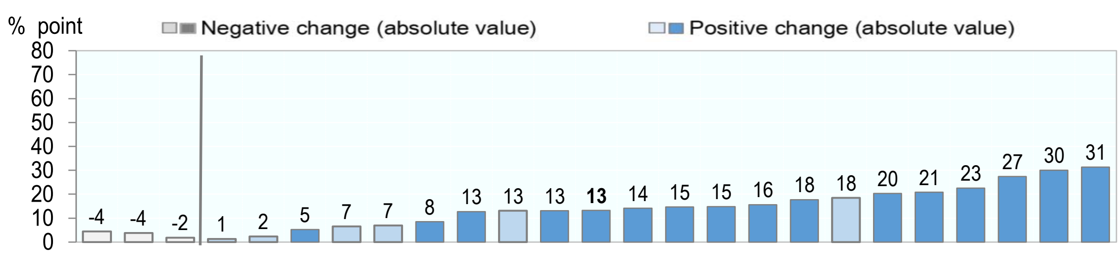
In secondary education, this pedagogical practice spread in almost all OECD countries covered. Between 2007 and 2015, the percentage of students frequently asked to apply scientific formulas to routine problems rose by 13 percentage points on average. Only in New Zealand and Slovenia was there a small 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

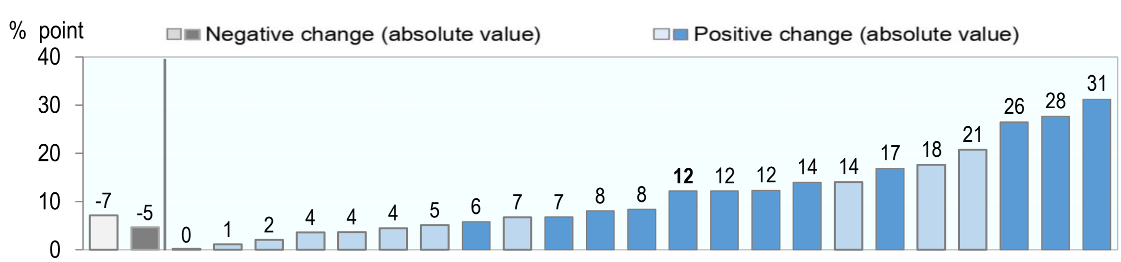
The share of students systematically using computers to process and analyse data during 8th grade science lessons increased by 12 percentage points on average in OECD education systems between 2015 and 2007. The overall absolute change, regardless of change direction, amounted to 12 percentage points 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

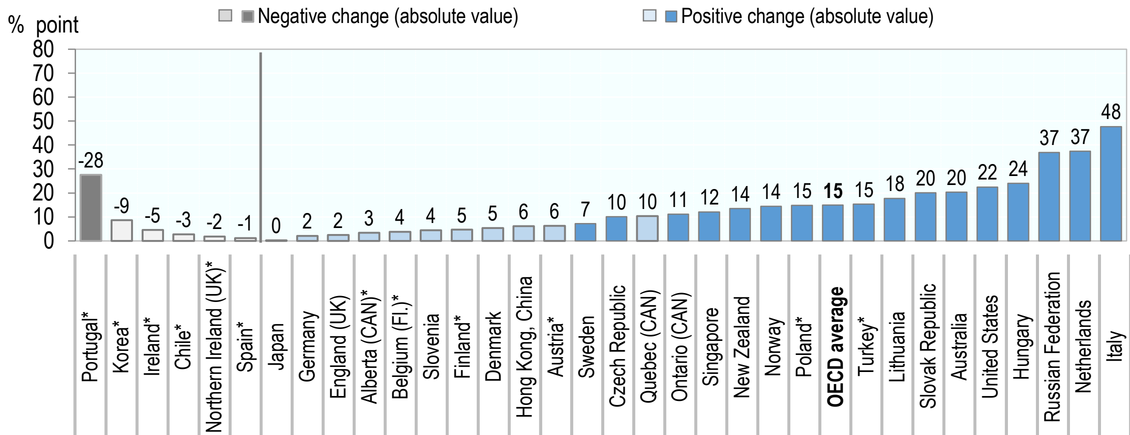
The share of students frequently using computers for practising skills and procedures in 8th grade science lessons through has increased by 17 percentage points on average between 2007 and 2015. The absolute change taking into account increases and decreases was the same, corresponding to a large effect 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



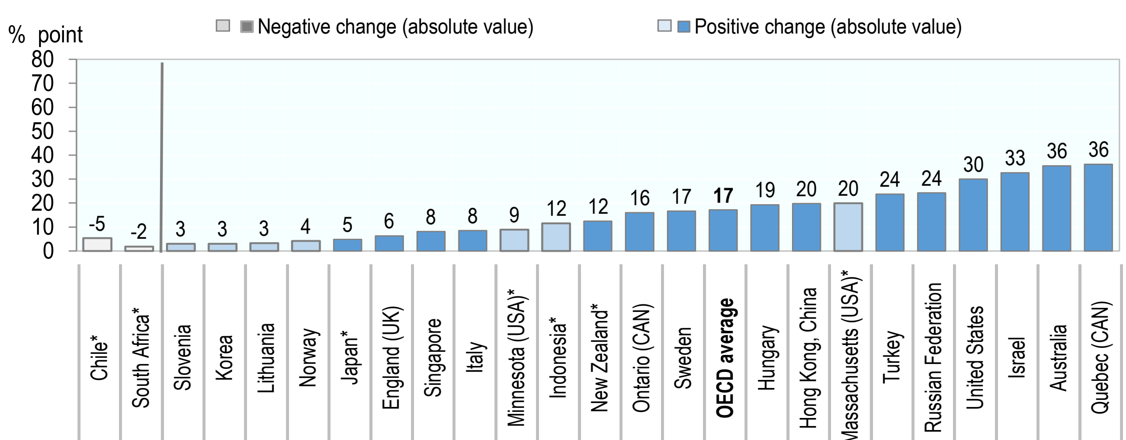
% of students		Portugal*	Korea*	Ireland*	Chile*	Northern Ireland (UK)*	Spain*	Japan	Germany	England (UK)	Alberta (CAN)*	Belgium (Fl.)*	Slovenia	Finland*	Denmark	Hong Kong, China	Austria*	Sweden	Czech Republic	Quebec (CAN)	Ontario (CAN)	Singapore	New Zealand	Norway	Poland*	**OECD average**	Turkey*	Lithuania	Slovak Republic	Australia	United States	Hungary	Russian Federation	Netherlands	Italy
	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



% of students		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)
	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

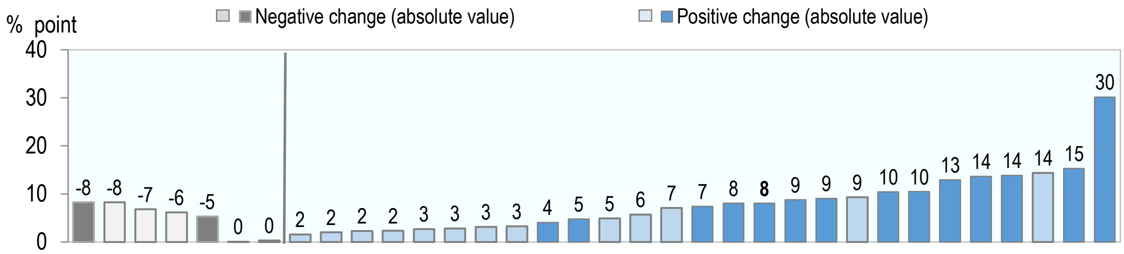
With the exception of Korea, all OECD systems made greater use of computer simulations to study natural phenomena in science lessons. The share of students frequently participating in this pedagogical activity rose by 12 percentage points on average between 2007 and 2015. Positive and negative variations 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



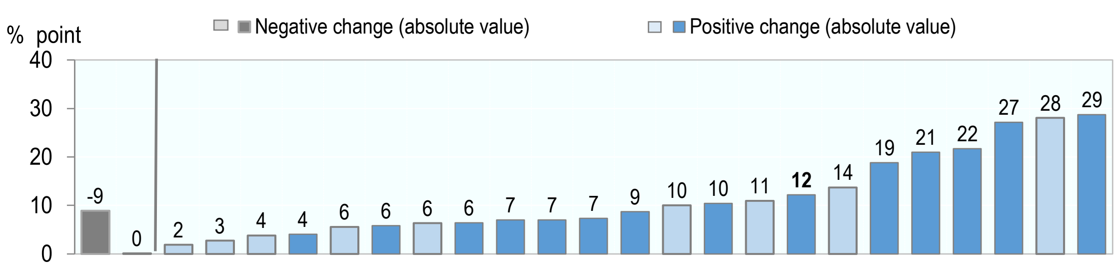
% of students	Ireland*	Chile*	Korea*	Spain*	Japan	Austria*	Portugal*	Northern Ireland (UK)*	Turkey*	England (UK)	Germany	Hong Kong, China	Norway	Finland*	Belgium (Fl.)*	Netherlands	Denmark	Slovenia	Russian Federation	Quebec (CAN)	Lithuania*	Sweden	**OECD average**	Hungary	Czech Republic	Ontario (CAN)	Australia	New Zealand	Slovak Republic	Poland*	Singapore	Alberta (CAN)*	United States	Italy
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



% of students	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
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

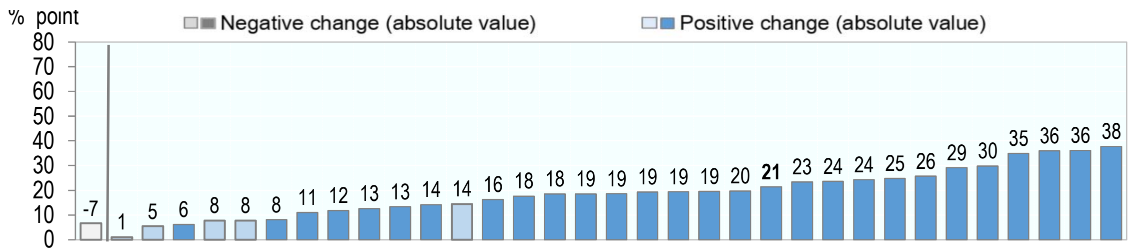
This teaching practice is increasingly being used in secondary schools within OECD countries or systems. The average share of students regularly exposed to it has risen by 15 percentage points between 2007 and 2015. The magnitude of the change, including expansions and contractions, amounted to 16 percentage 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



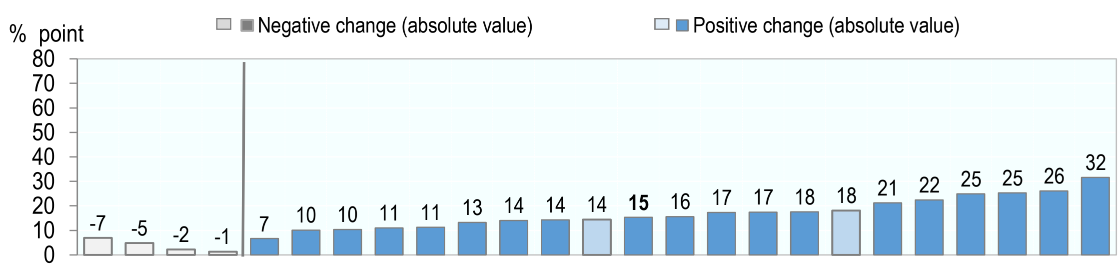
% of students	Ireland*	Belgium (Fl.)*	Northern Ireland (UK)*	Denmark	Portugal*	Austria*	Netherlands	Spain*	Finland*	Korea*	Ontario (CAN)	Chile*	Alberta (CAN)*	Norway	Slovenia	Sweden	Czech Republic	Japan	Germany	New Zealand	Russian Federation	United States	**OECD average**	Singapore	Lithuania	Australia	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

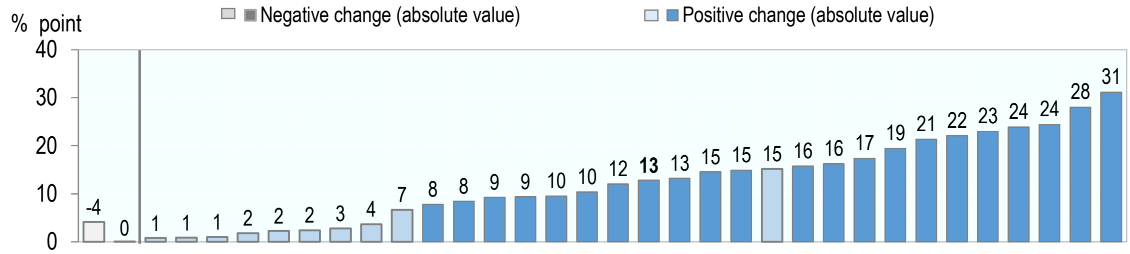
Expansions have outweighed contractions of the practice in the OECD area, leading on average to a 5 percentage point increase in the share of students participating in these activities in half of their science classes or more. When increases and decreases are accounted for, innovation in this learning 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



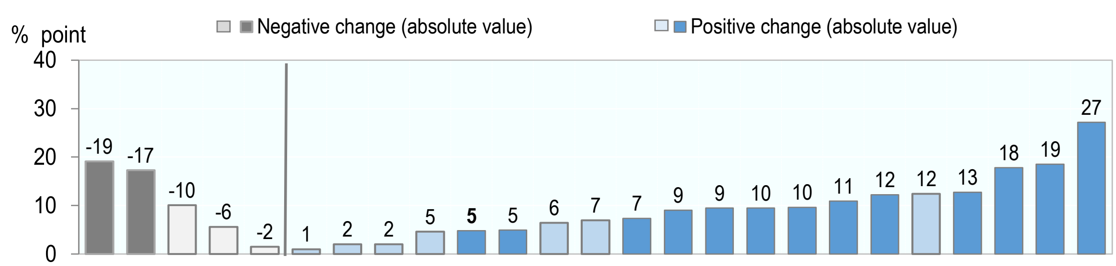
% of students	Chile*	Netherlands	Denmark	Slovenia	Austria*	Finland*	Portugal*	Ontario (CAN)	Northern Ireland (UK)*	Turkey*	Korea*	United States	Belgium (Fl.)*	Hungary	Japan	Ireland*	Italy	Quebec (CAN)	**OECD average**	Russian Federation	Spain*	Czech Republic	Alberta (CAN)*	England (UK)	Slovak Republic	Lithuania	Germany	New Zealand	Sweden	Hong Kong, China	Norway	Poland*	Singapore	Australia
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



% of students	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*
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

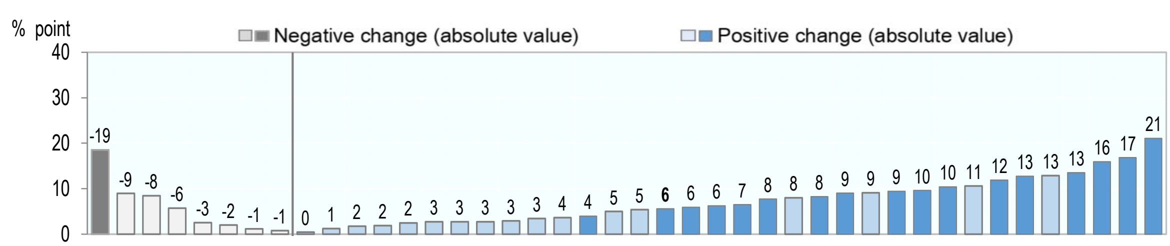
Doing practical experiments in laboratories became a more widespread practice in most OECD systems, with a 6-percentage point expansion on average between 2006 and 2015. Innovation has been modest in this area, with positive and negative changes amounting to 7 percentage points in the change of students' 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

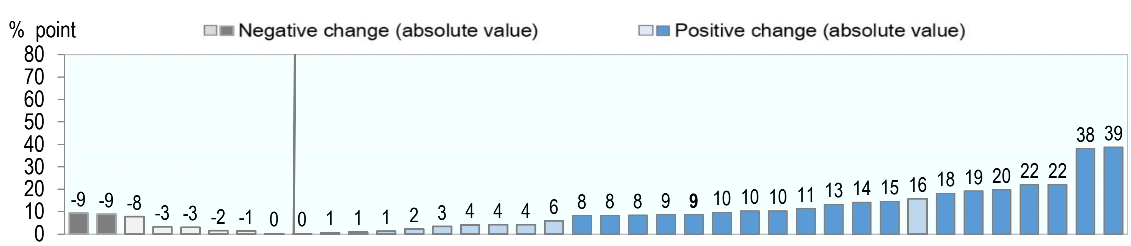
On average, the share of students frequently taught with these strategies increased by 9 percentage points between 2006 and 2016. Taking both directions of change into account, the average absolute change between 2006 and 2016 amounted to 10 percentage points, corresponding to a small effect size of 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

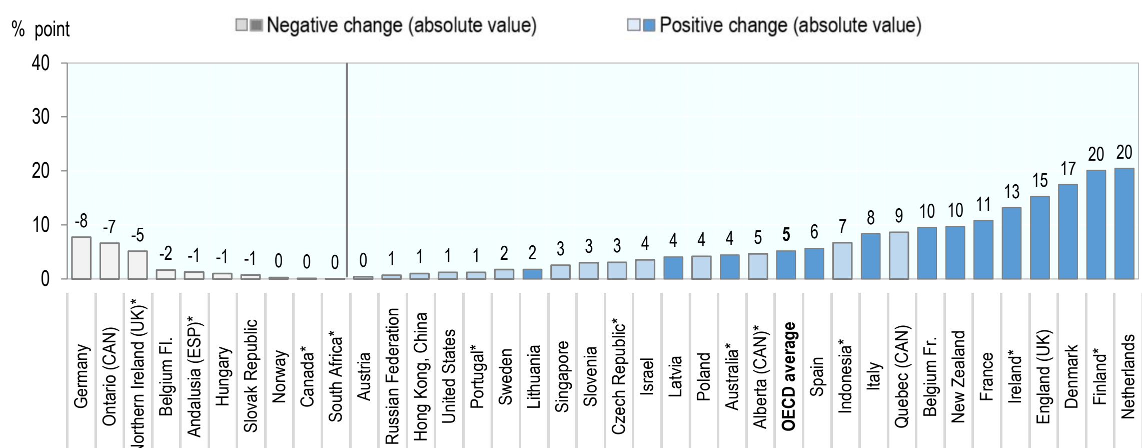
Positive and negative changes in the systematic teaching of new vocabulary were small or modest for most OECD systems. On average, the share of 4th grade students exposed to the practice every week increased by 5 percentage points between 2006 and 2016. The overall innovation in this domain represented 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



% of students	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
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

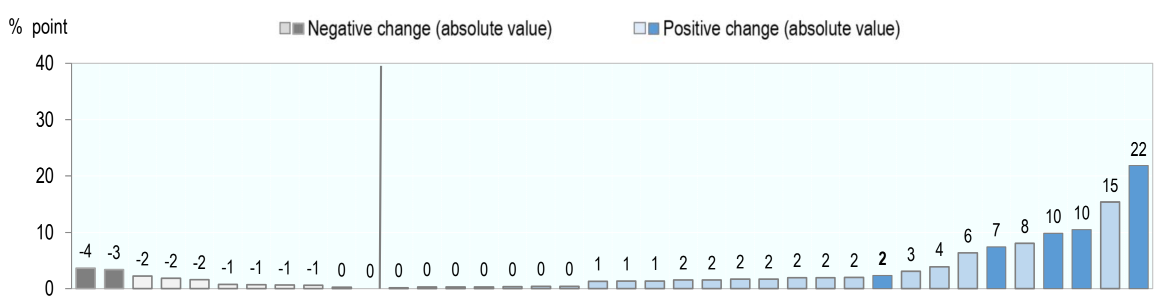
Most countries in the sample saw very little change in the use of this nearly universal practice between 2006 and 2016. At the OECD level, the share of 4th grade students who had a teacher asking them to explain their understanding of a text at least once a week increased by 2 percentage points on average 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



% of students	Canada*	Singapore	Slovenia	Sweden	Finland*	Austria	Latvia	Portugal*	Czech Republic*	Israel	Hungary	Netherlands	Northern Ireland (UK)*	Lithuania	Russian Federation	Slovak Republic	France	Poland	Germany
2016	92	91	93	79	79	87	97	99	99	99	100	87	98	100	100	99	91	99	95
2011	96	95	98	77	80	95	m	100	99	100	100	90	98	100	99	99	92	97	95
2006	m	95	95	81	m	88	98	m	m	99	100	87	m	100	100	99	91	99	94

% of students	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
2016	95	99	97	98	99	84	98	99	98	**93**	m	87	95	88	m	90	91	m	87
2011	97	99	96	97	95	92	99	97	96	**94**	96	83	99	86	95	m	96	94	91
2006	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

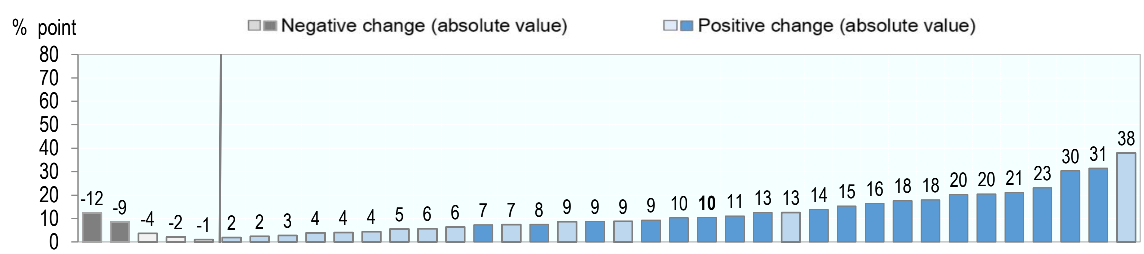
Most OECD education systems experienced an increase in the use of this practice (10 percentage points on average). Downward and upward changes taken into account, the absolute change between 2006 and 2016 amounted to 13 percentage points on average, corresponding to a moderate effect size of 0.29. The 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	Hungary	Slovenia	Finland*	Germany	Australia*	Singapore	Portugal*	Netherlands	Canada*	Israel	New Zealand	Andalusia (ESP)*	Alberta (CAN)*	Slovak Republic	Russian Federation	France	Austria	Ireland*
2016	75	47	20	24	83	66	98	37	61	92	70	61	m	62	90	41	25	66
2011	74	61	24	30	84	78	96	48	57	98	72	56	51	64	83	41	27	58
2006	88	55	m	26	m	64	m	34	m	88	65	m	45	56	82	34	17	m

% of students	England (UK)	Northern Ireland (UK)*	Czech Republic*	Denmark	**OECD average**	United States	Italy	South Africa*	Belgium Fl.	Belgium Fr.	Ontario (CAN)	Norway	Lithuania	Latvia	Hong Kong, China	Spain	Quebec (CAN)	Poland	Sweden	Indonesia*
2016	83	73	41	49	**58**	82	83	m	48	45	69	29	90	55	71	61	62	86	36	m
2011	82	64	32	41	**57**	81	83	59	m	32	71	29	91	m	77	58	48	74	19	82
2006	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

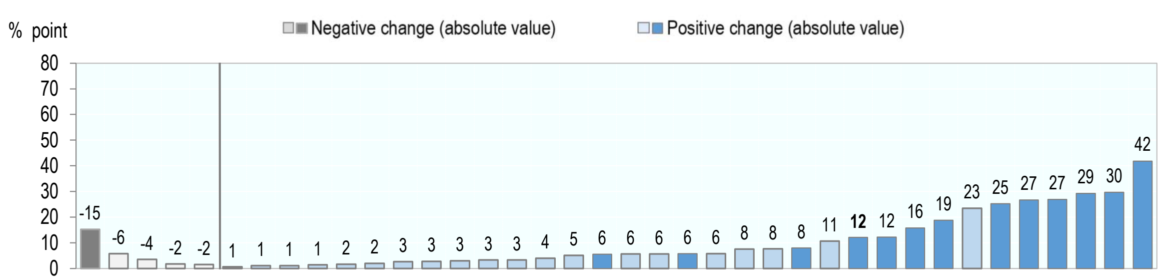
Between 2006 and 2016, this practice spread by 12 percentage points on average in the OECD area. The average absolute change, grouping positive and negative variations, was 13 percentage points, translating into a moderate effect size of 0.3. Over half of the students were asked to draw inferences and 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



% of students	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
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

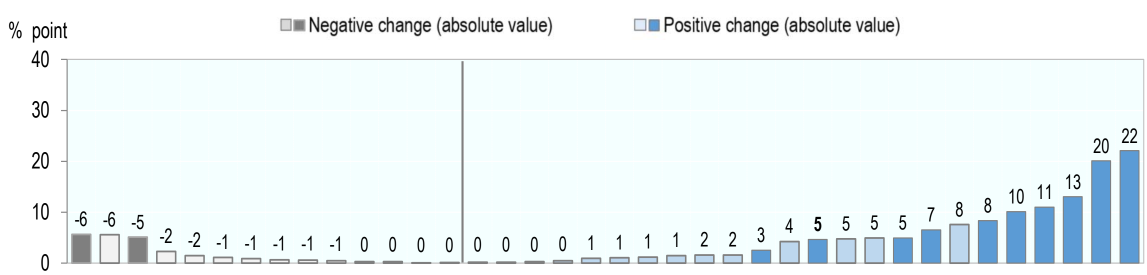
Most education systems saw little changes in the use of this nearly universal practice, on average it had a small net increase of 5 percentage points between 2006 and 2016. The overall change (including expansions and contractions) was 6 percentage points, equating a small effect size of 0.17. In 2016, 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	Germany	Netherlands	Singapore	Canada*	Finland*	Indonesia*	Belgium Fl.	Portugal*	Israel	Lithuania	United States	Czech Republic*	Poland	Slovak Republic	Hungary	Andalusia (ESP)*	Spain	Russian Federation	Italy
2016	89	78	89	91	86	m	76	99	99	99	98	97	100	98	97	98	96	100	99
2011	90	88	95	94	88	85	m	100	100	100	99	97	99	99	99	98	97	99	100
2006	95	84	95	m	m	86	77	m	99	100	98	m	100	97	97	m	95	100	98

% of students	New Zealand	Australia*	France	Ireland*	Northern Ireland (UK)*	Latvia	Alberta (CAN)*	**OECD average**	Quebec (CAN)	Hong Kong, China	Slovenia	England (UK)	South Africa*	Belgium Fr.	Austria	Ontario (CAN)	Denmark	Sweden	Norway
2016	96	96	89	99	96	100	m	92	79	94	90	99	m	86	91	95	92	79	89
2011	98	95	91	97	94	m	94	**93**	89	96	91	97	86	78	92	97	86	78	90
2006	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

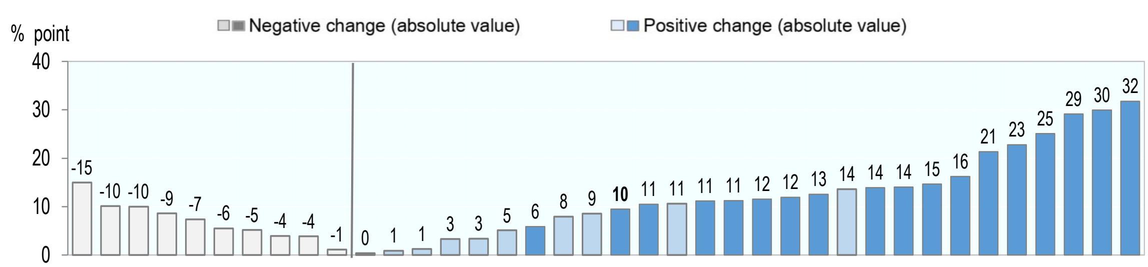
This relatively uncommon practice has spread more often than it has receded and expanded by 10 percentage points on average in the OECD area. The absolute change was a little less than 12 percentage points between 2006 and 2016, corresponding to a moderate effect size of 0.27. In 2016, on average, only 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



% of students	Portugal*	Northern Ireland (UK)*	South Africa*	Israel	Indonesia*	Russian Federation	France	Belgium Fr.	England (UK)	Poland	Quebec (CAN)	Germany	Slovenia	Netherlands	Alberta (CAN)*	Canada*	Belgium Fl.	Latvia	Slovak Republic
2016	44	27	m	48	m	21	21	6	29	8	15	15	7	29	m	41	9	25	23
2011	59	37	17	41	13	23	27	m	34	21	22	10	12	23	40	36	m	m	17
2006	m	m	27	57	21	27	26	10	33	9	15	15	6	25	36	m	3	17	15

% of students	**OECD average**	Finland*	Ireland*	Denmark	Hong Kong, China	Singapore	Czech Republic*	Lithuania	Italy	Sweden	Norway	Ontario (CAN)	Australia*	Austria	New Zealand	Spain	Andalusia (ESP)*	Hungary	United States
2016	**34**	31	30	51	16	25	17	26	49	56	47	43	68	37	69	37	43	35	53
2011	**26**	21	19	43	13	20	5	18	27	58	27	38	52	13	57	29	14	5	26
2006	**24**	m	m	40	5	14	m	14	36	42	33	29	m	16	46	12	m	5	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/10.1787/888933904182

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

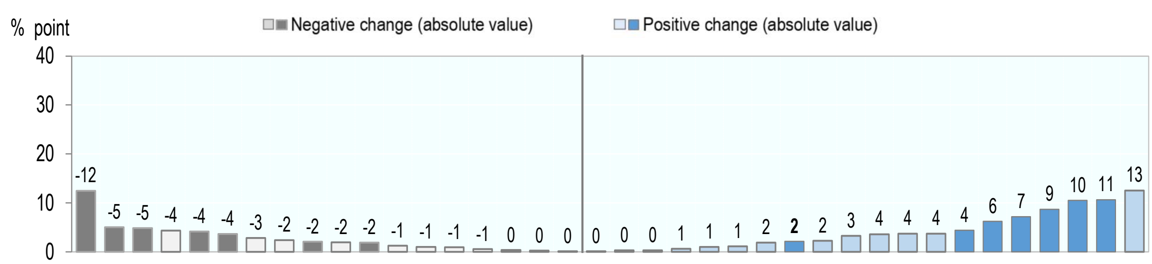
This practice has remained stable between 2006 and 2016, with a slight increase by 2 percentage points. Ignoring change direction, the absolute change has amounted to 4 percentage points, associated to a small effect size of 0.14. Orally explaining or summarising a text at least once a week in 2016 concerned 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.



% of students	Netherlands	Germany	Singapore	Alberta (CAN)*	Lithuania	Australia*	Belgium Fl.	Czech Republic*	Portugal*	Latvia	Russian Federation	Austria	Hong Kong, China	Slovak Republic	Canada*	Hungary	Poland	Israel	South Africa*
2016	62	92	86	m	95	93	82	95	98	97	98	83	80	98	89	100	99	93	m
2011	79	96	89	87	92	96	m	98	100	m	99	87	88	98	89	98	99	97	85
2006	75	97	90	91	99	m	85	m	m	99	100	84	81	99	m	100	99	93	85

% of students	Ireland*	Northern Ireland (UK)*	New Zealand	Denmark	Slovenia	England (UK)	**OECD average**	Andalusia (ESP)*	Finland*	Belgium Fr.	United States	Quebec (CAN)	Italy	Spain	Norway	Ontario (CAN)	Sweden	France	Indonesia*
2016	98	96	92	87	96	97	**90**	99	84	71	97	79	97	97	90	94	75	95	m
2011	98	96	95	87	94	89	**91**	96	80	73	96	80	96	96	90	94	77	89	98
2006	m	m	91	86	95	95	**88**	m	m	67	93	75	92	91	83	86	65	85	85

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

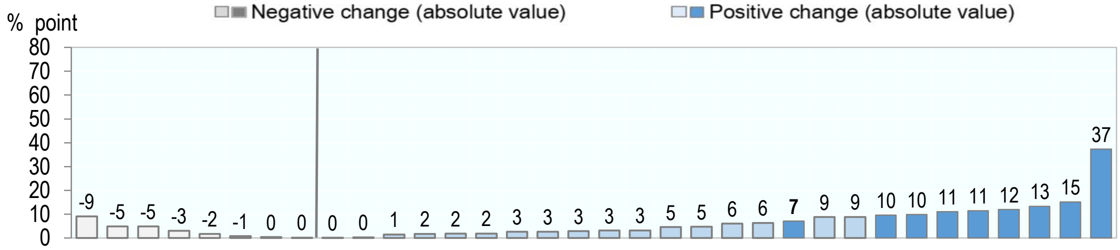
The average share of 8th grade students regularly being asked to read textbooks or resource materials during science lesson went up from 43 % in 2007 to 63% in 2015. This 20-percentage point absolute change between 2007 and 2015 corresponds to a large effect size of 0.41, a high level of innovation. 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

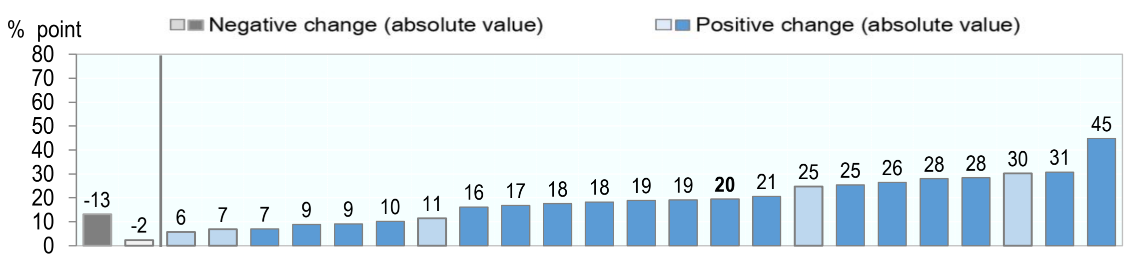


		Netherlands	Russian Federation	Denmark	Finland*	Northern Ireland (UK)*	Singapore	Belgium (Fl.)*	Chile*	New Zealand	Hong Kong, China	Ireland*	Slovak Republic	Turkey*	Spain*	Czech Republic	United States	Germany	Alberta (CAN)*	England (UK)	Poland*	Korea*	Italy	Austria*	**OECD average**	Ontario (CAN)	Quebec (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

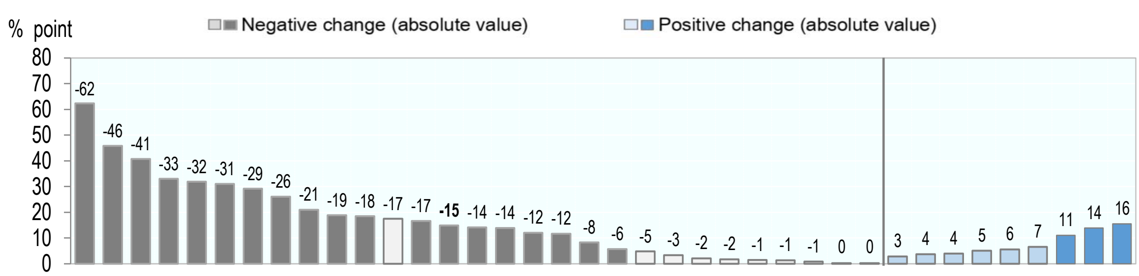
This practice has overwhelmingly declined across OECD countries. Between 2006 and 2016, there was a 15 percentage point decrease in the average proportion of 4th grade students regularly asked to read non-fiction – while the absolute change in both direction amounted to 19 percentage points, corresponding 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

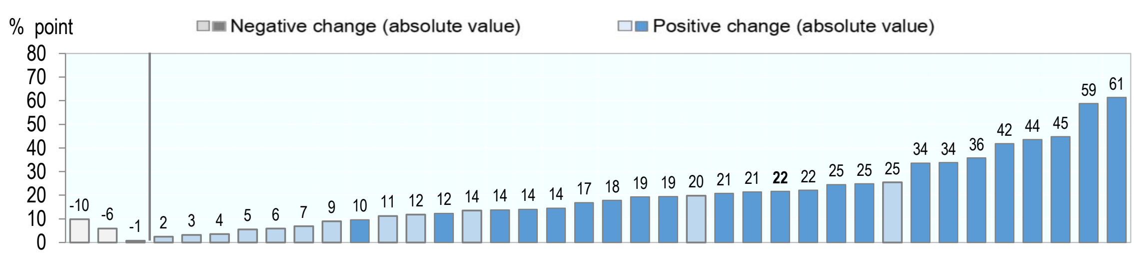
This practice has gained significant ground in OECD countries. Between 2006 and 2016, the share of 4th grade students regularly asked to look for information in reading increased by 22 percentage points on average. The absolute change was 22 percentage points as well, corresponding to a large effect 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



% of students		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
	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

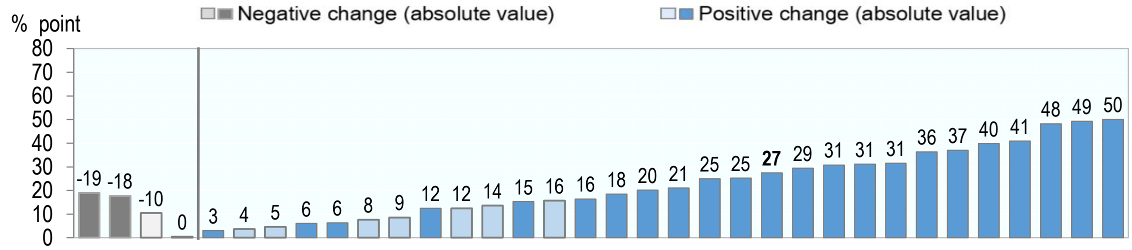
Like in primary education, the share of 8th grade students using computers to look up for ideas and information in mathematics lessons each week increased, this time by 18 percentage points. With an absolute change also equal to 18 percentage points between 2007 and 2015, corresponding to a very large 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



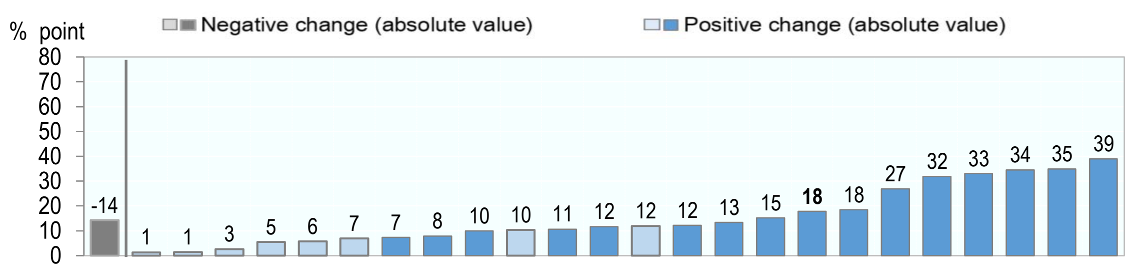
% of students	Poland*	Korea*	Chile*	Belgium (Fl.)*	Japan*	Portugal*	Turkey*	Finland*	Sweden	Northern Ireland (UK)*	Ireland*	Hungary	Austria*	Spain*	Denmark	Alberta (CAN)*	Germany*	Hong Kong, China	Czech Republic	Singapore	Slovenia	England (UK)	**OECD average**	Ontario (CAN)	Norway	Quebec (CAN)	Italy	Netherlands	United States	Lithuania	Russian Federation	Slovak Republic	Australia	New Zealand
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



% of students	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
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

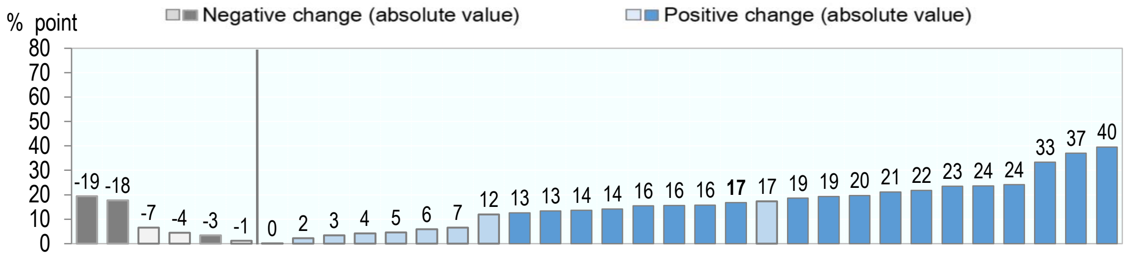
As in primary education, the use of computers to look up for ideas and information in science lessons has gained ground across secondary schools. The average share of 8th grade students regularly participating in this exercise has increased by 21 percentage points between 2007 and 2015 in OECD systems. 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



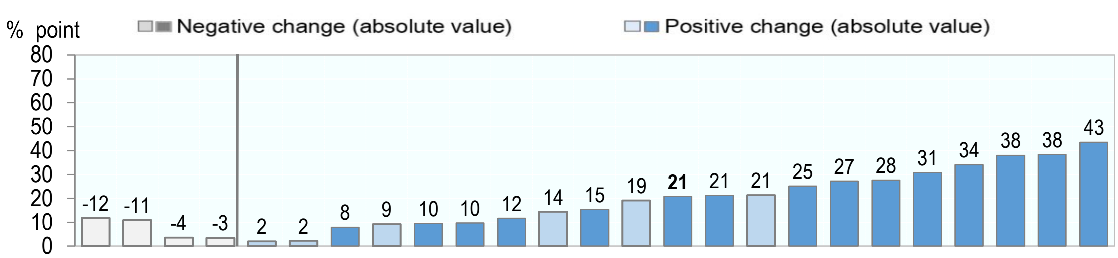
		Hong Kong, China	Portugal*	Quebec (CAN)	Ireland*	Japan	Chile*	Poland*	Belgium (Fl.)*	Germany	Korea*	Denmark	Northern Ireland (UK)*	Finland*	Alberta (CAN)*	Australia	Singapore	England (UK)	Spain*	Turkey*	Sweden	Czech Republic	**OECD average**	Austria*	Lithuania	New Zealand	Norway	United States	Hungary	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.

StatLink https://doi.org/10.1787/888933904334

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

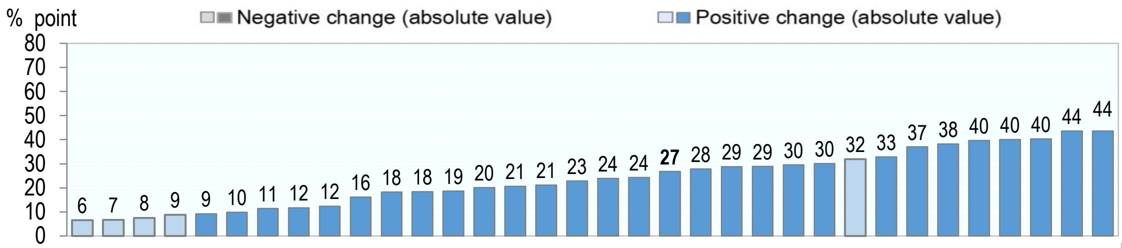
As in primary education, the share of secondary students regularly observing and describing natural phenomena during science lessons saw a net increase and an absolute change of 26 percentage points, corresponding to a very large effect size of 0.57. This has also been a substantial innovation. In 2015, 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.

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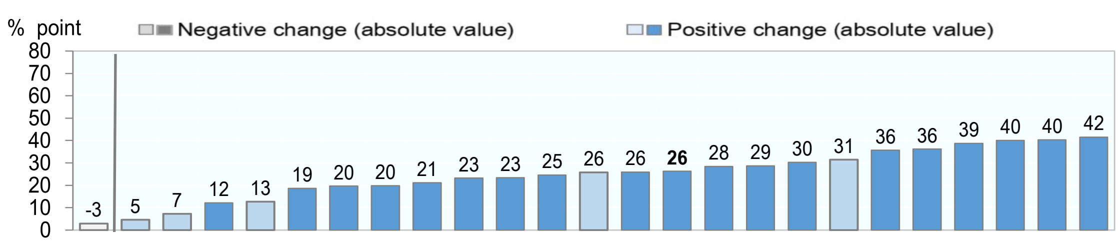
Figure 6.2. 8th grade students observing and describing natural phenomena in science lessons

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

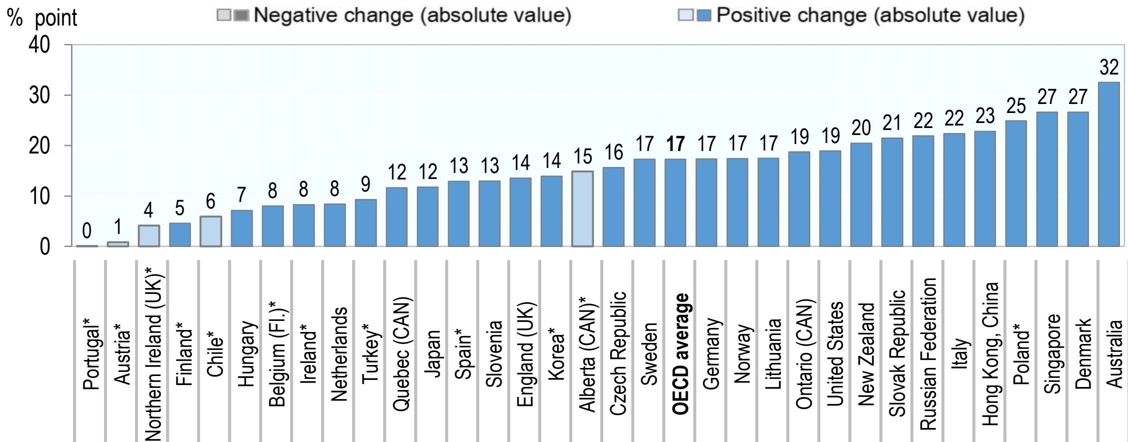
At the secondary level, the practice has also spread across OECD systems with the average share of 8th grade students regularly designing or planning experiments in science going from 19% in 2007 to 31% in 2015. The absolute change, taking into account expansions and retractions, amounted to 14 percentage 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



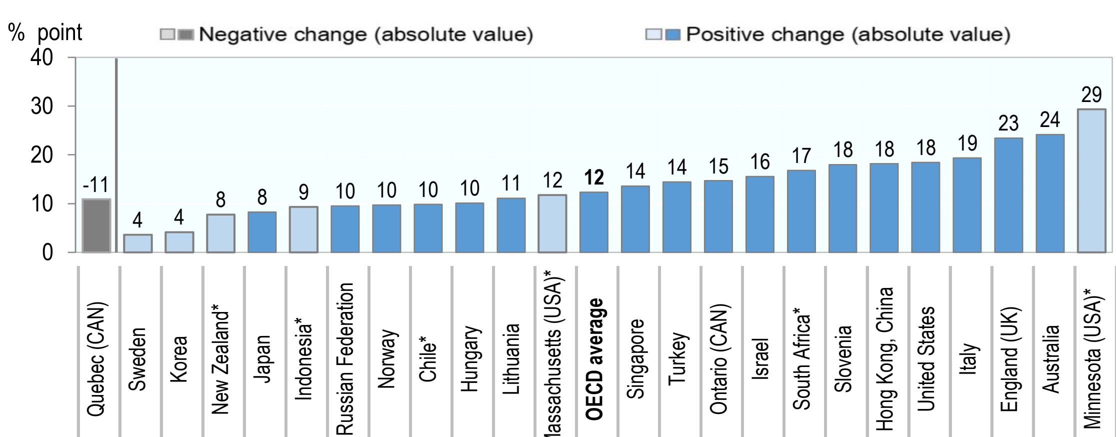
		Portugal*	Austria*	Northern Ireland (UK)*	Finland*	Chile*	Hungary	Belgium (Fl.)*	Ireland*	Netherlands	Turkey*	Quebec (CAN)	Japan	Spain*	Slovenia	England (UK)	Korea*	Alberta (CAN)*	Czech Republic	Sweden	**OECD average**	Germany	Norway	Lithuania	Ontario (CAN)	United States	New Zealand	Slovak Republic	Russian 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

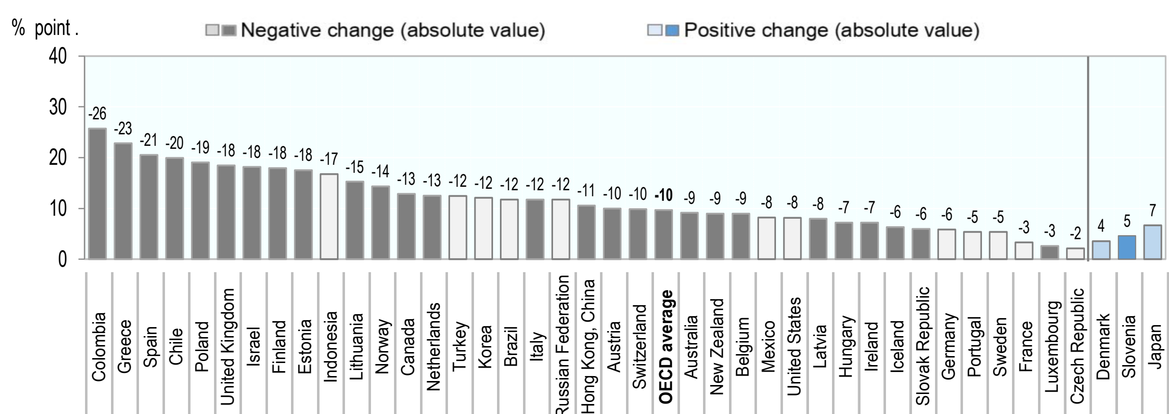
Innovation in OECD countries resulted in the reduced use of this practice. Between 2006 and 2015, the share of 15 year old students asked to draw conclusions from an experiment in all or most of their science lessons decreased by 10 percentage points on average. Together, negative and positive variations 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
	2015	37	31	27	35	40	49	39	37	30	39	47	35	53	39
	2006	62	53	48	55	59	67	57	55	47	56	62	49	66	51

% of students		Turkey	Korea	Brazil	Italy	Russian Federation	Hong Kong, China	Austria	Switzerland	**OECD average**	Australia	New Zealand	Belgium	Mexico	United States
	2015	40	14	32	24	52	40	28	51	**42**	56	49	40	52	61
	2006	53	26	44	36	63	50	38	61	**51**	65	58	49	60	69

% of students		Latvia	Hungary	Ireland	Iceland	Slovak Republic	Germany	Portugal	Sweden	France	Luxembourg	Czech Republic	Denmark	Slovenia	Japan
	2015	43	27	55	20	31	59	48	56	65	46	34	66	40	33
	2006	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

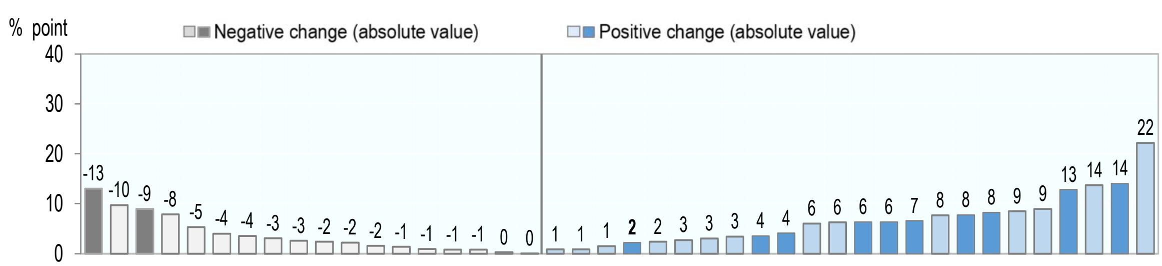
Between 2006 and 2015, the share of 15 year old students whose science teacher regularly explained the relevance of broad science topics in everyday life increased by 2 percentage point on average. Increases and reductions taken into account, the absolute change amounted to 5 percentage points, corresponding 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



% of students		Greece	Colombia	Italy	Chile	France	Israel	Russian Federation	Slovak Republic	United States	Netherlands	Latvia	Estonia	Germany	Poland	Switzerland	Norway	Belgium	Hong Kong, China	Austria	Austria	Lithuania	**OECD average**	Brazil	United Kingdom	Spain	Australia	Slovenia	Canada	Czech Republic	Hungary	New Zealand	Ireland	Iceland	Mexico	Finland	Luxembourg	Korea	Turkey	Sweden	Japan	Denmark	Indonesia
	2015	47	65	39	55	37	51	67	51	55	39	59	57	37	47	48	42	37	48	44	44	56	**50**	61	48	50	58	47	62	49	56	57	54	55	65	48	49	43	55	54	33	58	71
	2006	60	74	48	63	43	55	71	54	57	42	62	58	39	48	49	42	38	48	44	44	55	**48**	59	45	47	55	43	58	43	49	51	47	49	57	41	41	35	46	41	19	44	49

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

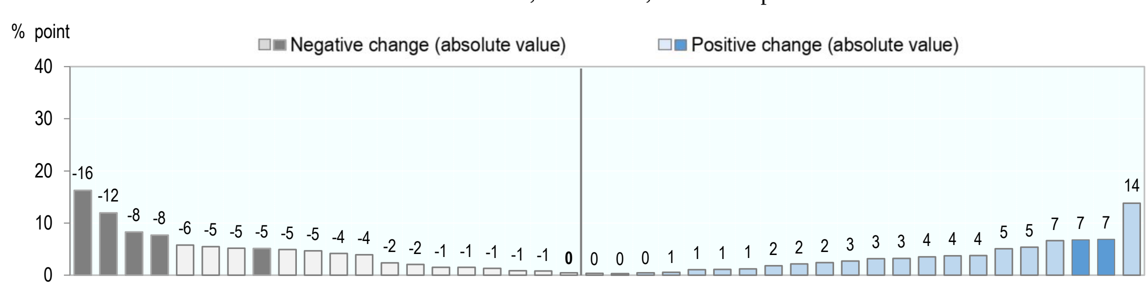
While positive and negative changes have cancelled each other across OECD countries, students experienced an absolute change in this practice of about 4 percentage points on average, corresponding to a small absolute effect size of 0.08. This practice is common across countries and concerned 59% of students 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



% of students		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**
	2015	50	51	54	54	60	64	46	58	45	69	52	55	54	51	54	56	64	47	67	**59**
	2006	67	63	62	61	66	69	51	63	50	74	56	59	56	53	56	57	65	48	68	**60**

% of students		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
	2015	61	68	61	66	73	61	66	74	68	63	58	65	65	49	70	65	57	72	56	58	62	40
	2006	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

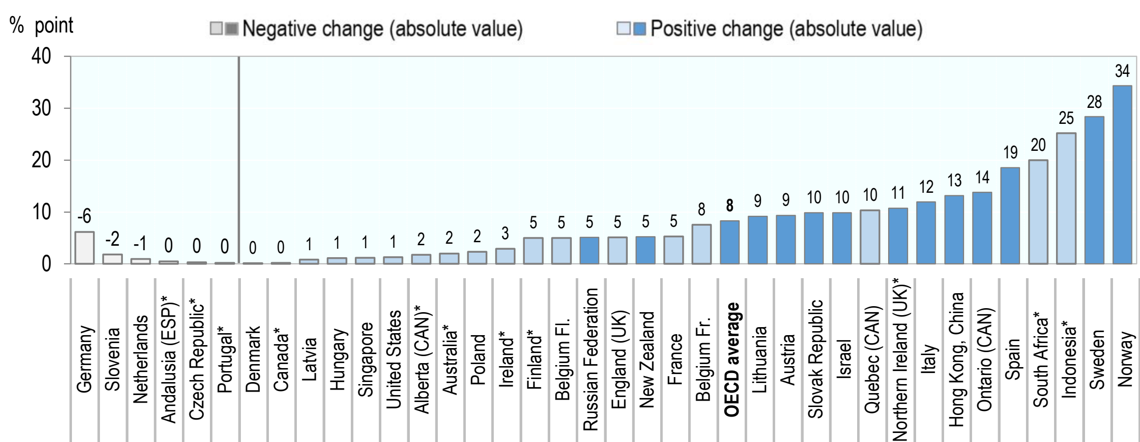
The share of primary students regularly comparing read text with their own experience rose by 8 percentage points on average between 2006 and 2016 in OECD systems. The practice spread in a majority of OECD countries. Looking at both negative and positive changes, the absolute change amounted to 9 percentage 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

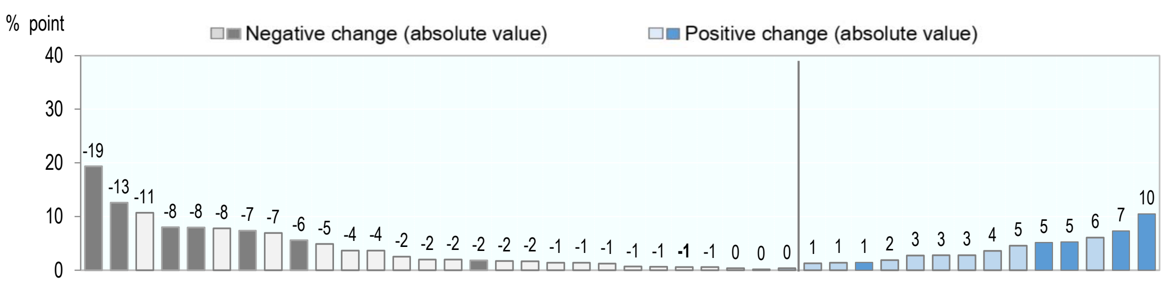
Most OECD countries saw little change in the use of this practice. Overall, negative changes slightly surpassed positive ones resulting in an average decline of 1 percentage point in the share of 15 year old students systematically given the opportunities to explain their ideas in science lessons. Accounting 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
	2015	10	21	33	19	27	21	16	39	15	20	33	24	15	14	11	9	24	7	21	20	22
	2006	30	34	43	27	35	28	24	45	20	25	37	28	17	16	13	11	25	8	22	22	23

% of students		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	8	12	**21**	29	35	22	29	25	10	8	18	27	11	12	15	15	24	13	29	68	24
	2006	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

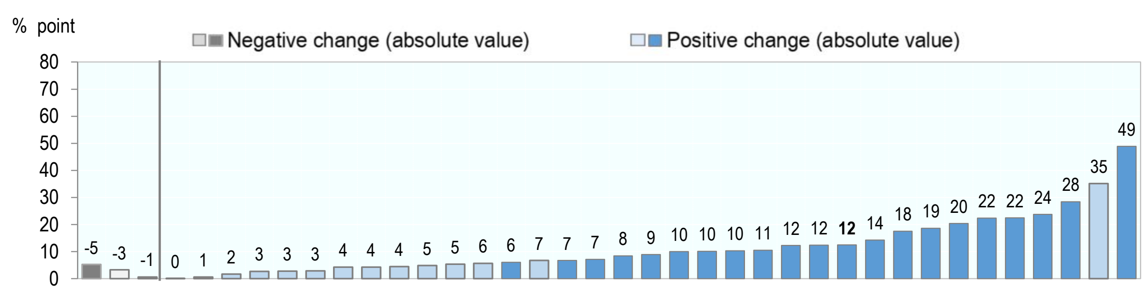
Most countries in the sample saw an expansion of the use of this practice, the OECD average rising by 12 percentage points between 2006 and 2016. Ignoring the direction of country-level changes, the average absolute change was a little over 13 percentage points which translated to a moderate effect size 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



% of students	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
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

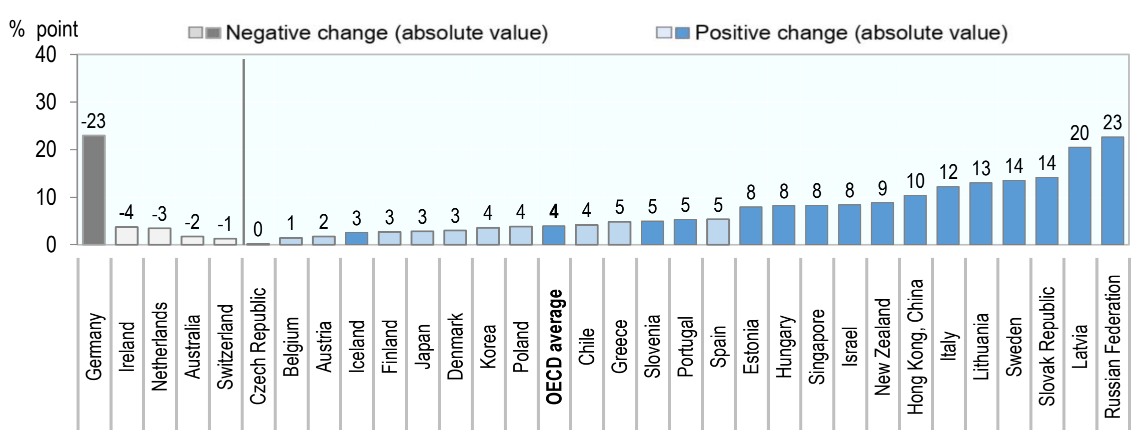
Across the OECD area, the use of this practice has more often increased than decreased. Overall, 4% more of the students reported to be doing these simulations at school at least once a month in 2015 than in 2009. The absolute change was around 6 percentage points, representing a small effect size of 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.



% of students	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
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

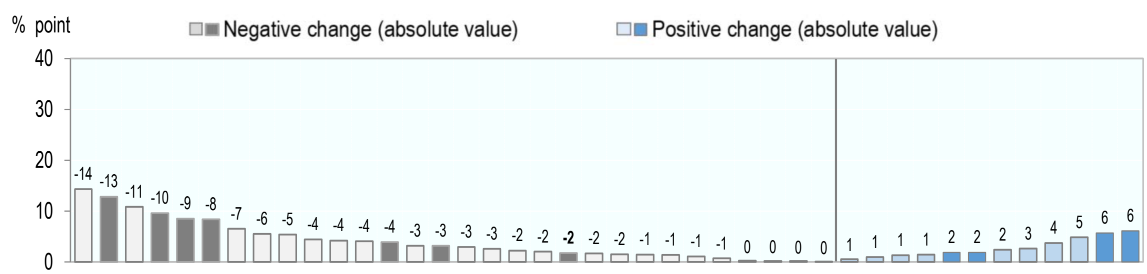
Between 2006 and 2015, negative changes slightly outweighed positive ones across OECD countries, leading to a net decrease of almost 2 percentage points in the share 15 year old students allowed to design their own experiments in most science lessons. The absolute change was 3 percentage points, with 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



% of students	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**
2015	23	16	22	22	20	15	30	26	36	25	9	30	6	10	12	13	13	11	16	**16**
2006	38	29	33	31	28	23	37	31	42	30	14	34	10	13	15	16	16	13	18	**17**

% of students	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
2015	11	11	11	13	17	13	11	15	12	12	16	14	10	6	11	18	15	21	23	22	20	28
2006	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

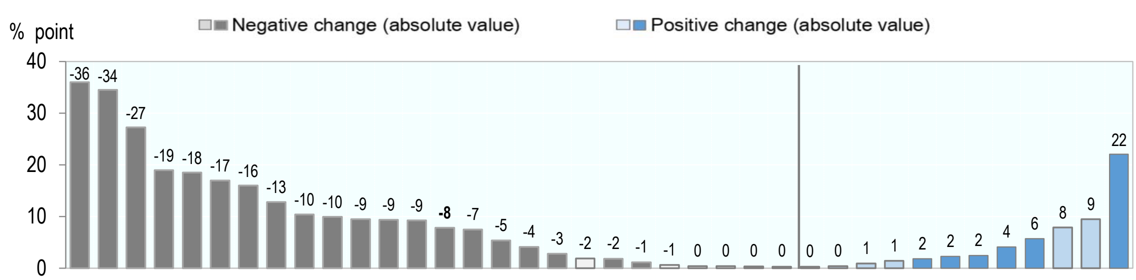
At the OECD level, the contraction of this practice strongly outweigh its spreading, leading to an average net decrease of 8 percentage points between 2006 and 2016. Accounting for changes in both directions, the absolute change was 9 percentage points on average, corresponding to a modest effect size 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



% of students	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
2016	39	38	59	56	61	66	64	66	79	76	67	63	69	**77**	74	76	78	80	89
2011	70	59	76	m	71	79	70	76	91	83	63	65	78	**82**	78	82	82	82	89
2006	75	73	86	75	79	83	79	79	89	86	77	72	m	**85**	82	81	m	82	91

% of students	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*
2016	91	89	89	96	90	92	80	93	81	95	m	97	94	94	93	87	m	m	60
2011	93	87	90	96	90	92	80	94	m	96	97	95	92	93	91	82	88	87	38
2006	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

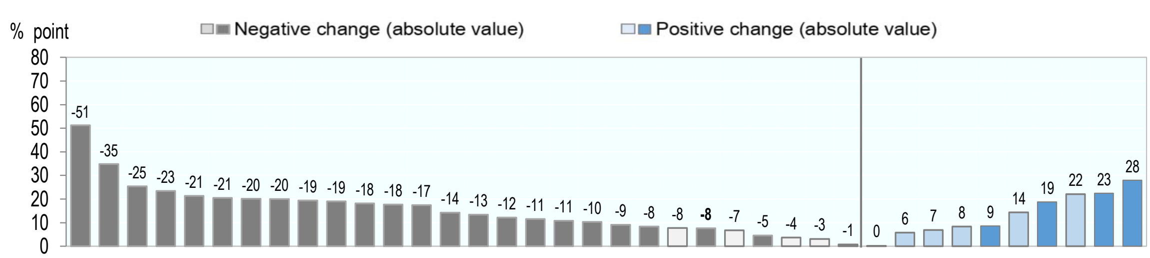
In OECD systems, 61% of 4th grade students were given time to read books of their own choice at least once a week on average in 2016, against 68% in 2006, a net decline by 7 percentage points. The average absolute change of 13 percentage points, including increases and reductions, corresponds to a moderate 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



% of students	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
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

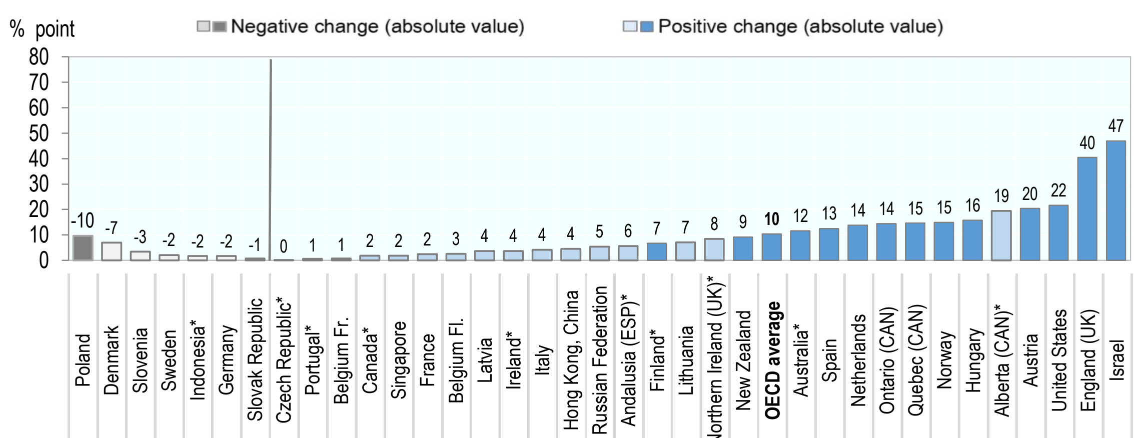
This practice has mostly spread across OECD systems. Between 2006 and 2016, the share of 4th grade students systematically receiving individualised reading instruction rose by 10 percentage points on average. The absolute change, regardless of direction, amounted to 12 percentage points and corresponds 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

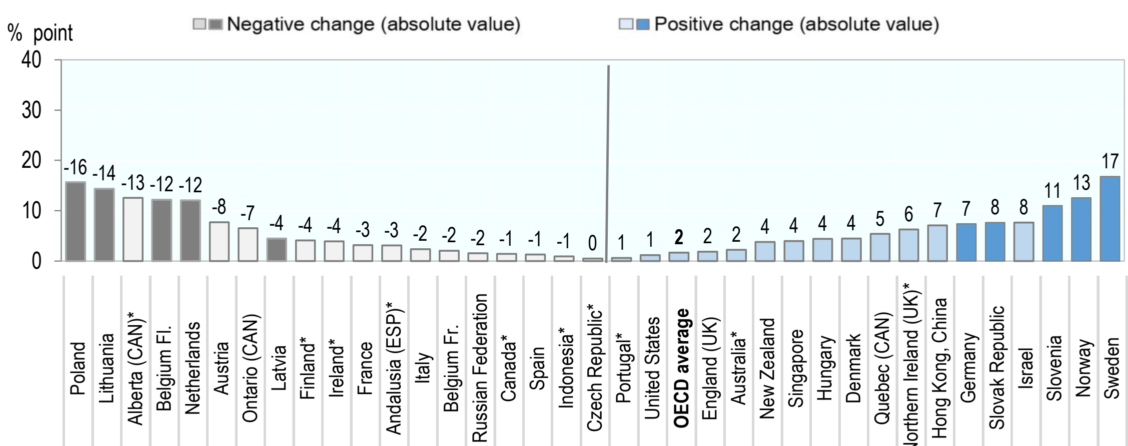
On average, this practice remained stable, with a slight expansion by 2 percentage points between 2006 and 2016. During this period, the mean absolute change was 7 percentage points, corresponding to a small effect size of 0.15. There is a substantial use of systematic whole-class teaching in 4th grade 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



% of students	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*
2016	63	62	m	44	44	52	69	93	77	74	83	95	96	82	98	73	92	m	80
2011	99	59	60	m	37	54	75	m	81	78	83	98	96	83	98	75	96	89	80
2006	79	76	73	56	56	59	75	97	m	m	86	m	99	84	99	m	94	90	m

% of students	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
2016	94	76	**71**	51	55	13	85	84	64	91	46	87	74	85	81	71	74	73
2011	93	69	**70**	43	53	11	77	73	57	91	40	88	66	78	74	71	68	69
2006	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

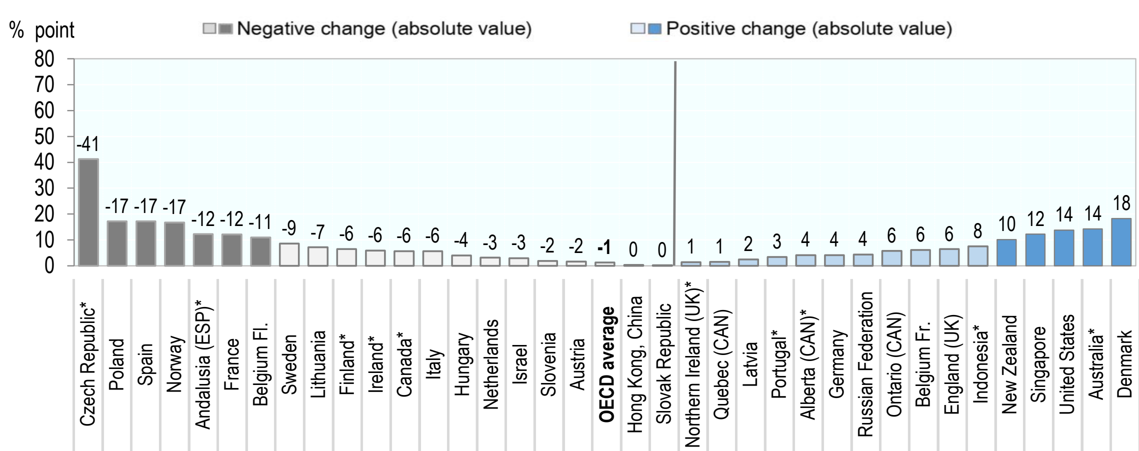
There has been little change on average in this practice, with positive and negative changes outweighing one another and leading to an average net decrease of just 1 percentage point in OECD countries between 2006 and 2016. The average absolute change was 8 percentage points, corresponding to a small 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



% of students		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
	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

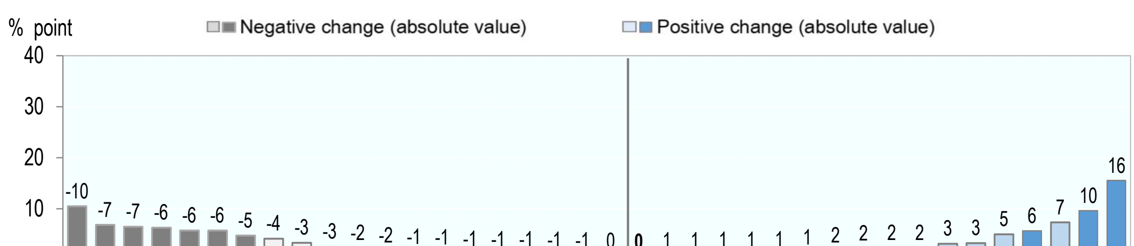
Positive changes and negative changes have balanced each other with an average zero net change between 2006 and 2016. The absolute change in this practice, positive and negative, was 4 percentage points on average, corresponding to a minor effect size of 0.14. Reading aloud to the class in primary reading 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

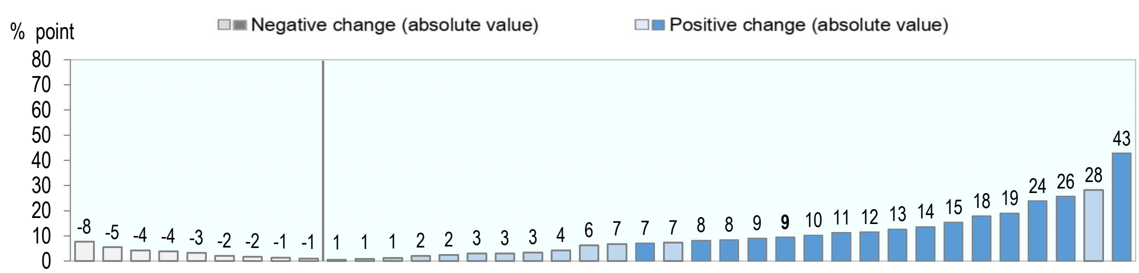
In the OECD area, the percentage of 4th grade students whose reading teachers regularly ask them to engage in peer discussion on read text rose by 9 percentage points on average between 2006 and 2016. The absolute change, regardless of direction, was 10 percentage points on average, corresponding to 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



% of students	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)
2016	66	82	77	m	81	91	88	42	71	50	39	m	73	73	64	84	70	56	82
2011	74	89	m	71	85	93	90	41	72	41	29	76	71	84	59	79	66	m	85
2006	m	87	81	75	84	93	m	43	m	50	38	75	m	71	61	81	67	52	76

% of students	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
2016	81	81	75	91	89	91	**74**	66	70	93	80	82	81	70	58	74	66	m	82
2011	69	73	86	89	81	91	**70**	64	68	83	83	68	75	71	39	73	51	97	58
2006	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

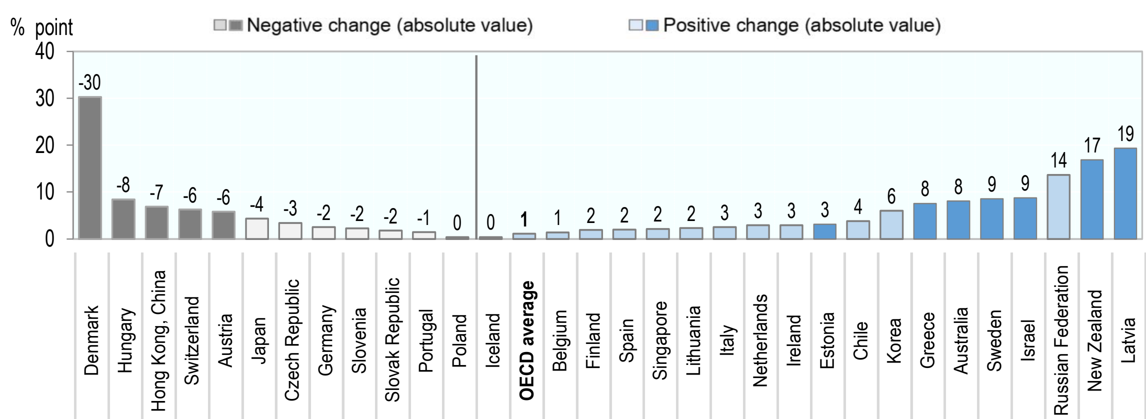
Positive changes compensated negatives ones across OECD countries. On average, the share of 15 year old students using school computers for group work and communication at least once a month increased by 1 percentage points between 2009 and 2015. The absolute change, including increases and reductions, 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



% of students		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
	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

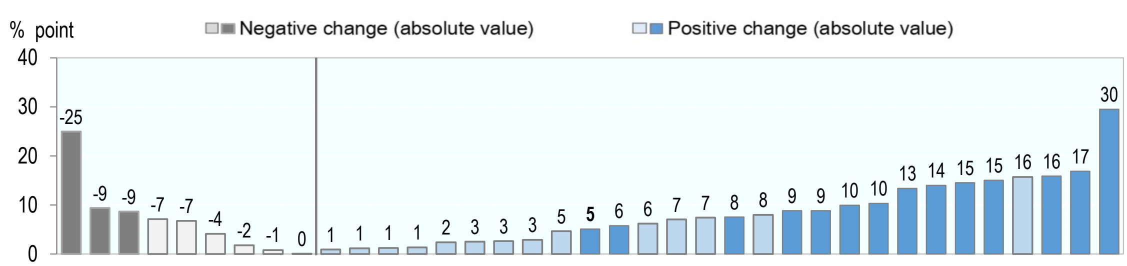
Increases in the use of this practice have prevailed over decreases across OECD countries. Between 2006 and 2016, there was an average net increase by 5 percentage points, while the mean absolute change, mirroring positive and negative changes, was 9 percentage points, corresponding to a modest effect 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



% of students		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
	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

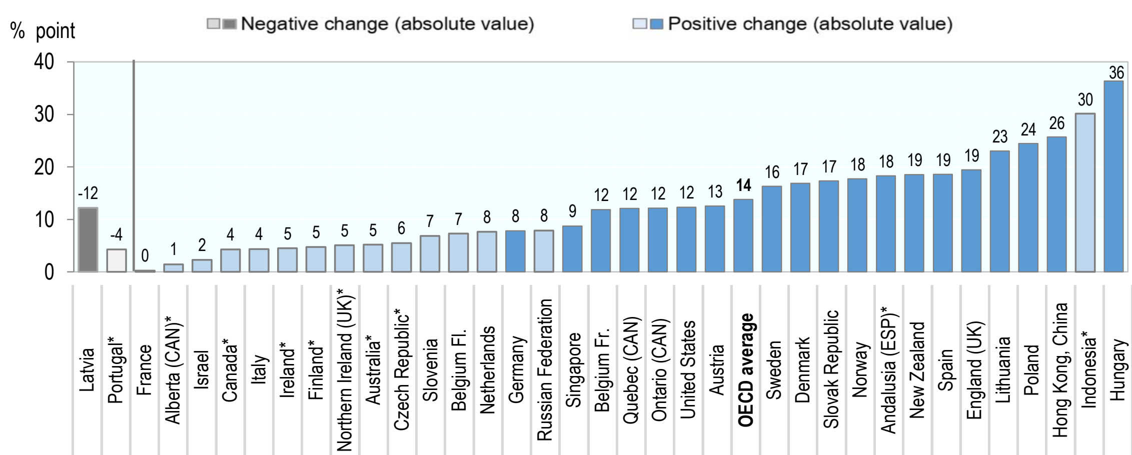
At the OECD level, the share of 4th grade students whose teachers systematically create mixed-ability groups increase by 14 percentage points on average between 2006 and 2016. The overall absolute change was the same, corresponding to a moderate absolute effect size of 0.3. This practice is used to a 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



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

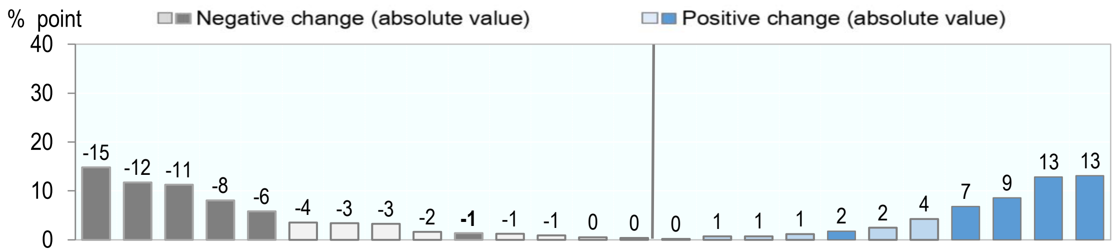
While positive and negative changes have nullified each other, the mean absolute change in this practice at the OECD level was 7 percentage points. This change translates into a small effect size of 0.18. In 2015, on average 23% of students got science homework at least twice a week, with a span ranging 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



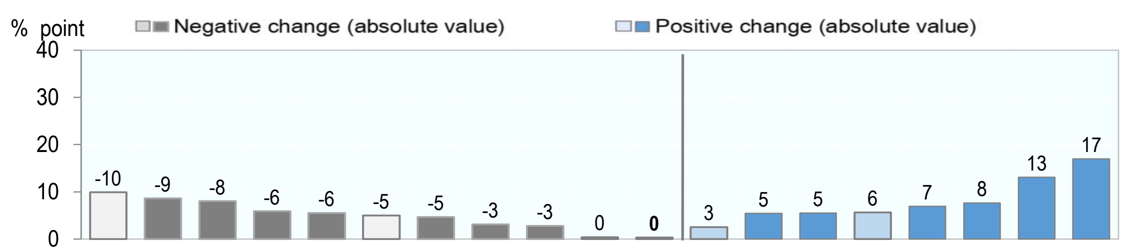
% of students	Ontario (CAN)	Norway	United States	Korea	Italy	Australia	New Zealand*	Indonesia*	Massachusetts (USA)*	**OECD average**	Israel	Hungary	Sweden	Lithuania	England (UK)	Hong Kong, China	Chile*	Minnesota (USA)*	Russian Federation	Singapore	Japan	South Africa*	Turkey	Slovenia	Quebec (CAN)
2015	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



% of students	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)
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

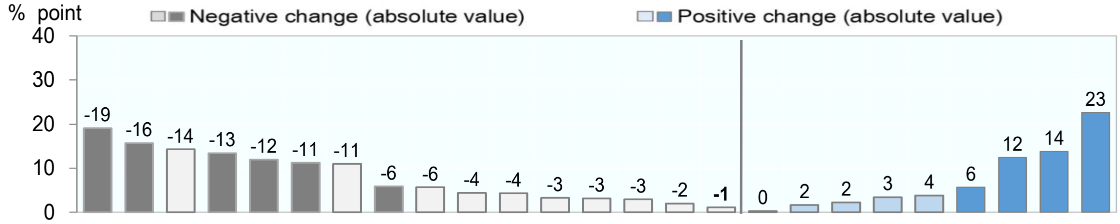
The share of students whose science teachers constantly monitor the completion of their homework decreased by 3 percentage points on average in OECD systems. Combining positive and negative variations, the absolute change was 8 percentage points, corresponding to a small effect size of 0.18. In 2015, 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



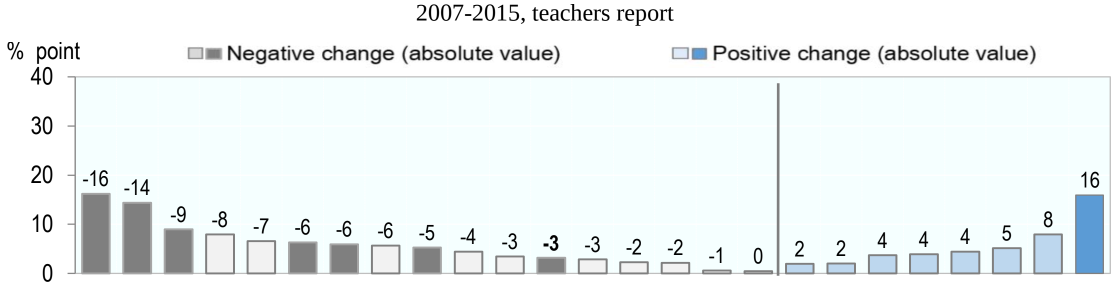
		Sweden	Ontario (CAN)	Minnesota (USA)*	Hong Kong, China	Italy	New Zealand*	Quebec (CAN)	United States	South Africa*	Israel	Hungary	Russian Federation	England (UK)	Indonesia*	Singapore	**OECD average**	Massachusetts (USA)*	Australia	Lithuania	Japan	Chile*	Korea	Slovenia	Norway	Turkey
% of students	2015	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

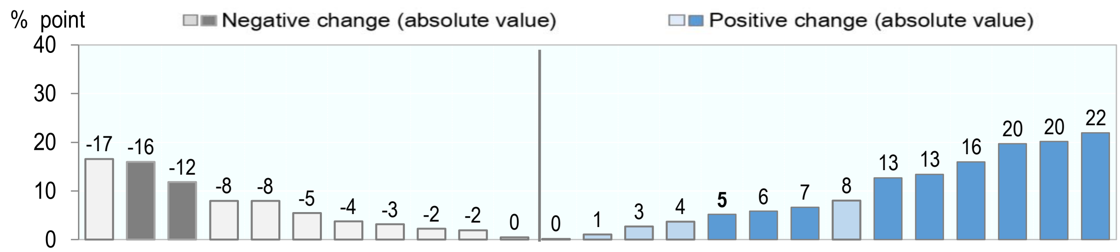
At the OECD level, this practice has more often expanded than retracted, leading to an average net increase of 3 percentage points in the share of 8th grade students regularly exposed to it in science. Combining variations in both directions, the absolute change reached 10 percentage points on average, 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



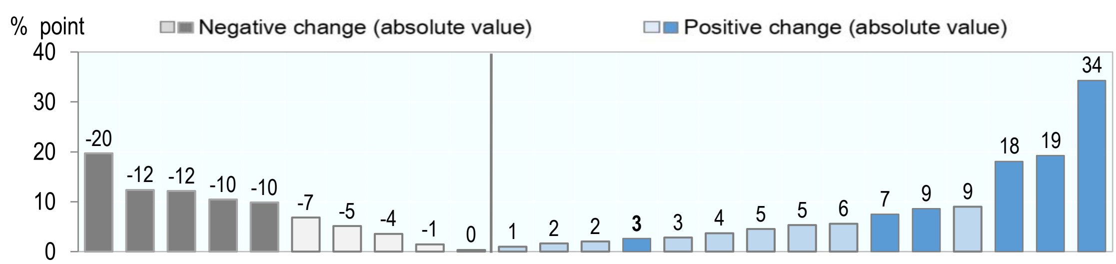
		Indonesia*	Italy	Israel	Hungary	Ontario (CAN)	Massachusetts (USA)*	New Zealand*	Lithuania	Chile*	Russian Federation	United States	South Africa*	Hong Kong, China	Turkey	Norway	**OECD average**	Singapore	Slovenia	Minnesota (USA)*	Korea	Quebec (CAN)	Australia	England (UK)	Sweden	Japan
% of students	2015	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

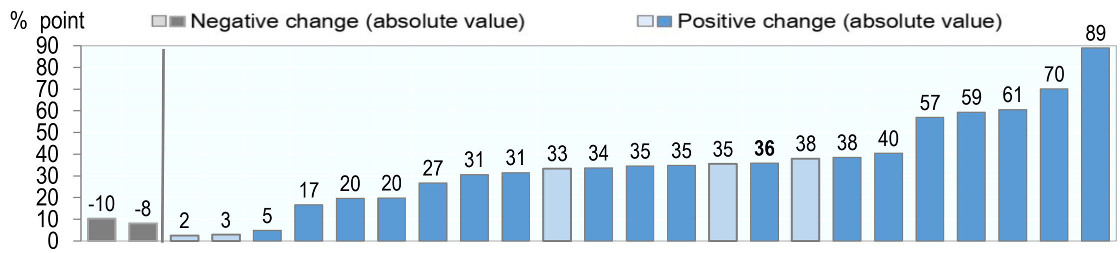
The use of systematic homework discussion in science class has increased in most OECD countries. On average, the proportion of 8th grade science students exposed to this practice went up from 25% in 2007 to 55% in 2015. The 30 percentage-point absolute change in this practice corresponds to a large effect 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



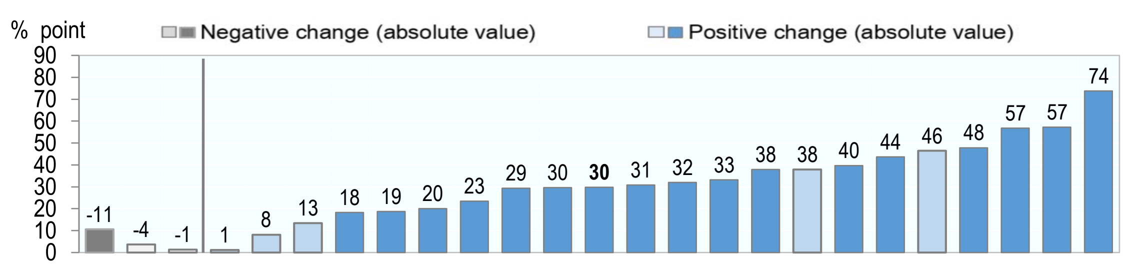
% of students	Chile*	New Zealand*	South Africa*	Hong Kong, China	Japan	Turkey	Sweden	Korea	United States	England (UK)	Australia	Massachusetts (USA)*	Italy	Norway	Ontario (CAN)	Indonesia*	**OECD average**	Minnesota (USA)*	Singapore	Israel	Russian Federation	Slovenia	Quebec (CAN)	Lithuania	Hungary
2015	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



% of students	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
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

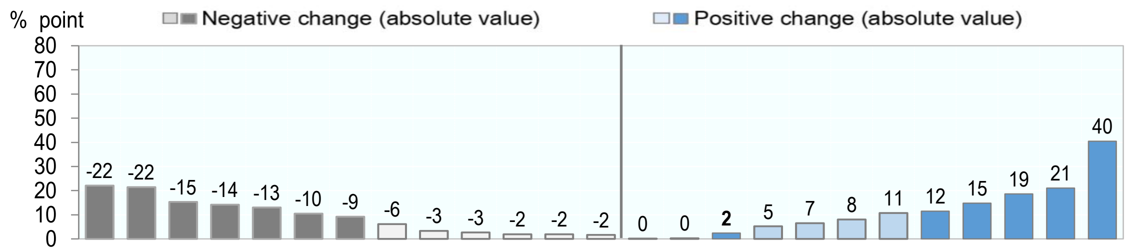
In science, the share of 8th grade students receiving a systematic correction of assignments decreased by 2 percentage points on average. Combining variations in both directions, the absolute change reached 11 percentage points, corresponding to a modest effect size of 0.23. Systematic correction and 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



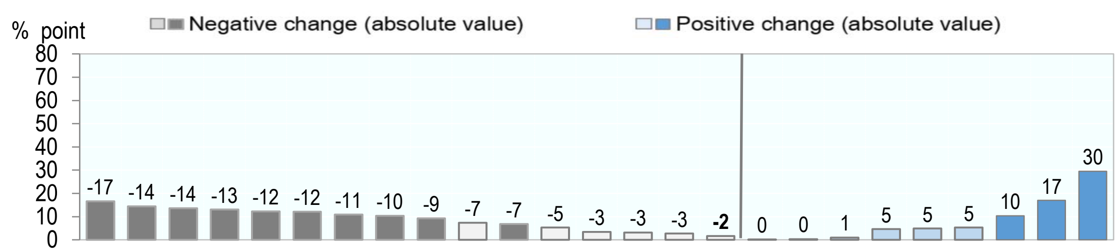
% of students		Sweden	Australia	England (UK)	Hungary	Hong Kong, China	Slovenia	Lithuania	Chile*	Indonesia*	Russian Federation	Singapore	Ontario (CAN)	South Africa*	New Zealand*	United States	**OECD average**	Norway	Minnesota (USA)*	Quebec (CAN)	Massachusetts (USA)*	Israel	Japan	Turkey	Italy	Korea
	2015	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



% of students		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
	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

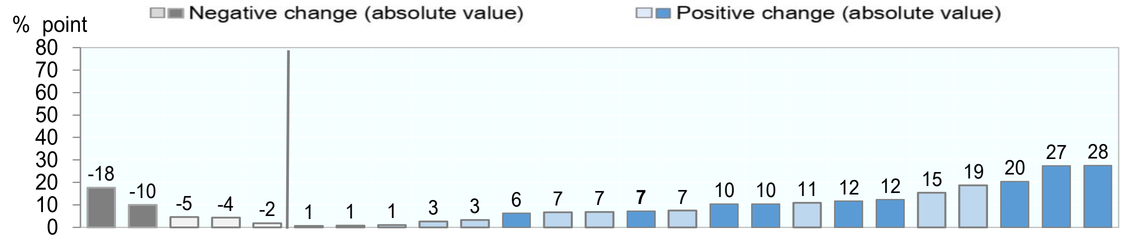
A large majority of countries saw the use of classroom tests in 8th grade science gain ground. At the OECD level, on average 72% of 8th grade students were extensively assessed through classroom tests in science lessons in 2015, compared to 60% in 2007. The absolute change in this practice was 16 percentage 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



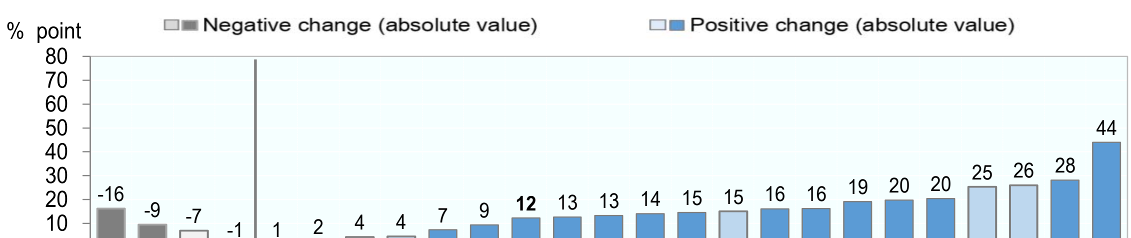
% of students		Hungary	Italy	Australia	Chile*	South Africa*	Norway	New Zealand*	Hong Kong, China	Russian Federation	Ontario (CAN)	United States	Sweden	Lithuania	**OECD average**	Korea	Israel	Singapore	Massachusetts (USA)*	Turkey	Quebec (CAN)	Indonesia*	Minnesota (USA)*	Slovenia	Japan	England (UK)
	2015	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



% of students		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
	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

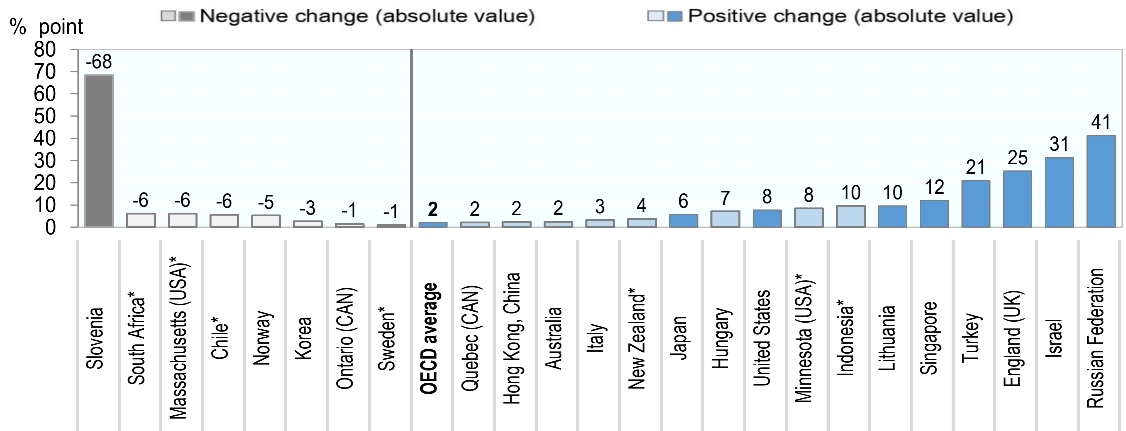
In OECD systems, the practice diffused slightly more than it receded, resulting in an average net increase of 2 percentage points. The average absolute change amounted to 12 percentage points, corresponding to modest effect size of 0.28. The use of this assessment method remains low on average (22% of 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



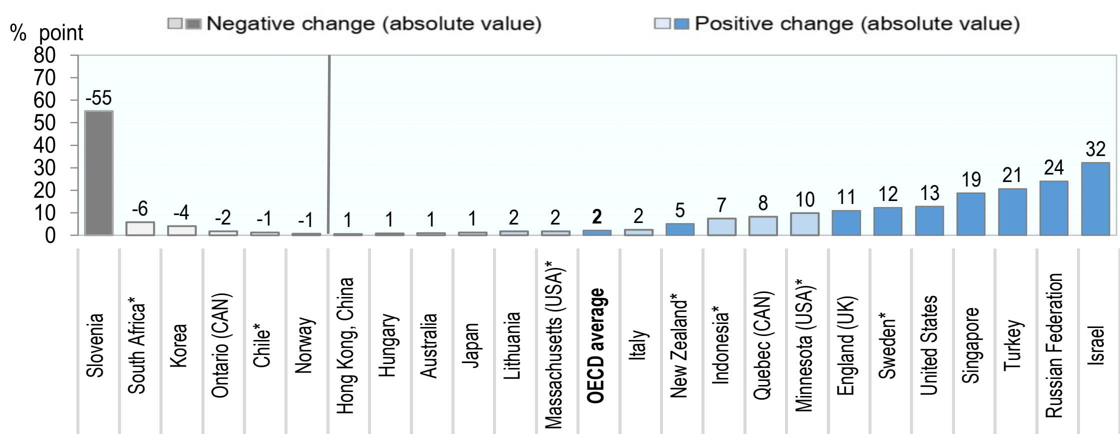
% of students	Slovenia	South Africa*	Massachusetts (USA)*	Chile*	Norway	Korea	Ontario (CAN)	Sweden*	**OECD average**	Quebec (CAN)	Hong Kong, China	Australia	Italy	New Zealand*	Japan	Hungary	United States	Minnesota (USA)*	Indonesia*	Lithuania	Singapore	Turkey	England (UK)	Israel	Russian Federation
2015	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



% of students	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
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

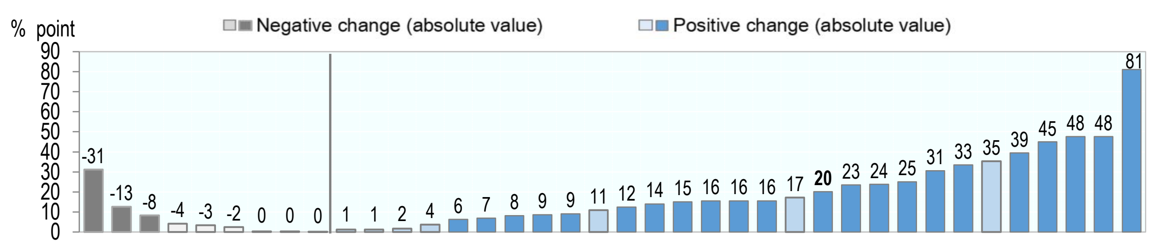
At the OECD level, the share of 4th grade students who were given a written test in reading at least once a week went from an average of 21% in 2006 to 41% in 2016. The average absolute change, reflecting the positive and negative variation, amounted to 21 percentage points, corresponding to a large 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



% of students	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)*
2016	13	22	13	42	64	20	10	25	28	22	31	56	14	13	8	27	20	17	m
2011	m	35	16	55	74	22	10	31	29	m	29	53	17	17	8	31	8	17	26
2006	44	m	21	46	67	m	m	25	m	21	m	54	10	6	1	19	11	8	15

% of students	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
2016	82	17	42	39	24	33	m	**41**	53	38	32	47	68	m	65	47	61	73	95
2011	69	8	27	49	20	33	54	**39**	30	21	14	41	67	75	56	5	72	78	97
2006	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

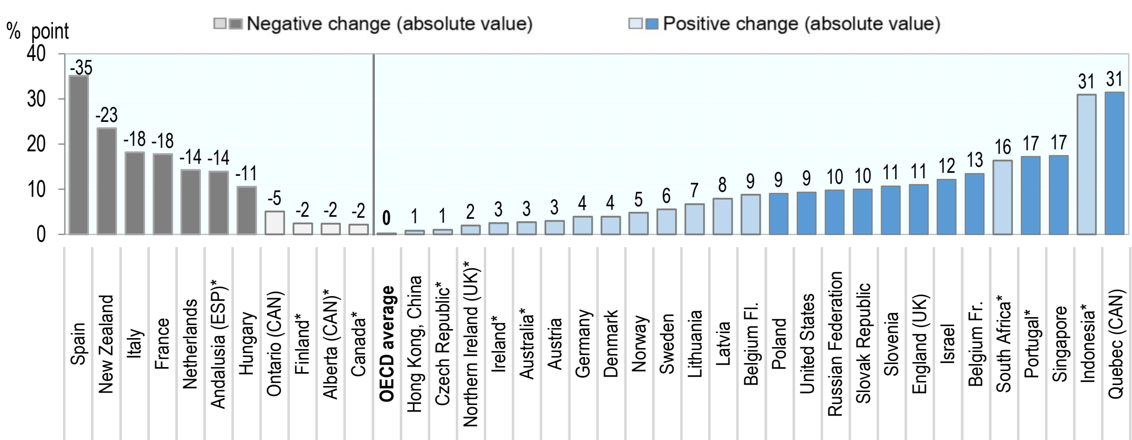
While expansions and contractions have cancelled each other across OECD countries, the overall absolute change in the share of 4th grade students significantly assessed through classroom tests in reading amounted to 13 percentage points on average. This corresponds to a moderate absolute effect size 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



% of students	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)
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

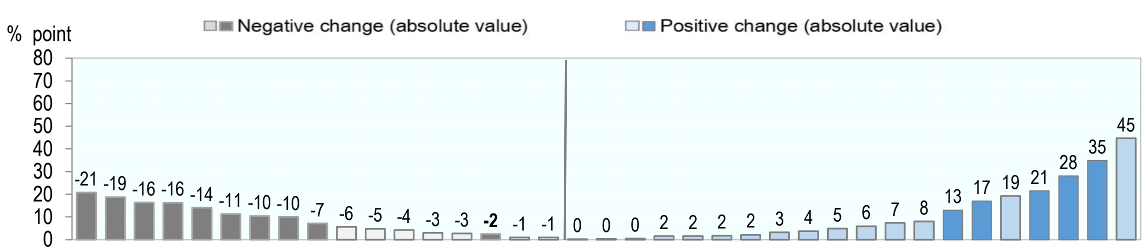
Between 2006 and 2016, OECD systems presented both positive and negative changes in the use of this practice, leading to a slightly negative average net change (-2 percentage points). The mean absolute change, accounting for changes in both directions, was 9 percentage points, corresponding to a modest 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



% of students	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
2016	22	18	47	13	22	11	34	23	4	27	m	42	12	8	**23**	13	15	11
2011	m	22	74	10	28	6	54	29	5	35	3	46	10	11	**26**	12	22	13
2006	43	36	64	30	36	22	44	33	11	32	8	m	15	m	**25**	14	16	11

% of students	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*
2016	15	4	7	7	9	43	18	49	26	18	19	44	35	41	m	41	77	62	m
2011	15	4	9	11	7	41	15	50	m	12	8	36	12	38	32	19	67	70	76
2006	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

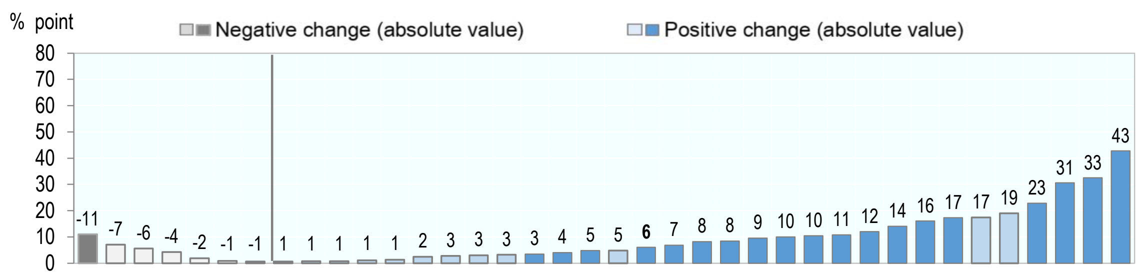
In OECD systems, on average 13% of 4th grade students with reading difficulties had a teacher aide or an adult volunteer supporting them academically in 2016, compared to 7% in 2006. When both increases and decreases are accounted for, the absolute change amounted to 7 percentage points on average, corresponding 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



% of students	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.
2016	10	m	8	11	32	12	7	9	5	1	11	3	5	12	9	13	7	4	9
2011	21	13	13	16	34	10	8	13	3	1	10	10	3	22	10	9	9	5	5
2006	m	20	13	16	m	13	m	9	4	1	m	1	2	9	6	m	4	0	4

% of students	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)
2016	30	**13**	28	15	10	13	11	15	15	21	16	17	19	m	m	25	32	38	62
2011	25	**12**	29	6	4	4	13	10	28	12	m	12	20	24	24	20	24	m	44
2006	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

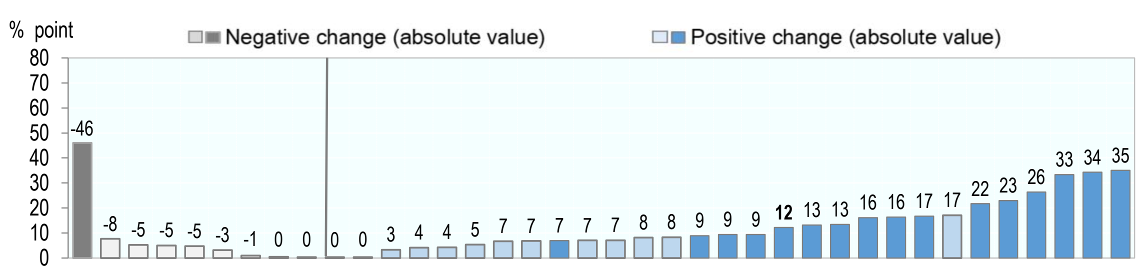
In 4th grade reading lessons, across OECD systems, this approach generally spread and the share of students exposed to it increased by 12 percentage points on average. As a result of negative and positive changes, the absolute change was 14 percentage points, corresponding to a moderate absolute effect 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



% of students	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*
2016	44	27	25	60	38	46	43	48	44	26	57	56	97	46	31	43	41	46
2011	m	23	22	57	m	30	44	55	46	25	56	56	96	38	31	37	34	39
2006	91	34	30	65	43	49	44	48	45	m	m	53	93	41	25	m	m	m

% of students	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
2016	m	59	41	m	33	32	21	**42**	31	66	35	49	51	m	40	46	41	58	60	68
2011	38	52	37	59	24	22	26	**36**	18	55	33	33	35	61	42	40	13	27	59	61
2006	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

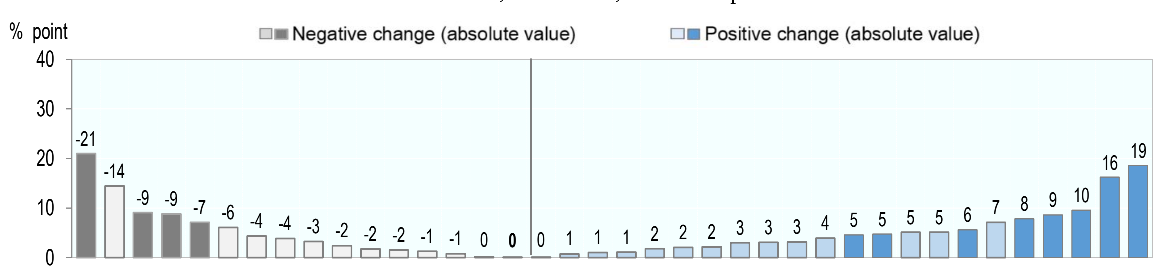
Contractions have fully balanced expansions of the practice across OECD systems, but on average there has been an absolute change of 6 percentage points in the use of this practice, corresponding to a moderate-low absolute effect size of 0.22. This scaffolding technique in reading is widely used, with 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	Poland	South Africa*	Denmark	Germany	Norway	Indonesia*	Spain	Slovak Republic	Sweden	Slovenia	New Zealand	Hungary	Lithuania	Portugal*	Belgium Fr.	**OECD average**
2016	78	m	74	72	89	m	83	92	87	94	92	96	96	99	73	**89**
2011	98	75	83	78	95	77	78	92	95	95	96	99	97	100	72	**91**
2006	99	90	84	80	96	84	87	95	90	97	94	98	98	m	73	**89**

% of students	Northern Ireland (UK)*	Canada*	France	Andalusia (ESP)*	Ireland*	Australia*	Finland*	Austria	Ontario (CAN)	Czech Republic*	Italy	Netherlands	Israel	Hong Kong, China	Belgium Fl.	Singapore	Alberta (CAN)*	United States	Russian Federation	Latvia	England (UK)	Quebec (CAN)
2016	95	94	83	85	91	96	85	89	97	85	96	99	96	87	92	84	m	96	98	93	94	88
2011	95	93	87	84	89	94	82	91	99	82	91	99	96	93	m	82	98	94	97	m	90	86
2006	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

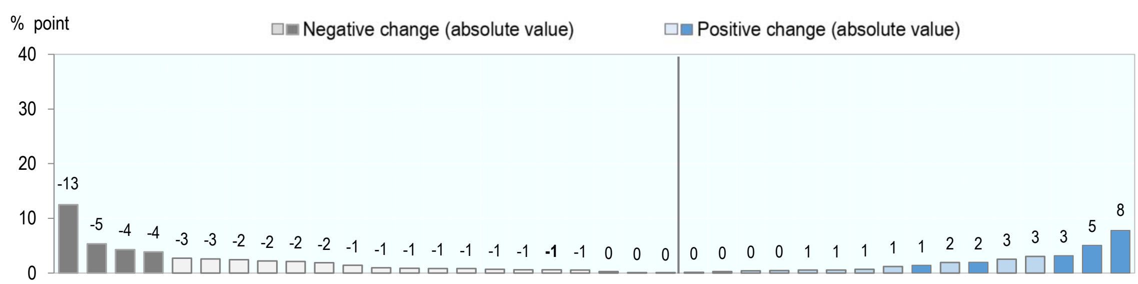
Between 2006 and 2016, the use of this practice has both increased and decreased across OECD countries, resulting in a net decline of 1 percentage point in the share of 4th grade students instructed by teachers who ask parental help for students falling behind in reading. The mean absolute change in 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	Quebec (CAN)	United States	Andalusia (ESP)*	Sweden	Hong Kong, China	Belgium Fr.	New Zealand	Norway	Alberta (CAN)*	Latvia	South Africa*	Singapore	Belgium Fl.	Hungary	Denmark	Canada*	England (UK)	**OECD average**
2016	84	92	95	95	80	91	91	97	m	97	m	81	91	97	99	94	98	**96**
2011	86	95	100	99	86	93	92	99	96	m	96	86	m	96	99	94	98	**96**
2006	97	97	m	99	83	93	93	99	98	99	97	82	91	97	100	m	99	**96**

% of students	Netherlands	Slovak Republic	Portugal*	Poland	Australia*	Northern Ireland (UK)*	Austria	Indonesia*	Spain	Germany	Slovenia	Ireland*	Russian Federation	France	Lithuania	Finland*	Ontario (CAN)	Czech Republic*	Italy	Israel
2016	98	98	99	99	91	97	99	m	99	98	100	96	100	86	100	97	97	100	98	98
2011	98	97	99	98	91	96	98	96	100	100	99	95	100	88	98	94	97	96	98	97
2006	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

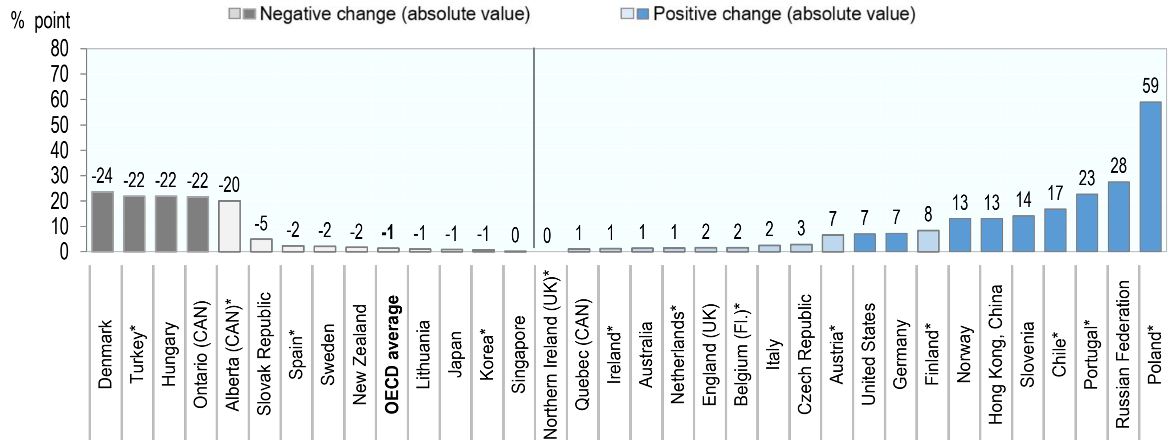
Between 2007 and 2015, the share of 8th grade students with access to a science laboratory at school decreased by 2 percentage points on average in OECD systems. Only a small number of countries innovated in this domain and the absolute change in the access to this resource amounted to 3 percentage points, 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



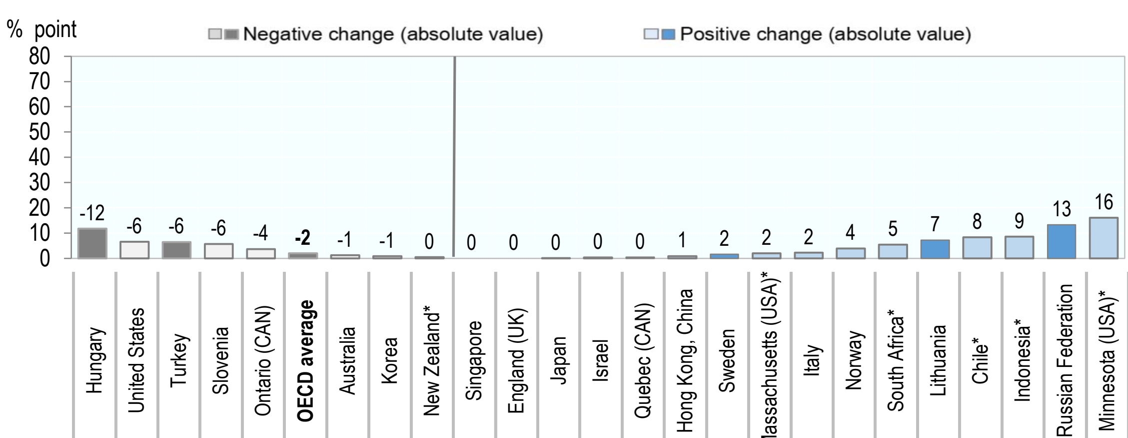
% of students	Denmark	Turkey*	Hungary	Ontario (CAN)	Alberta (CAN)*	Slovak Republic	Spain*	Sweden	New Zealand	**OECD average**	Lithuania	Japan	Korea*	Singapore	Northern Ireland (UK)*	Quebec (CAN)	Ireland*	Australia	Netherlands*	England (UK)	Belgium (Fl.)*	Italy	Czech Republic	Austria*	United States	Germany	Finland*	Norway	Hong Kong, China	Slovenia	Chile*	Portugal*	Russian Federation	Poland*
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



% of students	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)*
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

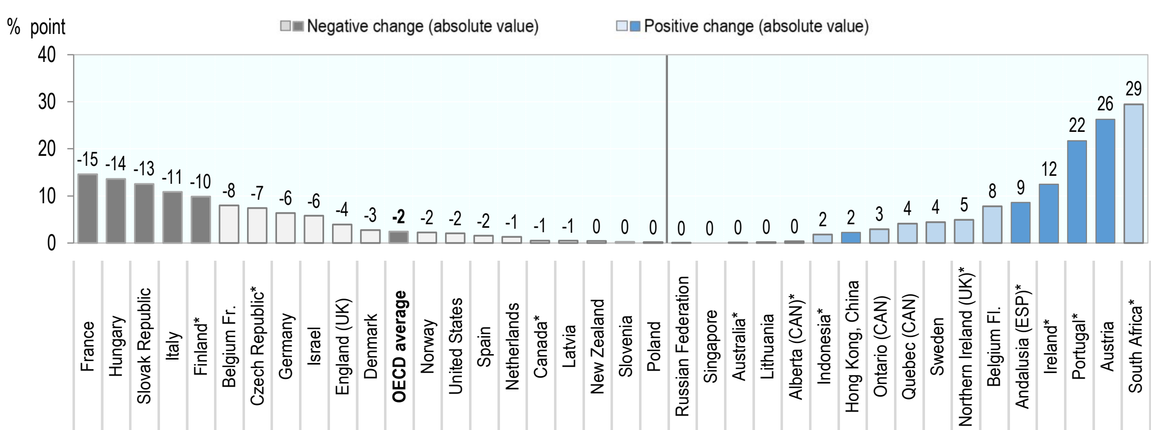
OECD systems have experienced differing trends, although on average the net availability of school libraries in primary education has slightly decreased by 2 percentage points between 2006 and 2016. All country-level variations lead to an average absolute change of 6 percentage points, corresponding 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



% of students	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*
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

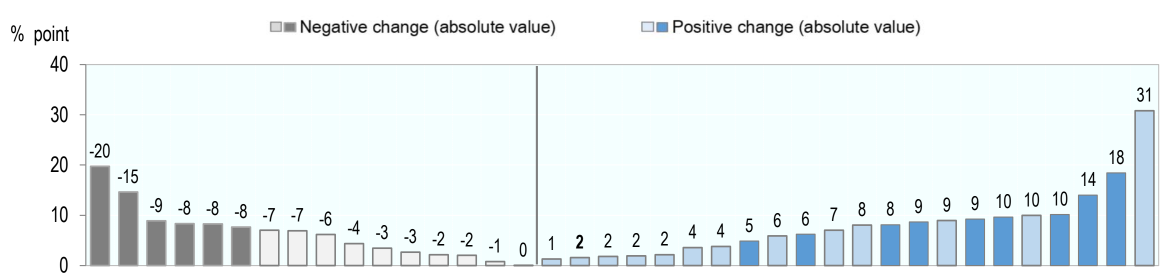
OECD countries experienced both increases and reductions in the share of 4th grade students with access to a library or reading corner in the classroom, while overall the net OECD average rose by 2 percentage points. Positive and negative changes combined resulted in a modest average absolute change 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



% of students	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**
2016	38	53	74	90	63	80	41	48	45	87	93	88	96	97	95	96	71	**77**
2011	60	67	77	94	69	86	52	65	51	92	97	91	98	99	95	m	80	**79**
2006	58	m	83	98	71	88	48	55	m	m	m	m	m	99	m	96	70	**75**

% of students	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*
2016	93	98	m	87	84	97	79	84	67	77	92	93	75	94	45	m	98	72	74	m
2011	89	99	98	82	87	95	78	92	m	73	87	91	89	87	38	58	99	59	55	71
2006	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

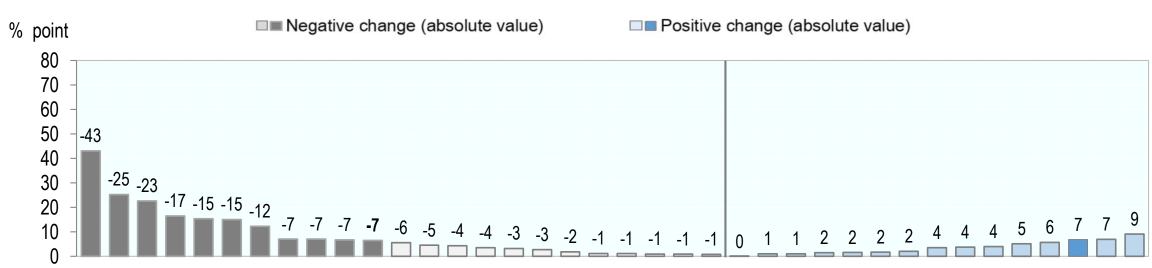
This practice has become a bit less common in OECD systems, with the average share of primary students allowed to borrow books from the classroom library going down from 79% to 72% between 2006 and 2016. Regardless of change direction, the absolute change was 8 percentage points, corresponding to a modest 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



% of students	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
2016	45	48	62	71	68	65	77	92	85	85	**72**	65	82	78	62	m	75	95
2011	77	64	68	86	72	85	m	98	88	89	**75**	65	79	64	63	78	78	97
2006	88	74	84	88	83	80	90	99	92	92	**79**	70	86	82	65	81	m	97

% of students	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
2016	62	76	75	62	m	89	76	83	61	51	22	89	97	88	95	88	94	80	m	86
2011	69	70	80	m	86	89	85	80	60	49	17	89	95	84	91	83	88	73	71	67
2006	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

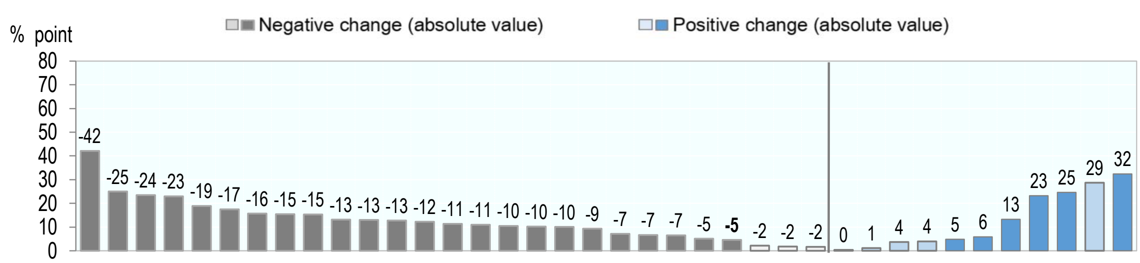
Between 2006 and 2016, the share of primary students using computers at least once a week has decreased in a majority of countries. In the OECD education systems covered, it has decreased by 5 percentage points on average. Negative and positive variations resulted in an average absolute change of 14 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



% of students	Italy	England (UK)	Czech Republic*	Ireland*	France	Northern Ireland (UK)*	Hong Kong, China	Portugal*	Israel	Canada*	United States	Ontario (CAN)
2016	21	60	23	23	22	59	42	25	52	54	61	56
2011	43	84	47	46	39	76	57	41	71	67	76	66
2006	63	85	m	m	41	m	58	m	68	m	74	69

% of students	Spain	Austria	Australia*	Quebec (CAN)	Germany	Singapore	Lithuania	Poland	Andalusia (ESP)*	Netherlands	Belgium Fr.	**OECD average**
2016	28	16	74	41	14	25	12	26	19	59	16	**41**
2011	45	25	85	57	28	28	20	42	25	71	21	**51**
2006	41	27	m	52	24	35	21	33	m	65	21	**46**

% of students	Alberta (CAN)*	Latvia	Slovenia	Hungary	Belgium Fl.	Finland*	Indonesia*	Slovak Republic	Russian Federation	Norway	Sweden	New Zealand	South Africa*	Denmark
2016	m	22	23	34	29	37	m	43	26	54	54	77	m	71
2011	73	m	25	67	m	33	28	44	30	58	38	73	70	44
2006	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

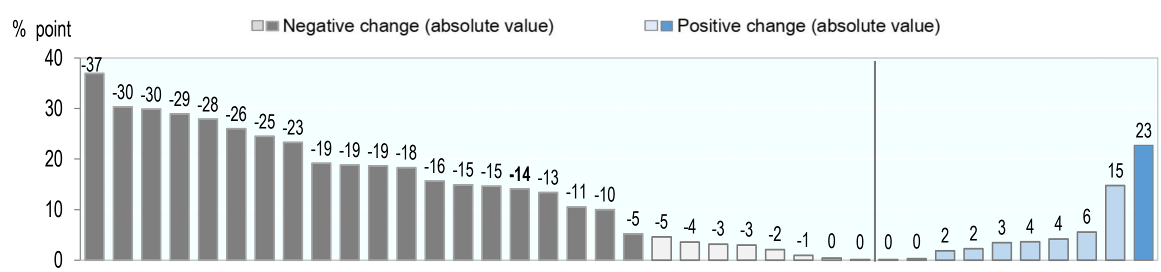
This activity has been reduced in most OECD countries, with 14% less of 4th grade students visiting at least once a month another library than their classroom library in 2016 compared to 2006. Combining the few positive changes to the numerous decreases, we reach an average absolute change of less than 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



% of students	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
2016	56	61	50	69	47	70	46	70	71	76	78	56	37	85	51	**70**	59	52	81
2011	49	72	60	76	52	85	43	m	80	84	82	54	41	85	m	**71**	53	51	89
2006	93	91	80	98	75	96	70	94	90	95	97	75	52	100	65	**84**	72	63	91

% of students	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)*
2016	92	92	91	64	90	m	94	93	40	93	43	72	80	69	65	72	m	m	69
2011	94	95	94	48	94	93	95	93	40	93	42	70	62	62	61	67	62	63	46
2006	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

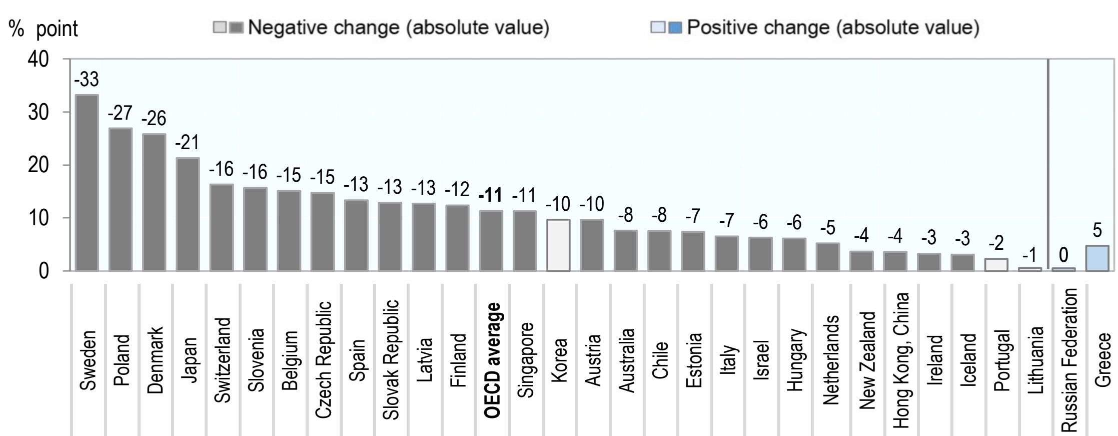
With the exception of Greece, all OECD systems covered experienced falling access to desktop computers in schools. Between 2009 and 2015, the share of 15 year old students with access to this resource at school decreased by 11 percentage points on average. The average absolute change was 12 percentage 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



% of students	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
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

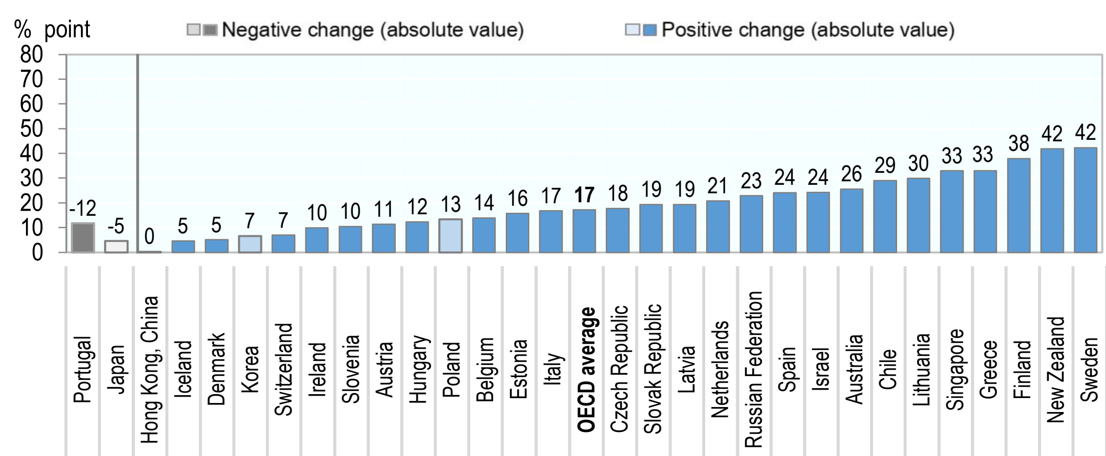
Among OECD countries, by and large, access to laptops and notebooks for students at school has scaled up. Between 2009 and 2015, the share of 15 year old students having access to these devices in their schools rose by 17 percentage points on average. The average absolute change amounted to 18 percentage 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



% of students		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
	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

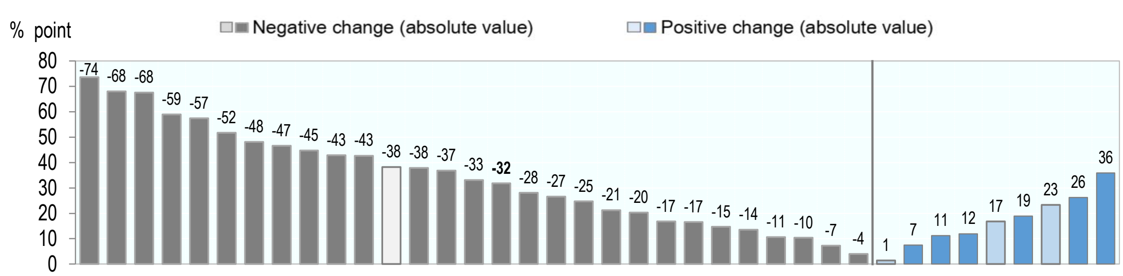
The share of students with computers available during 4th grade reading lessons has decreased by 32 percentage points on average in OECD education systems. The average absolute change was 35 percentage points, corresponding to a very large absolute effect size of 0.85. In 2016, 51% of primary students 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



% of students	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)
2016	17	25	19	21	35	7	30	45	54	55	25	m	55	53	14	**51**	70	30	66	77
2011	36	11	37	24	45	2	20	30	m	47	20	61	64	79	47	**50**	74	45	88	47
2006	90	93	86	80	93	58	78	92	99	98	68	99	93	90	m	**83**	98	57	91	98

% of students	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
2016	65	39	37	37	83	29	87	75	93	92	72	31	77	m	65	m	56	62
2011	73	56	m	38	73	39	85	82	86	87	64	20	65	39	46	37	29	40
2006	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

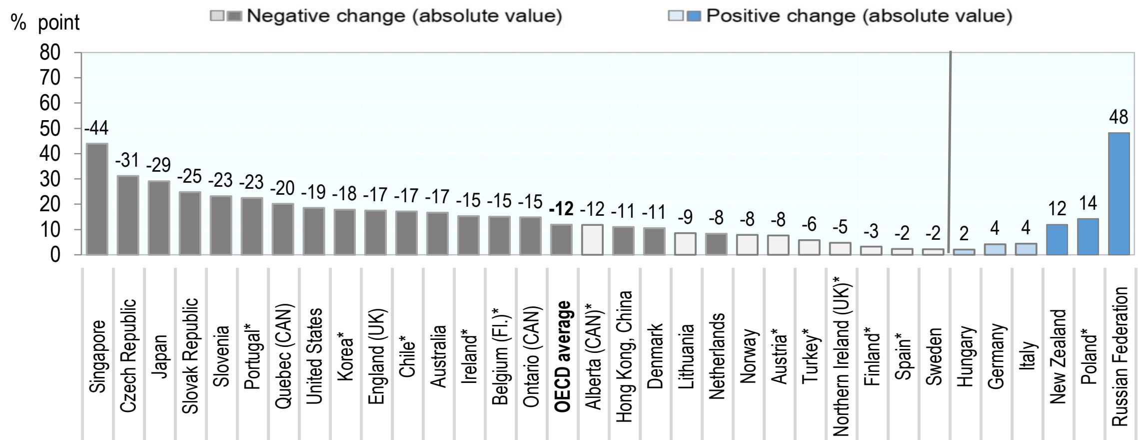
The availability of computers and tablets during 8th grade maths lessons decreased significantly in OECD countries (10 percentage points on average). The absolute change was 18 percentage points, corresponding to a moderate-high effect size of 0.37. At the OECD level, the share of 8th grade students 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



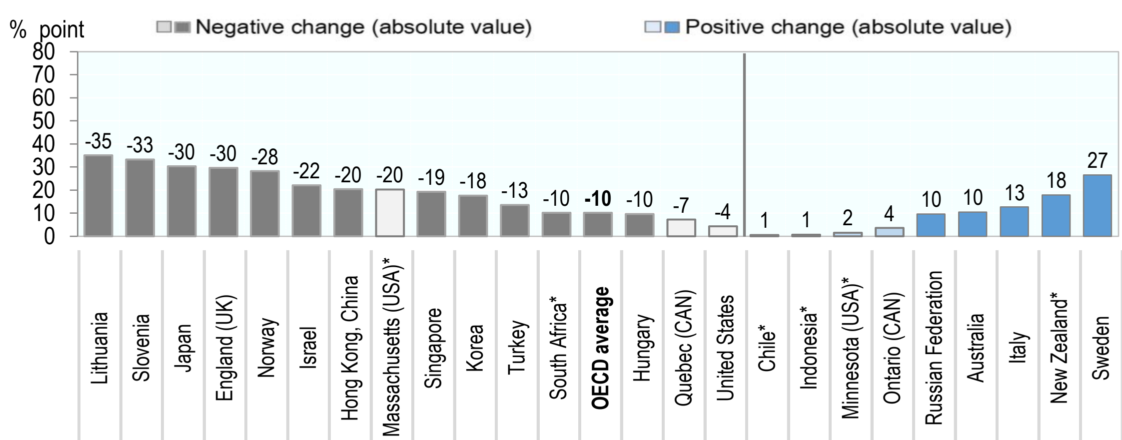
		Singapore	Czech Republic	Japan	Slovak Republic	Slovenia	Portugal*	Quebec (CAN)	United States	Korea*	England (UK)	Chile*	Australia	Ireland*	Belgium (Fl.)*	Ontario (CAN)	**OECD average**	Alberta (CAN)*	Hong Kong, China	Denmark	Lithuania	Netherlands	Norway	Austria*	Turkey*	Northern Ireland (UK)*	Finland*	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

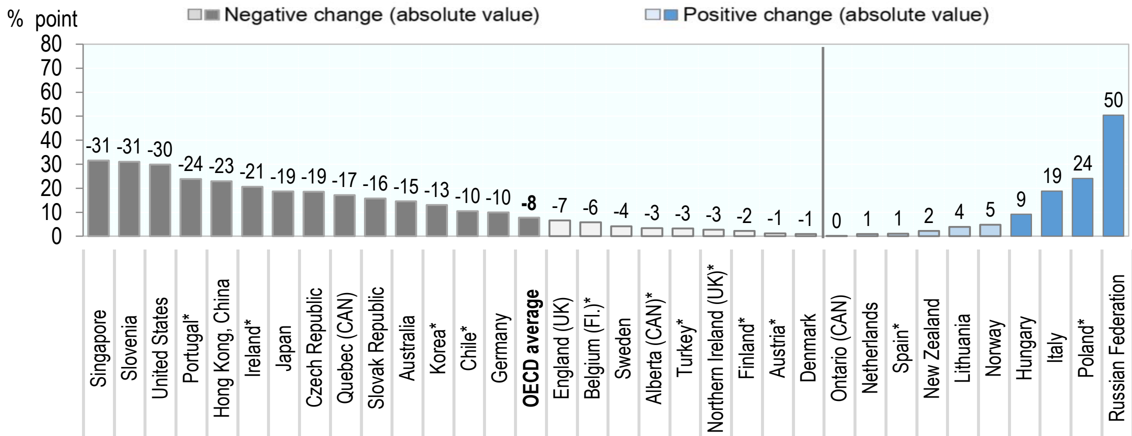
At the OECD level, contractions overcome expansions in the availability of computers and tablets in science lessons, leading to an average net decline of 12 percentage points in the share of 8th grade students. Regardless of its direction, the absolute change was 18 percentage points on average, corresponding 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



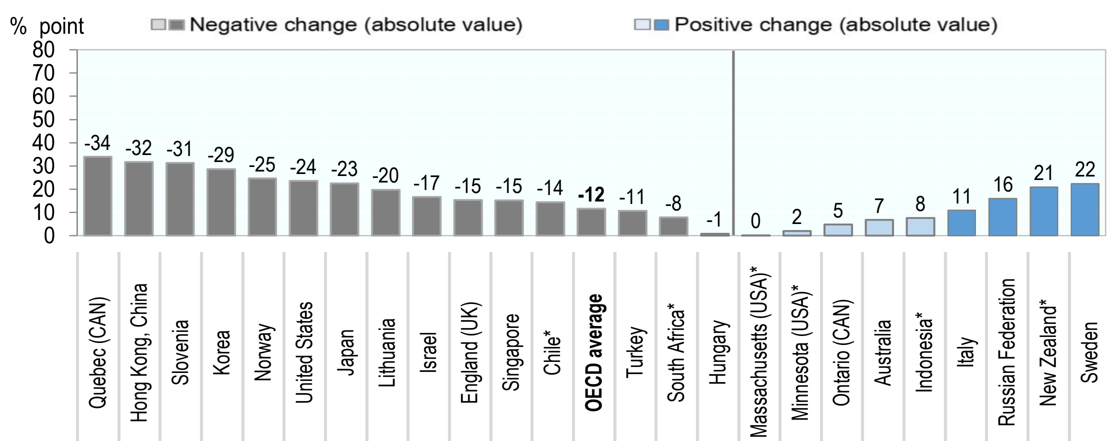
% of students	Singapore	Slovenia	United States	Portugal*	Hong Kong, China	Ireland*	Japan	Czech Republic	Quebec (CAN)	Slovak Republic	Australia	Korea*	Chile*	Germany	**OECD average**	England (UK)	Belgium (Fl.)*	Sweden	Alberta (CAN)*	Turkey*	Northern Ireland (UK)*	Finland*	Austria*	Denmark	Ontario (CAN)	Netherlands	Spain*	New Zealand	Lithuania	Norway	Hungary	Italy	Poland*	Russian Federation
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



% of students	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
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

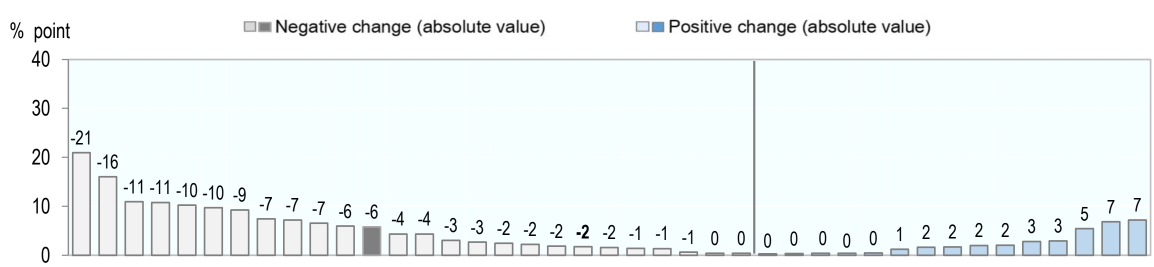
OECD systems present changes in both directions, although the average net change in the use of this practice was a slight decrease of about 2 percentage points. The absolute change amounted to 4 percentage points on average, corresponding to a small effect size of 0.17. Grouping students by ability into 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

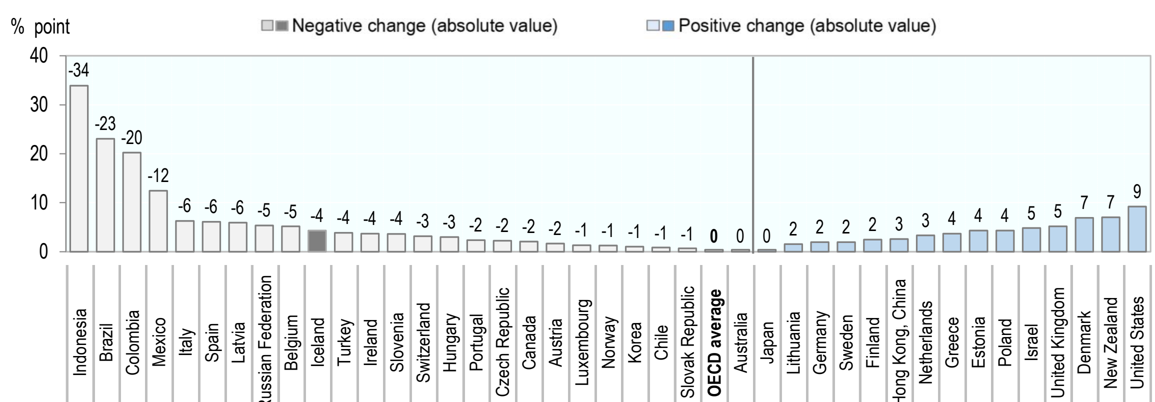
While contractions fully compensate expansions, on average the absolute change in the exposure of 15 year old students to this practice amounted to less than 4 percentage points for OECD countries, corresponding to a small effect size of 0.18. This practice is uncommon in the OECD countries covered: 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



% of students		Indonesia	Brazil	Colombia	Mexico	Italy	Spain	Latvia	Russian Federation	Belgium	Iceland	Turkey	Ireland	Slovenia	Switzerland	Hungary	Portugal	Czech Republic	Canada	Austria	Luxembourg	Norway	Korea	Chile	Slovak Republic	**OECD average**	Australia	Japan	Lithuania	Germany	Sweden	Finland	Hong Kong, China	Netherlands	Greece	Estonia	Poland	Israel	United Kingdom	Denmark	New Zealand	United States
	2015	18	10	9	14	18	5	2	20	5	0	1	1	15	3	1	3	0	7	5	2	6	5	2	2	**6**	5	0	3	6	6	5	5	9	4	6	5	6	7	13	12	12
	2006	52	33	30	26	25	11	8	26	10	4	5	5	19	6	4	6	2	9	7	4	7	6	3	3	**6**	5	0	2	4	4	2	2	6	0	2	1	1	1	6	5	3

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

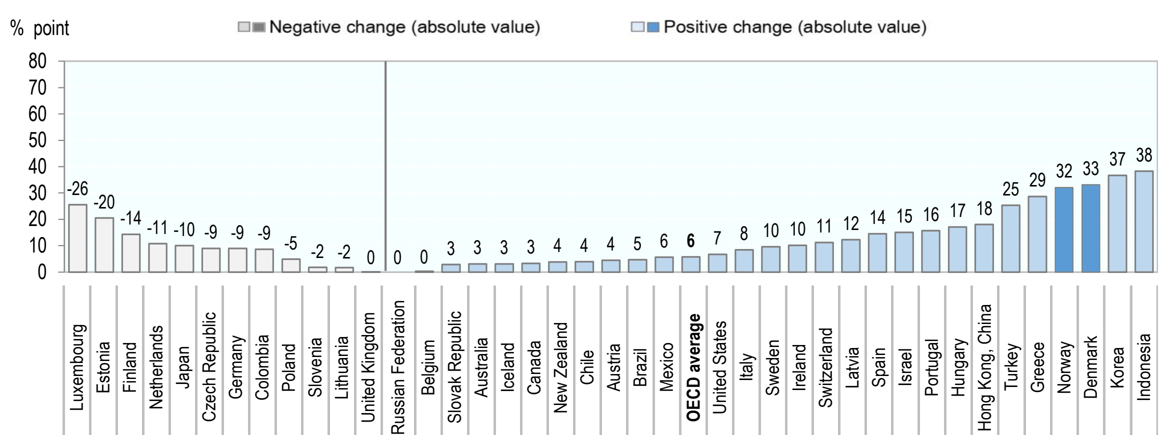
Most OECD countries show greater use of this practice, which recorded an average net increase of 6 percentage points between 2006 and 2015. The average absolute change was 12 percentage points, corresponding to a moderate effect size of 0.27. Within OECD countries, on average 68% were enrolled in a school 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	2015	2006
Luxembourg	51	77
Estonia	64	84
Finland	39	53
Netherlands	72	83
Japan	8	18
Czech Republic	50	59
Germany	38	47
Colombia	80	88
Poland	72	77
Slovenia	61	63
Lithuania	70	72
United Kingdom	84	84
Russian Federation	100	100
Belgium	55	55
Slovak Republic	76	74
Australia	91	88
Iceland	78	75
Canada	88	85
New Zealand	92	89
Chile	79	75
Austria	56	52
Brazil	88	83
Mexico	92	86
OECD average	**68**	**62**
United States	96	89
Italy	30	22
Sweden	80	70
Ireland	58	48
Switzerland	43	32
Latvia	64	52
Spain	78	64
Israel	83	68
Portugal	87	71
Hungary	47	30
Hong Kong, China	80	62
Turkey	98	73
Greece	77	48
Norway	74	42
Denmark	67	34
Korea	86	49
Indonesia	93	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

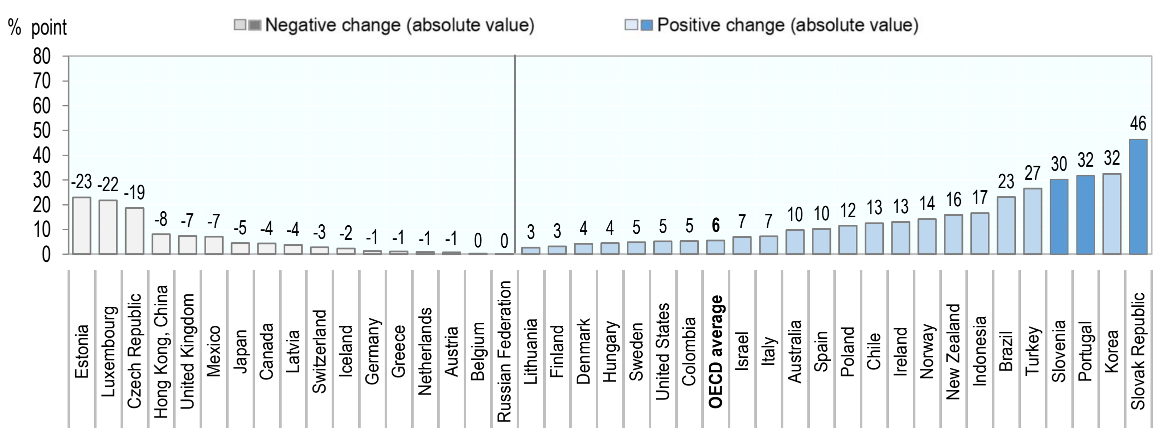
This practice has more spread than retracted in the past few years, leading to an average net increase of 6 percentage points in the share of students enrolled in schools posting achievement data publicly. Within the OECD area, the absolute change was 11 percentage points, corresponding to a moderate 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



% of students	2015	2006
Estonia	19	42
Luxembourg	35	57
Czech Republic	29	47
Hong Kong, China	46	54
United Kingdom	84	91
Mexico	19	26
Japan	2	6
Canada	47	52
Latvia	28	32
Switzerland	4	7
Iceland	25	27
Germany	11	12
Greece	21	22
Netherlands	77	78
Austria	5	6
Belgium	4	4
Russian Federation	72	72
Lithuania	23	20
Finland	7	4
Denmark	48	44
Hungary	33	28
Sweden	57	53
United States	83	78
Colombia	38	32
OECD average	**39**	**34**
Israel	35	28
Italy	34	26
Australia	66	56
Spain	21	11
Poland	53	42
Chile	50	38
Ireland	31	18
Norway	52	38
New Zealand	79	64
Indonesia	26	9
Brazil	41	18
Turkey	52	26
Slovenia	54	24
Portugal	59	28
Korea	51	19
Slovak Republic	70	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

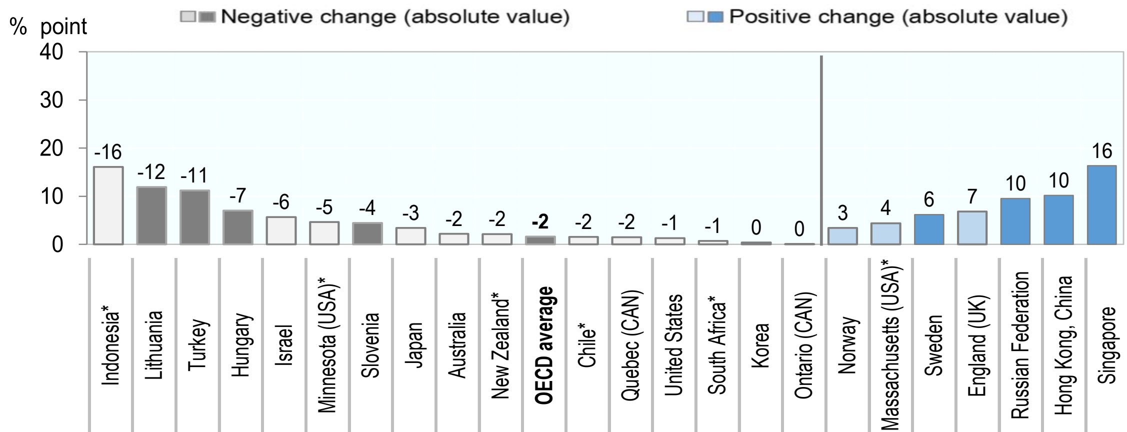
Between 2007 and 2015, this school practice decreased on average by 1 percentage point in OECD systems. The positive and negative variations together amounted to an average absolute change of 3 percentage points, corresponding to a small effect size of 0.15. In line with the situation for 8th grade maths 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



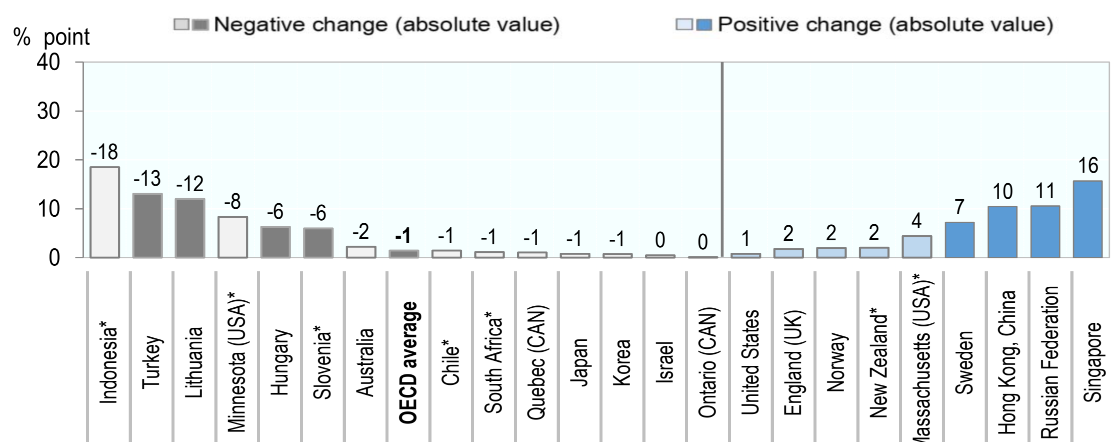
% of students		Indonesia*	Lithuania	Turkey	Hungary	Israel	Minnesota (USA)*	Slovenia	Japan	Australia	New Zealand*	**OECD average**	Chile*	Quebec (CAN)	United States	South Africa*	Korea	Ontario (CAN)	Norway	Massachusetts (USA)*	Sweden	England (UK)	Russian Federation	Hong Kong, China	Singapore
	2015	m	6	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



% of students		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
	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

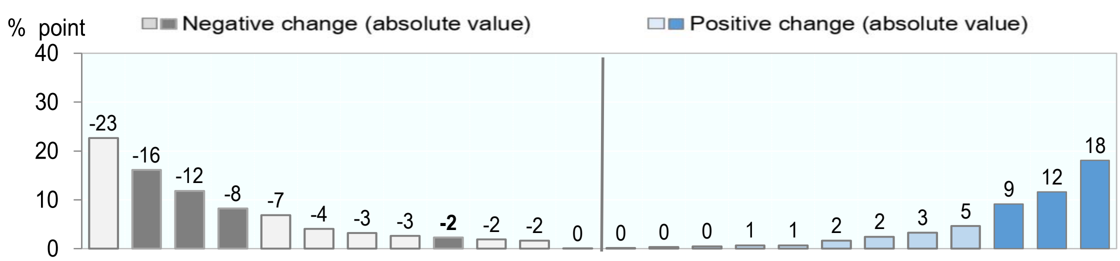
This school incentive policy to recruit and retain secondary teachers has more often lost than gained ground, resulting in an average net decrease of 2 percentage points for OECD systems. The average absolute change was 3 percentage points, corresponding to a small effect size of 0.13. At the OECD level, 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



% of students	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
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

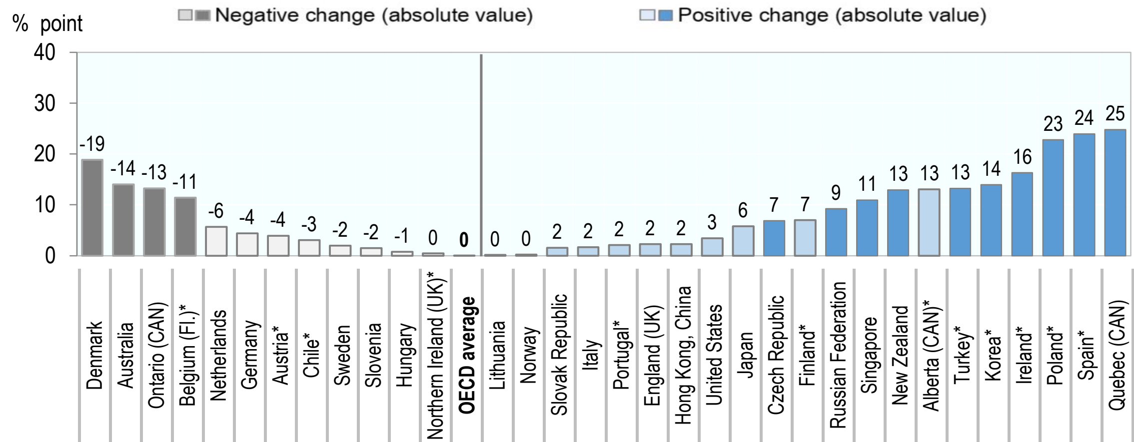
At the secondary level, most OECD countries covered have experienced an increase of parental involvement in students' education. Between 2007 and 2015, the percentage of 8th grade students enrolled in schools with high or very high parental involvement in school activities increased by 7 percentage points 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



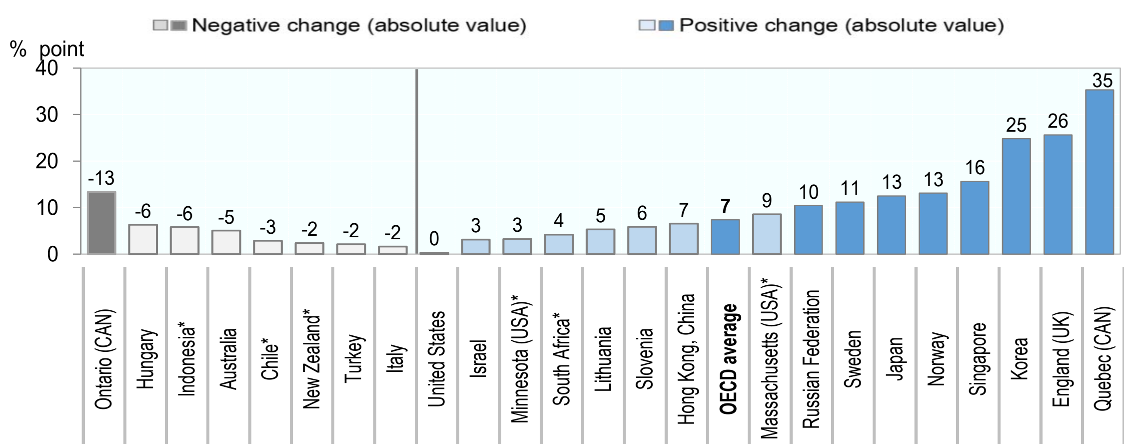
% of students	2015	2011	2007
Denmark	37	54	56
Australia	34	40	48
Ontario (CAN)	30	33	44
Belgium (Fl.)*	26	38	m
Netherlands	45	35	51
Germany	41	50	46
Austria*	m	44	48
Chile*	20	23	m
Sweden	24	17	26
Slovenia	15	15	16
Hungary	23	25	23
Northern Ireland (UK)*	46	47	m
OECD average	**36**	**32**	**36**
Lithuania	34	28	33
Norway	36	19	36
Slovak Republic	16	12	15
Italy	35	31	33
Portugal*	30	28	m
England (UK)	39	30	37
Hong Kong, China	52	43	50
United States	44	45	41
Japan	54	46	48
Czech Republic	14	4	7
Finland*	36	29	m
Russian Federation	35	24	25
Singapore	45	30	34
New Zealand	54	57	42
Alberta (CAN)*	m	58	45
Turkey*	29	16	m
Korea*	64	50	m
Ireland*	61	45	m
Poland*	47	24	m
Spain*	41	17	m
Quebec (CAN)	66	40	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	2015	2011	2007
Ontario (CAN)	27	27	41
Hungary	16	18	22
Indonesia*	m	29	34
Australia	24	24	29
Chile*	18	21	m
New Zealand*	25	27	m
Turkey	13	16	15
Italy	19	21	21
United States	31	33	31
Israel	26	26	22
Minnesota (USA)*	m	42	39
South Africa*	16	12	m
Lithuania	19	15	13
Slovenia	12	12	7
Hong Kong, China	24	23	17
OECD average	**30**	**23**	**22**
Massachusetts (USA)*	m	42	33
Russian Federation	20	13	9
Sweden	21	10	10
Japan	44	37	31
Norway	31	23	18
Singapore	30	21	15
Korea	62	43	37
England (UK)	43	23	17
Quebec (CAN)	51	14	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

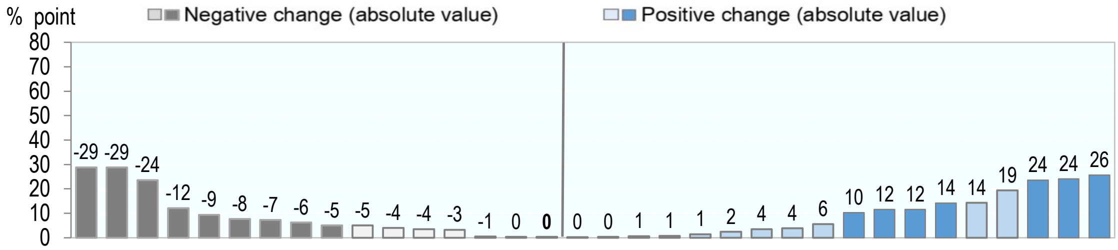
At the OECD level, negative changes overshadow positive ones, leading to an average decrease of 5 percentage points in the share of 8th grade students with maths teachers participating in content-related professional development. Increases and decreases together lead to an average absolute change of 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



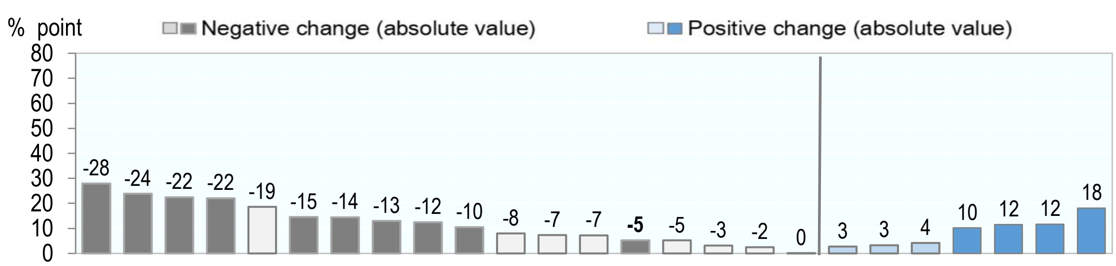
% of students	2015	2011	2007
Russian Federation	37	58	66
Hungary	14	28	43
Slovenia	20	32	43
Portugal*	46	58	m
New Zealand	74	72	83
Norway	17	25	25
Slovak Republic	5	11	13
Italy	16	28	22
Turkey*	5	10	m
Northern Ireland (UK)*	50	55	m
Lithuania	13	33	17
Finland*	6	9	m
Chile*	44	48	m
Japan	47	52	48
Denmark	22	29	23
OECD average	**41**	**42**	**41**
Germany	44	55	44
Korea*	32	32	m
Australia	70	67	69
Czech Republic	21	16	20
Ontario (CAN)	69	52	68
Belgium (Fl.)*	14	12	m
England (UK)	64	54	60
Hong Kong, China	78	66	74
Singapore	64	68	59
United States	71	67	61
Netherlands	22	21	11
Spain*	27	15	m
Ireland*	46	32	m
Alberta (CAN)*	m	71	57
Austria*	m	75	56
Poland*	85	61	m
Sweden	56	53	32
Quebec (CAN)	62	58	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



% of students	2015	2011	2007
Turkey	19	30	47
Lithuania	62	76	85
Hungary	28	34	51
Norway	17	21	39
Massachusetts (USA)*	m	76	95
Hong Kong, China	63	69	78
Chile*	48	63	m
Singapore	68	67	81
Russian Federation	71	68	84
Slovenia	60	61	70
Ontario (CAN)	74	64	82
England (UK)	59	60	66
Quebec (CAN)	49	53	57
OECD average	**52**	**50**	**57**
Japan	69	65	74
Australia	65	53	68
United States	78	73	81
Indonesia*	m	71	71
New Zealand*	66	64	m
Korea	51	51	48
Minnesota (USA)*	m	82	78
Italy	26	23	16
Israel	70	80	58
South Africa*	84	73	m
Sweden	58	36	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

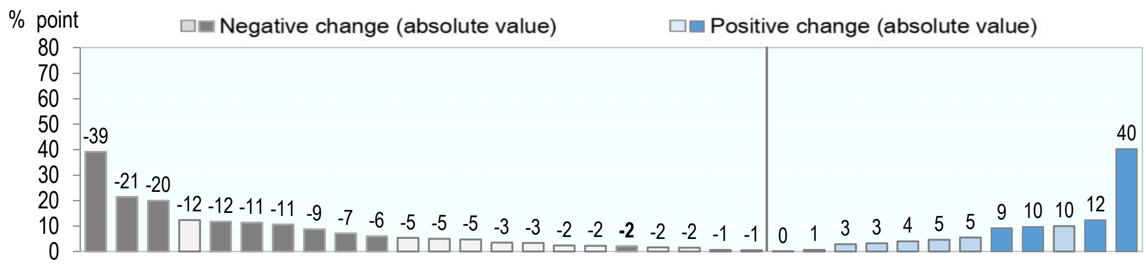
This practice has mainly decreased across the OECD area. The average net decrease amounted to 10 percentage points, with 49% of 8th grade science students instructed by teachers engaged in professional development about science content in 2015 against 59% in 2007. The absolute change amounted to 11 percentage, 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



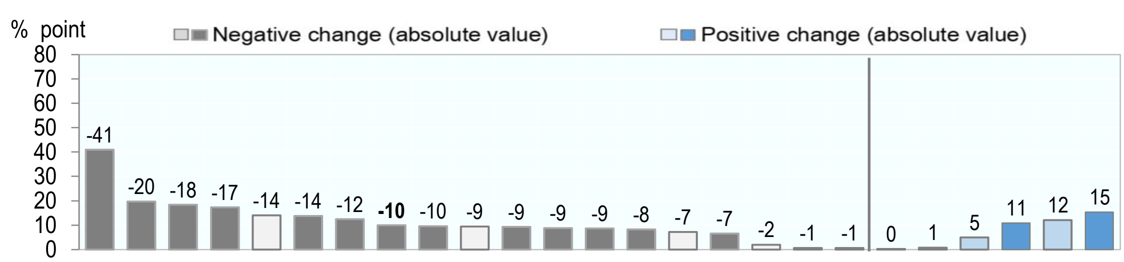
		Slovenia	Russian Federation	Hungary	Alberta (CAN)*	Portugal*	Hong Kong, China	Slovak Republic	Finland*	Lithuania	Turkey*	Denmark	Ireland*	Italy	Korea*	Ontario (CAN)	Belgium (Fl.)*	Spain*	**OECD average**	Chile*	Netherlands	Czech Republic	United States	Germany	Northern Ireland (UK)*	Quebec (CAN)	Singapore	Norway	Japan	England (UK)	Australia	Sweden	Austria*	New Zealand	Poland*
% 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



		Turkey	Ontario (CAN)	Norway	Hungary	Minnesota (USA)*	Lithuania	Quebec (CAN)	**OECD average**	Hong Kong, China	Massachusetts (USA)*	England (UK)	Sweden	Slovenia	Singapore	Chile*	United States	Israel	Korea	New Zealand*	Italy	Japan	Australia	Russian Federation	Indonesia*	South Africa*
% 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

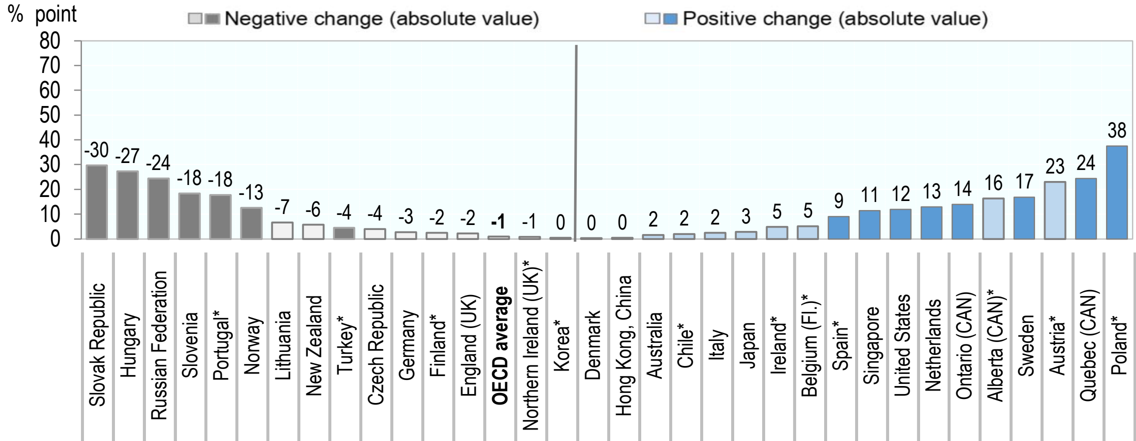
On average, this teacher practice saw a small net decline of 3 percentage points across the OECD area. Positive and negative changes together led to an absolute change of 12 percentage points, corresponding to a moderate-low effect size of 0.25. In 2015, slightly more than half of the 8th grade students 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



% of students	Slovak Republic	Hungary	Russian Federation	Slovenia	Portugal*	Norway	Lithuania	New Zealand	Turkey*	Czech Republic	Germany	Finland*	England (UK)	**OECD average**	Northern Ireland (UK)*	Korea*
2015	11	20	43	17	37	17	15	70	6	31	34	17	68	**43**	63	40
2011	20	45	59	23	54	30	31	67	11	26	43	19	72	**46**	64	40
2007	41	47	67	35	m	30	21	76	m	35	36	m	70	**44**	m	m

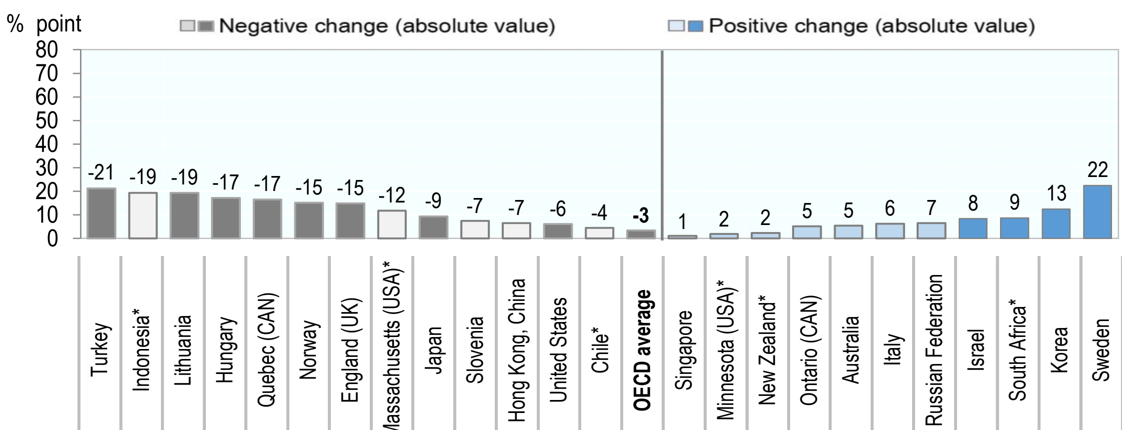
% of students	Denmark	Hong Kong, China	Australia	Chile*	Italy	Japan	Ireland*	Belgium (Fl.)*	Spain*	Singapore	United States	Netherlands	Ontario (CAN)	Alberta (CAN)*	Sweden	Austria*	Quebec (CAN)	Poland*
2015	23	82	62	33	28	57	37	16	34	81	62	28	81	m	58	m	63	69
2011	33	81	65	31	38	59	32	11	25	82	54	27	60	70	60	55	55	31
2007	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



% of students	Turkey	Indonesia*	Lithuania	Hungary	Quebec (CAN)	Norway	England (UK)	Massachusetts (USA)*	Japan	Slovenia	Hong Kong, China	United States	Chile*
2015	27	m	61	36	58	24	65	m	68	57	64	70	41
2011	41	50	60	67	46	27	73	80	70	59	67	73	46
2007	48	69	81	53	74	39	80	91	78	65	71	76	m

% of students	**OECD average**	Singapore	Minnesota (USA)*	New Zealand*	Ontario (CAN)	Australia	Italy	Russian Federation	Israel	South Africa*	Korea	Sweden
2015	**57**	90	m	63	79	66	40	80	71	58	63	70
2011	**59**	79	77	60	71	65	45	69	77	50	61	46
2007	**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

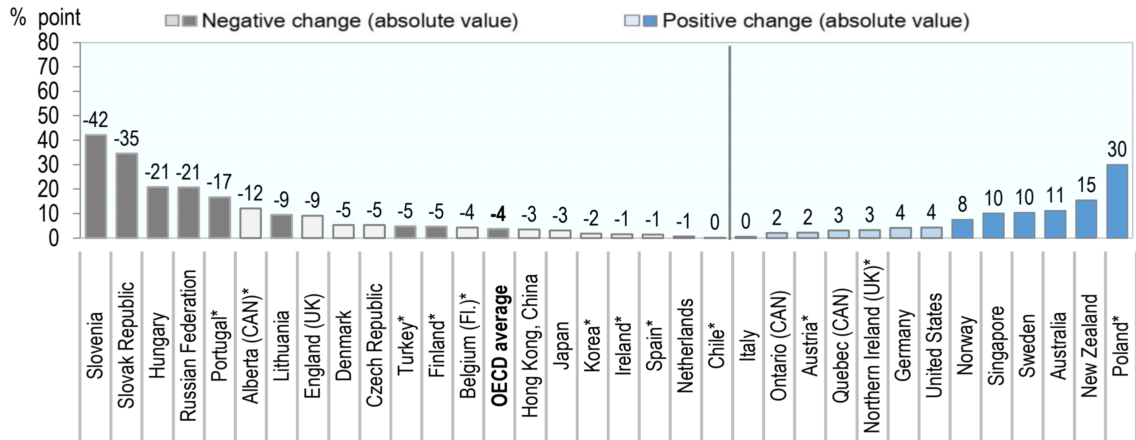
At the OECD level, increases and reductions in this teacher professional development practice let do a negative net average change of 3 percentage points. Counting changes in both directions, the absolute change amounted to 11 percentage points, corresponding to a moderate-low effect size of 0.24. While 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



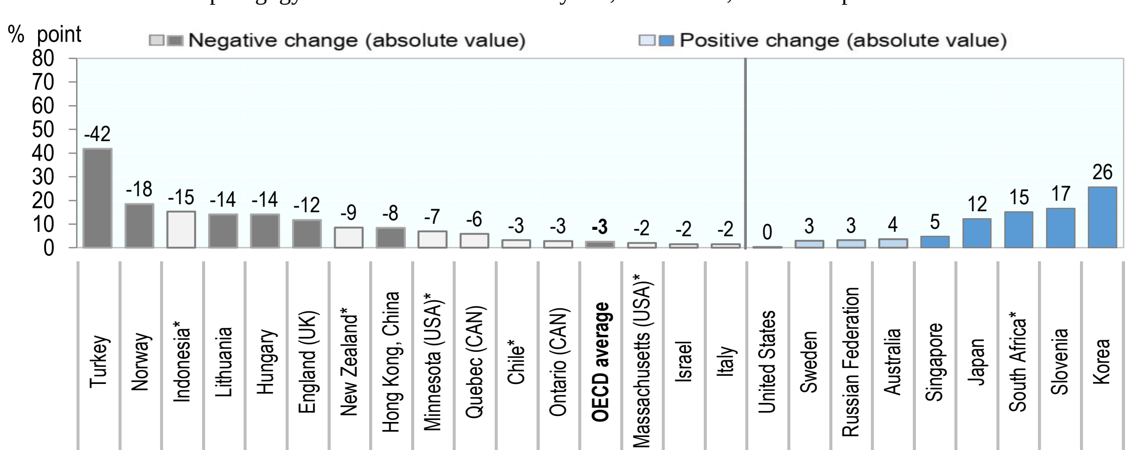
% of students		Slovenia	Slovak Republic	Hungary	Russian Federation	Portugal*	Alberta (CAN)*	Lithuania	England (UK)	Denmark	Czech Republic	Turkey*	Finland*	Belgium (Fl.)*	**OECD average**	Hong Kong, China	Japan	Korea*	Ireland*	Spain*	Netherlands	Chile*	Italy	Ontario (CAN)	Austria*	Quebec (CAN)	Northern Ireland (UK)*	Germany	United States	Norway	Singapore	Sweden	Australia	New Zealand	Poland*
	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		Turkey	Norway	Indonesia*	Lithuania	Hungary	England (UK)	New Zealand*	Hong Kong, China	Minnesota (USA)*	Quebec (CAN)	Chile*	Ontario (CAN)	**OECD average**	Massachusetts (USA)*	Israel	Italy	United States	Sweden	Russian Federation	Australia	Singapore	Japan	South Africa*	Slovenia	Korea
	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

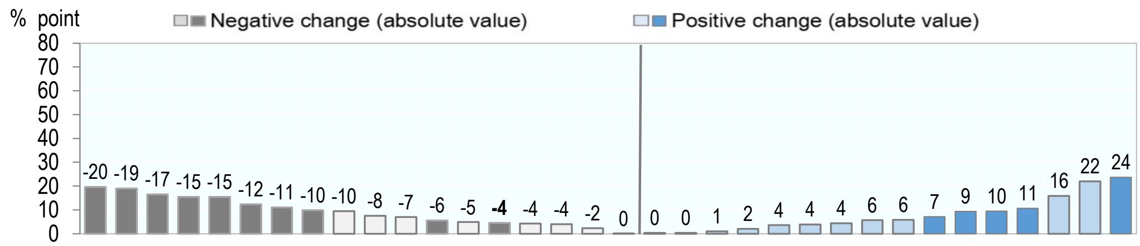
In most OECD countries, less 8th grade teachers have participated in training programmes on mathematics curriculum. On average, the percentage of 8th grade students taught by teachers who recently received science curriculum training decreased by 11 percentage points between 2007 and 2015. The absolute 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



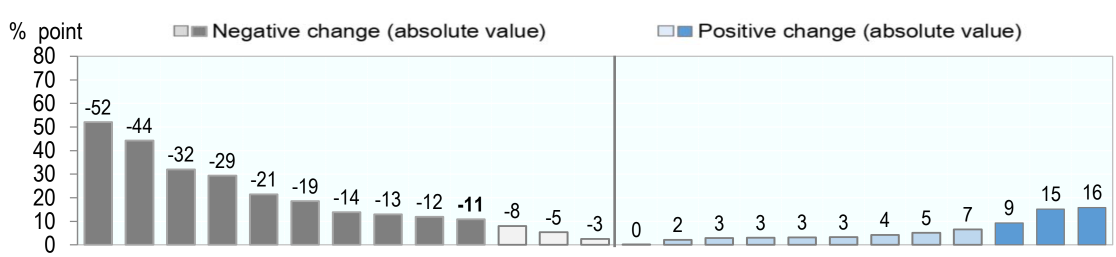
% of students	Slovak Republic	Ontario (CAN)	Hong Kong, China	New Zealand	Norway	Portugal*	Czech Republic	Hungary	Quebec (CAN)	Slovenia	Northern Ireland (UK)*	Turkey*	Australia	**OECD average**	Lithuania	Germany	Korea*	Russian Federation	Japan	Finland*	Denmark	Belgium (Fl.)*	Chile*	Ireland*	Spain*	Italy	England (UK)	United States	Netherlands	Singapore	Sweden	Alberta (CAN)*	Austria*	Poland*
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



% of students	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*
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

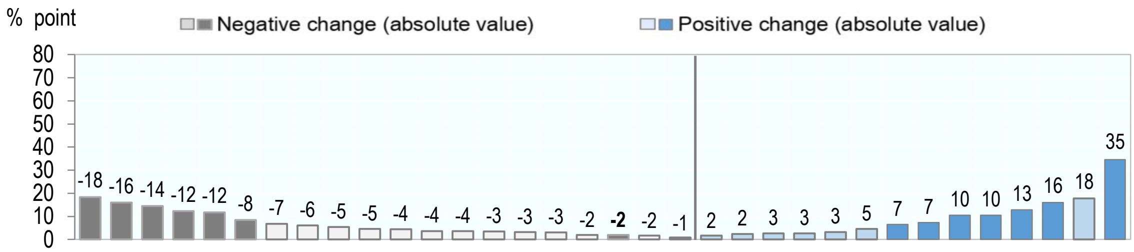
In most countries, 8th grade teacher participated less in science curriculum training than they used to. OECD systems experienced a decline by 9 percentage points on average between 2007 and 2015. The average absolute change of 16 percentage points corresponds to a moderate-high effect size of 0.36. 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.



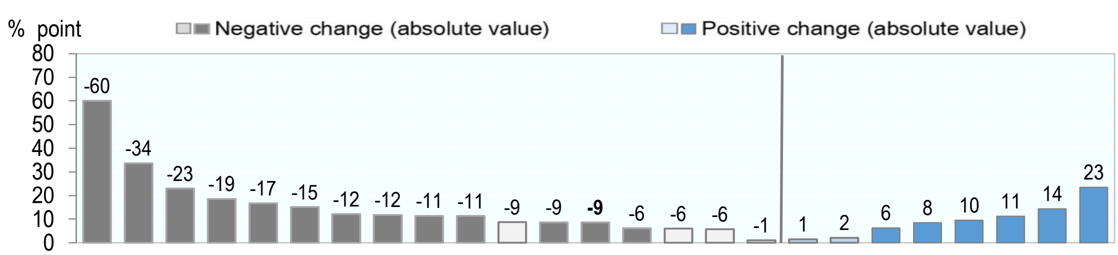
% of students	Slovak Republic	Portugal*	Slovenia	Czech Republic	Ontario (CAN)	Hungary	Chile*	Alberta (CAN)*	Norway	Korea*	Ireland*	Germany	Denmark	Northern Ireland (UK)*	Japan	Turkey*	Hong Kong, China	**OECD average**	United States	Quebec (CAN)	Italy	Spain*	Netherlands	Finland*	Belgium (Fl.)*	Russian Federation	Lithuania	New Zealand	Sweden	Singapore	England (UK)	Australia	Austria*	Poland*
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



% of students	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
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

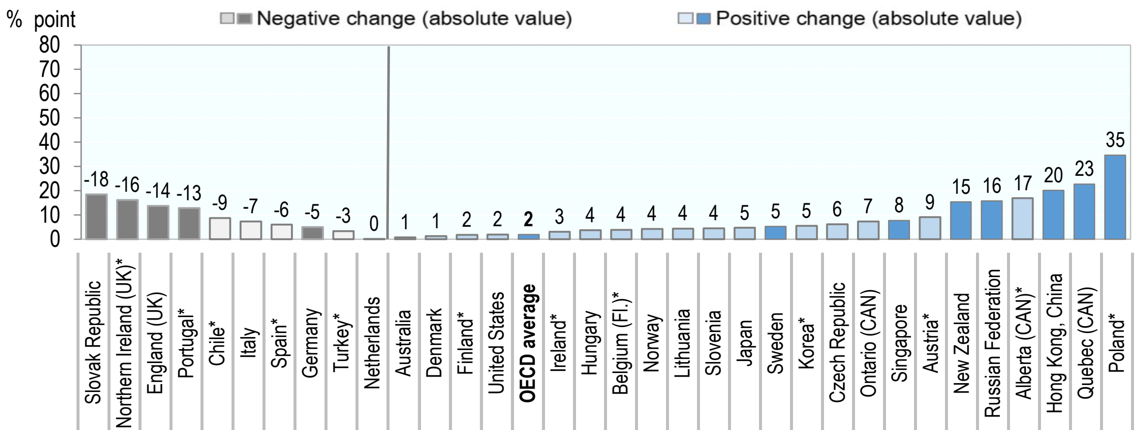
Between 2007 and 2015, the share of 8th grade students instructed by teachers having participated in a training to integrate ICT to their maths teaching increased by 7 percentage points on average in OECD countries. The absolute change was 11 percentage points, corresponding to a moderate effect size 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



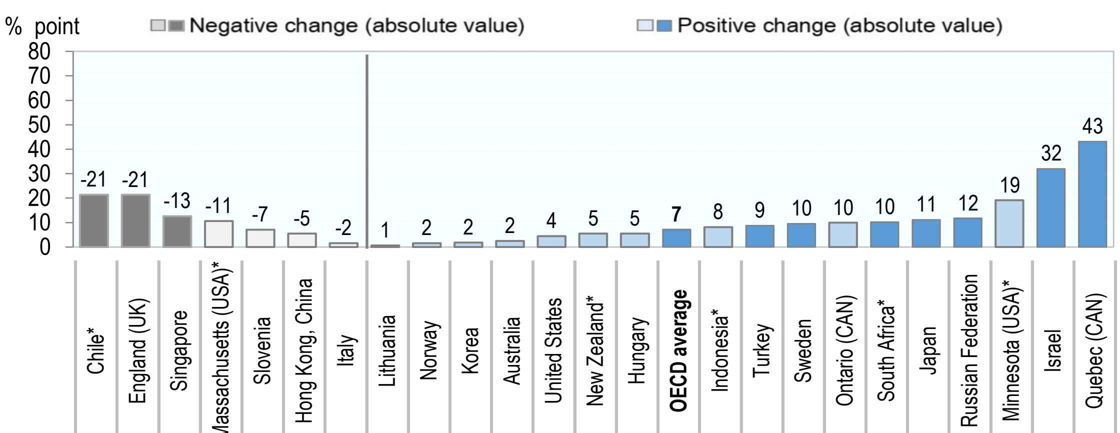
% of students	Slovak Republic	Northern Ireland (UK)*	England (UK)	Portugal*	Chile*	Italy	Spain*	Germany	Turkey*	Netherlands	Australia	Denmark	Finland*	United States	**OECD average**	Ireland*	Hungary	Belgium (Fl.)*	Norway	Lithuania	Slovenia	Japan	Sweden	Korea*	Czech Republic	Ontario (CAN)	Singapore	Austria*	New Zealand	Russian Federation	Alberta (CAN)*	Hong Kong, China	Quebec (CAN)	Poland*
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



% of students	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)
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

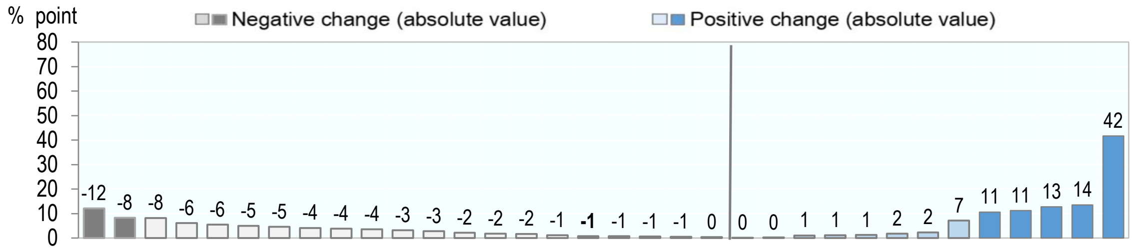
Both increases and reductions in this practice took place across OECD systems, leading to a positive net change of 4 percentage points. Regardless of the direction, the absolute change was 10 percentage points on average, corresponding to a moderate-low effect size of 0.23. In 2015, there were large 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



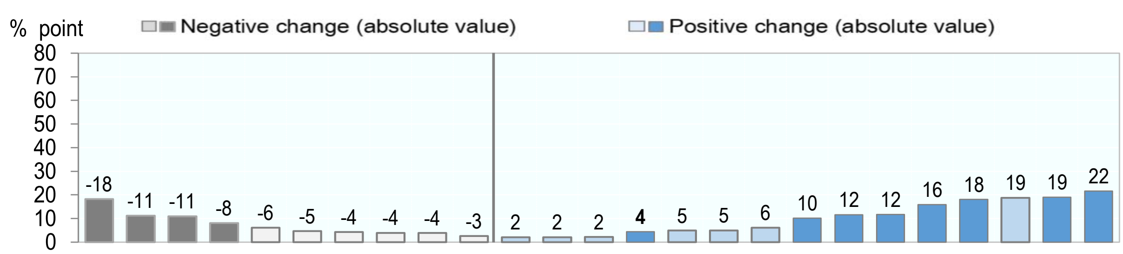
% of students	England (UK)	Portugal*	Chile*	Slovak Republic	Alberta (CAN)*	Spain*	Ireland*	Italy	Australia	Hungary	Austria*	Japan	Netherlands	Norway	Slovenia	Singapore	**OECD average**	Hong Kong, China	Turkey*	Germany	Belgium (Fl.)*	United States	Ontario (CAN)	Sweden	New Zealand	Denmark	Northern Ireland (UK)*	Finland*	Korea*	Quebec (CAN)	Czech Republic	Russian Federation	Lithuania	Poland*
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



% of students	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
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

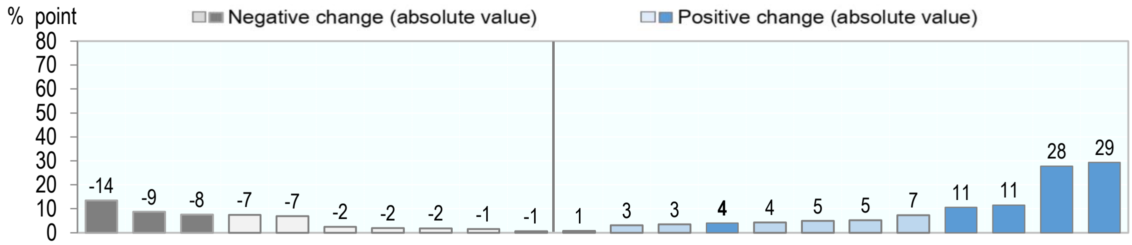
OECD countries experienced both expansions and contractions in this practice, leading to a slightly positive average net change of 2 percentage points. The absolute change in this practice was 8 percentage points, corresponding to a small effect size of 0.19. Like in primary education, Ontario (Canada) 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



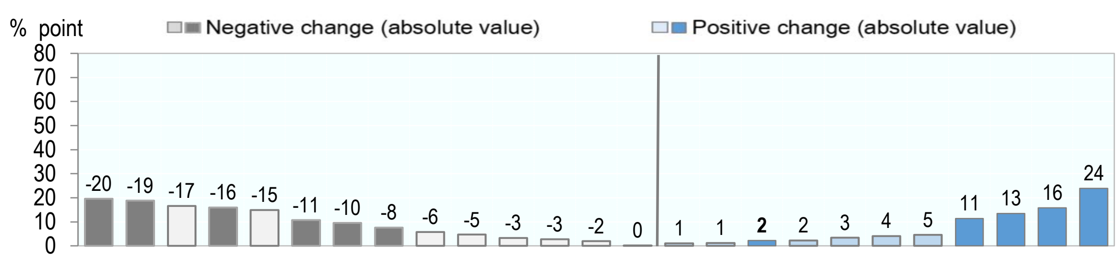
% of students		Slovak Republic	Hungary	Singapore	Russian Federation	England (UK)	Czech Republic	Norway	Italy	Australia	Hong Kong, China	Denmark	Lithuania	Netherlands	**OECD average**	Germany	Japan	New Zealand	Quebec (CAN)	United States	Slovenia	Ontario (CAN)	Sweden
	2015	17	17	58	51	52	29	16	20	50	71	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



% of students		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
	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

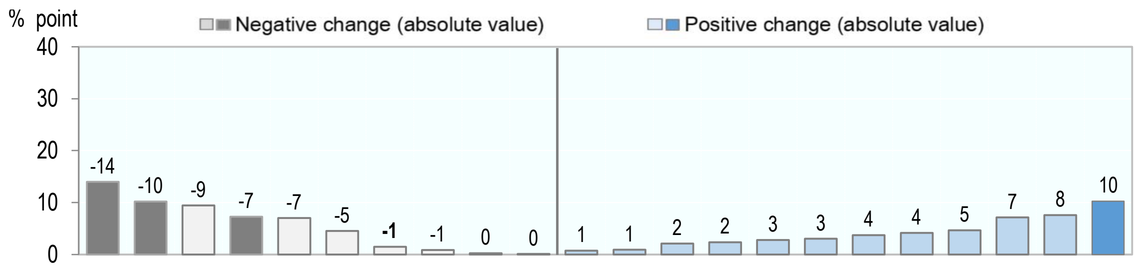
While positive and negative changes have nullified each other across OECD countries surveyed, there has been an average absolute change of 7 percentage points in the share of 8th grade students with science teachers participating in this kind of professional development. This corresponds to an effect 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



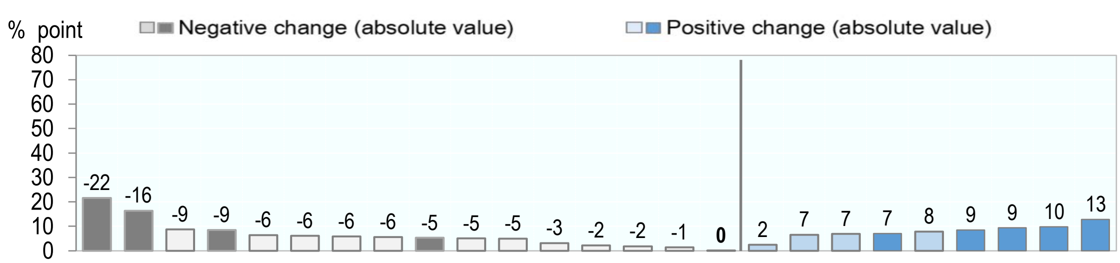
% of students		Hungary	New Zealand	England (UK)	Czech Republic	Slovak Republic	Australia	**OECD average**	Sweden	Italy	Japan	Germany	Slovenia	Quebec (CAN)	Lithuania	Norway	Denmark	Netherlands	Singapore	United States	Hong Kong, China	Russian Federation	Ontario (CAN)
	2015	12	37	33	17	21	32	**21**	12	12	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



% of students		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
	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

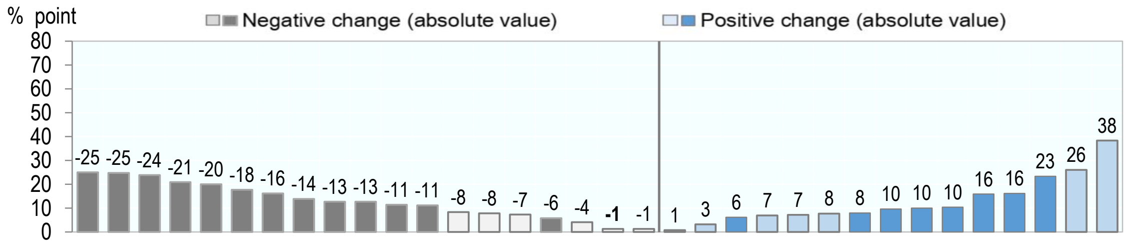
Mathematics teachers in the 8th grade across OECD education systems covered have more often reduced than increased their participation in assessment training, leading to an average net decrease of 8 percentage points. The absolute change accounted to 13 percentage points, with a moderate effect size 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



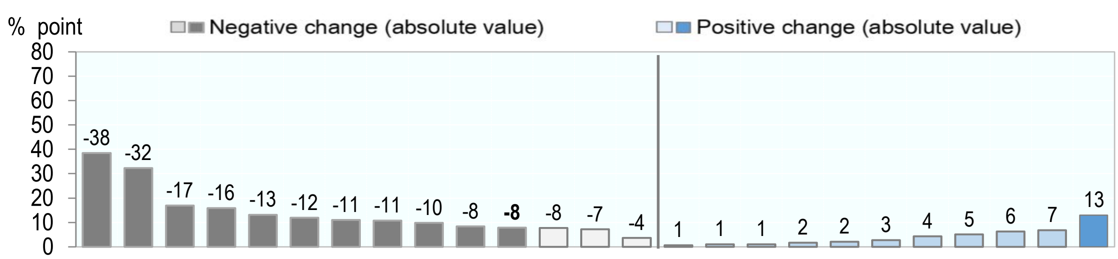
% of students	Finland*	Slovenia	Belgium (Fl.)*	Chile*	Poland*	Portugal*	Spain*	Hungary	Slovak Republic	Hong Kong, China	Czech Republic	Turkey*	Ireland*	Australia	Germany	New Zealand	Japan	**OECD average**	Italy	United States	Ontario (CAN)	Denmark	England (UK)	Korea*	Quebec (CAN)	Norway	Netherlands	Singapore	Russian Federation	Northern Ireland (UK)*	Lithuania	Sweden	Alberta (CAN)*	Austria*
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	Quebec (CAN)	Slovenia	Japan	England (UK)	Hong Kong, China	Hungary	Chile*	Australia	Singapore	United States	**OECD average**	Ontario (CAN)	Russian Federation	Massachusetts (USA)*	Norway	Israel	New Zealand*	Minnesota (USA)*	Indonesia*	Lithuania	South Africa*	Turkey	Sweden	Italy	Korea
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

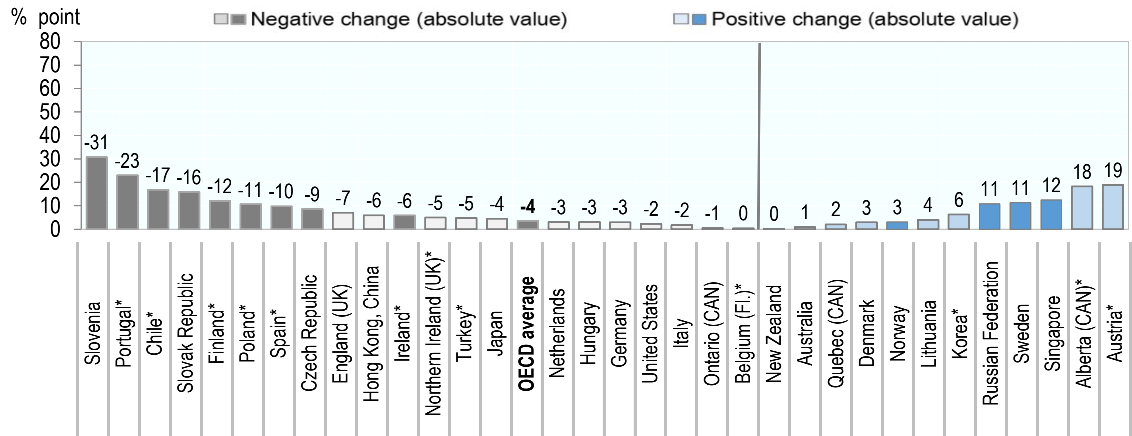
At the secondary level, most countries saw a decrease in this teacher practice. In 2015, 33% of 8th grade students had their science teachers participating in a programme on science assessment, against 43% in 2007. Positive and negative changes taken together lead to an absolute change of 13 percentage 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



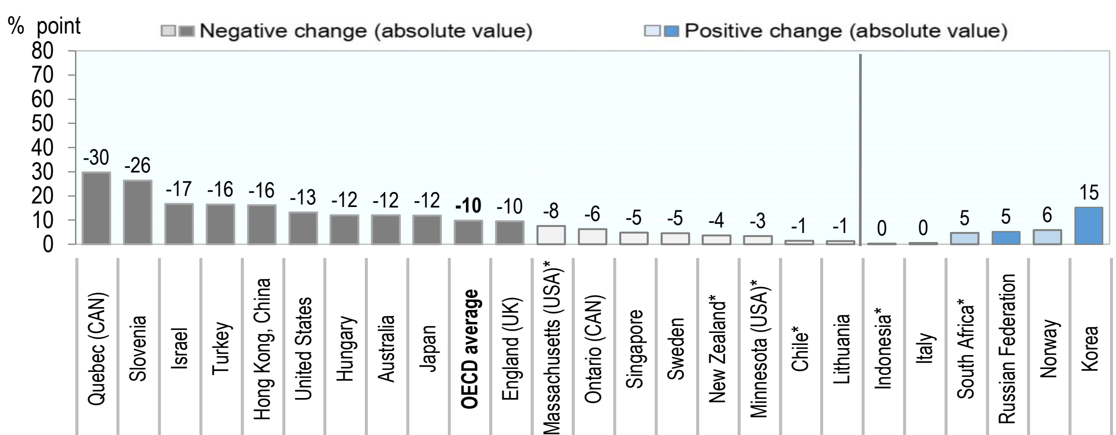
% of students		Slovenia	Portugal*	Chile*	Slovak Republic	Finland*	Poland*	Spain*	Czech Republic	England (UK)	Hong Kong, China	Ireland*	Northern Ireland (UK)*	Turkey*	Japan	**OECD average**	Netherlands	Hungary	Germany	United States	Italy	Ontario (CAN)	Belgium (Fl.)*	New Zealand	Australia	Quebec (CAN)	Denmark	Norway	Lithuania	Korea*	Russian Federation	Sweden	Singapore	Alberta (CAN)*	Austria*
	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



% of students		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
	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

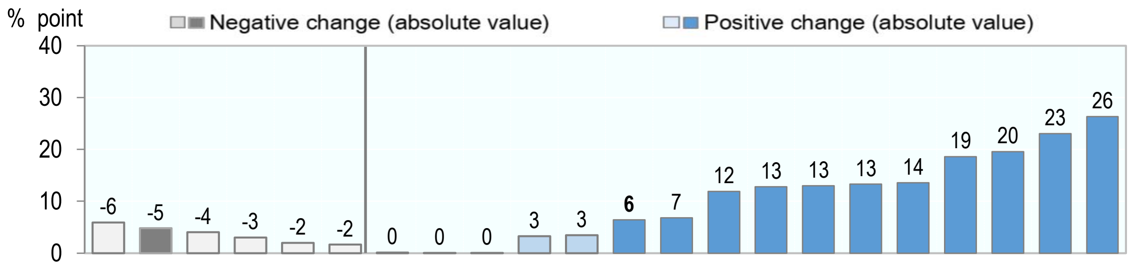
More countries have experienced an increase in this practice than a decrease. The average net increase for the covered OECD systems stood at 4 percentage points. Taking increases and decreases into account, the absolute average change was 9 percentage points, corresponding to a moderate-low effect size 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



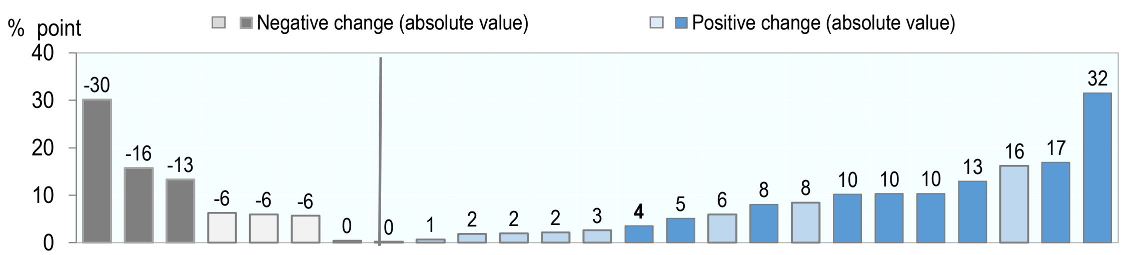
% of students		Norway	Lithuania	Quebec (CAN)	Hong Kong, China	Ontario (CAN)	New Zealand	Italy	Australia	Germany	Czech Republic	United States	**OECD average**	Slovak Republic	Sweden	Slovenia	England (UK)	Denmark	Hungary	Netherlands	Russian Federation	Singapore	Japan
	2015	20	4	14	42	10	10	9	13	4	4	22	**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



% of students		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
	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

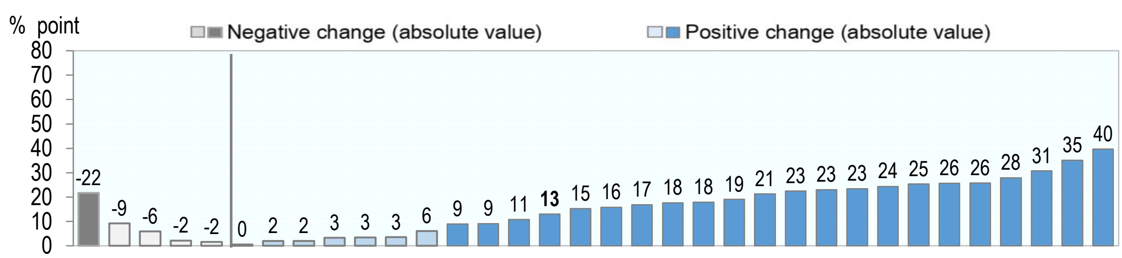
At the OECD level, this practice increased by 13 percentage points on average. Increases and decreases taken together yielded an average absolute change of 15 percentage points, corresponding to a moderate effect size of 0.33. The practice is common across OECD systems. In 2015, 66% of students had teachers 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



% of students	Norway	Alberta (CAN)*	Austria*	Chile*	Turkey*	Japan	Sweden	Italy	Belgium (Fl.)*	Ontario (CAN)	Finland*	Denmark	New Zealand	Portugal*	United States	**OECD average**	Czech Republic
2015	48	m	m	60	59	47	60	67	45	62	55	47	76	76	75	**66**	49
2011	60	53	33	62	60	55	52	49	41	51	51	32	67	67	66	**52**	35
2007	70	62	39	m	m	46	58	65	m	59	m	40	67	m	65	**53**	33

% of students	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
2015	71	67	63	72	61	74	82	69	80	71	51	72	82	84	76	74	64
2011	59	50	58	54	46	61	60	46	62	57	26	46	61	40	46	35	27
2007	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

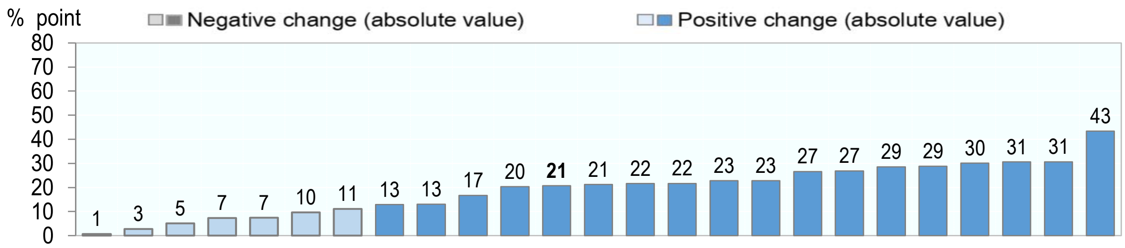
At the secondary level, the use of this practice among science teachers also increased in all OECD countries between 2007 and 2015. On average across the OECD region, 60% of secondary students had teachers frequently discussing the teaching of a topic with a colleague in 2015, against 39% in 2007. The 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



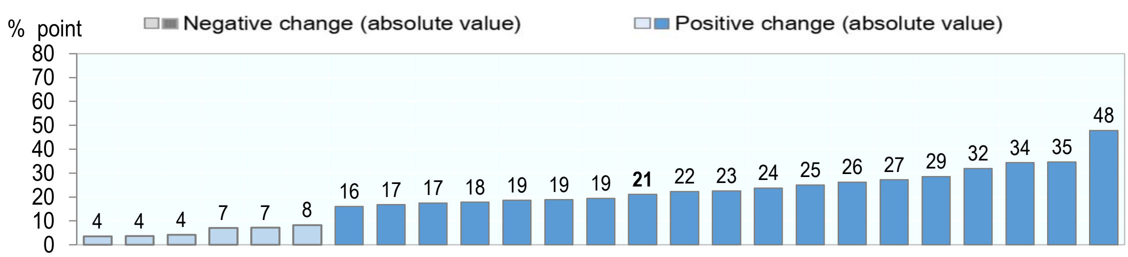
		Japan	Quebec (CAN)	Massachusetts (USA)*	Minnesota (USA)*	Ontario (CAN)	Chile*	Indonesia*	Turkey	England (UK)	Hong Kong, China	Slovenia	**OECD average**	South Africa*	United States	Lithuania	New Zealand*	Norway	Singapore	Sweden	Korea	Hungary	Italy	Australia	Russian Federation	Israel
% of students	2015	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

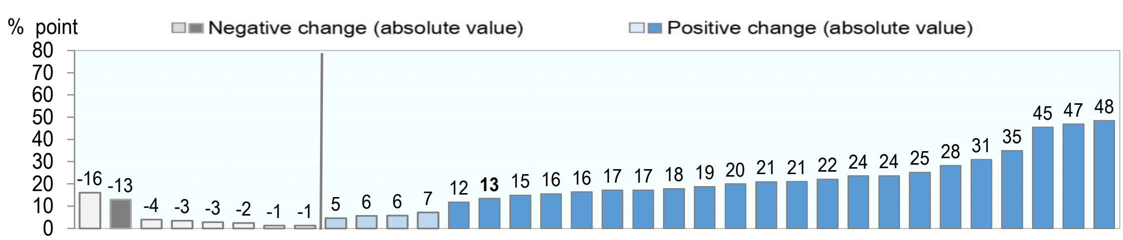
In primary education, this practice mainly expanded. With 63% of 4th grade students having teachers frequently collaborating with other teachers in planning and preparing instructional material in 2015, the OECD average has increased by 13 percentage points since 2007. The absolute change, mirroring 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	Alberta (CAN)*	Norway	Austria*	Ontario (CAN)	Chile*	Italy	Sweden	Belgium (Fl.)*	Denmark	Slovak Republic	Turkey*	Hungary	United States	**OECD average**	Australia	Finland*	Slovenia	Japan	Korea*	Singapore	Poland*	Russian Federation	England (UK)	New Zealand	Lithuania	Czech Republic	Northern Ireland (UK)*	Spain*	Netherlands	Quebec (CAN)	Ireland*	Germany	Hong Kong, China	Portugal*
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

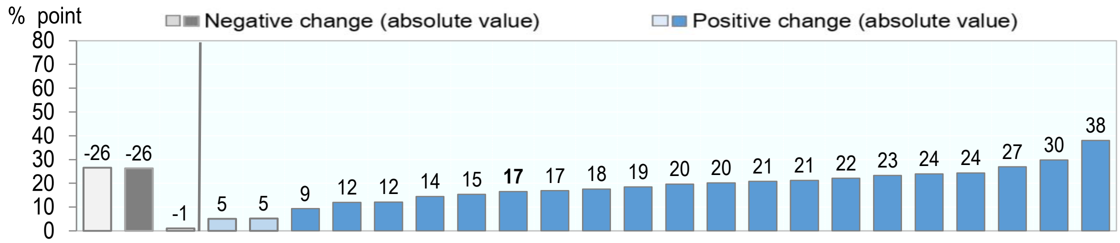
All OECD systems saw an increase in this form of teacher collaboration in 8th grade science. The share of secondary students with teachers frequently collaborating with colleagues to prepare and plan their science instructional materials rose by 19 percentage points between 2007 and 2015. The absolute 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.



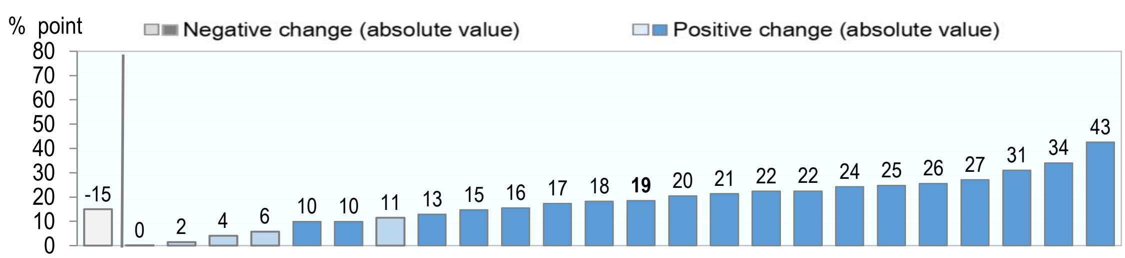
		Indonesia*	Japan	Minnesota (USA)*	Massachusetts (USA)*	Chile*	Slovenia	Ontario (CAN)	Hungary	Hong Kong, China	Korea	**OECD average**	England (UK)	Quebec (CAN)	Sweden	Norway	Singapore	Turkey	Lithuania	South Africa*	Australia	Russian Federation	United States	New Zealand*	Italy	Israel
% of students	2015	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

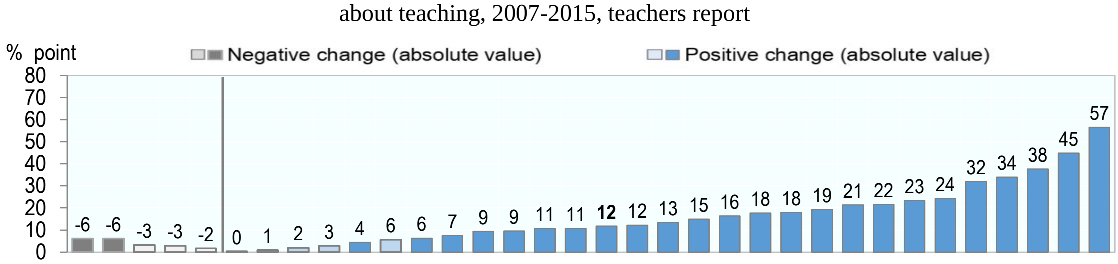
This practice has more often expanded than decreased across OECD systems. On average, the share of 4th grade students instructed by a teacher regularly visiting a colleague's classroom to learn about teaching increased by 12 percentage points. The absolute mean change, regardless of the direction, amounted 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



% of students	Portugal*	Norway	Denmark	Italy	Austria*	Sweden	Belgium (Fl.)*	Turkey*	Germany	Finland*	Alberta (CAN)*	Chile*	Ireland*	Spain*	Quebec (CAN)	Ontario (CAN)	Czech Republic
2015	9	6	4	9	m	8	2	7	7	11	m	12	11	22	15	15	11
2011	15	2	18	4	2	9	1	5	3	6	12	5	4	13	6	10	1
2007	m	12	7	12	4	8	m	m	4	m	7	m	m	m	6	4	0

% of students	**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
2015	**17**	23	13	18	21	20	19	21	24	29	25	29	33	35	40	52	70
2011	**9**	14	m	59	9	2	1	2	3	6	6	6	5	10	17	7	11
2007	**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 h 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

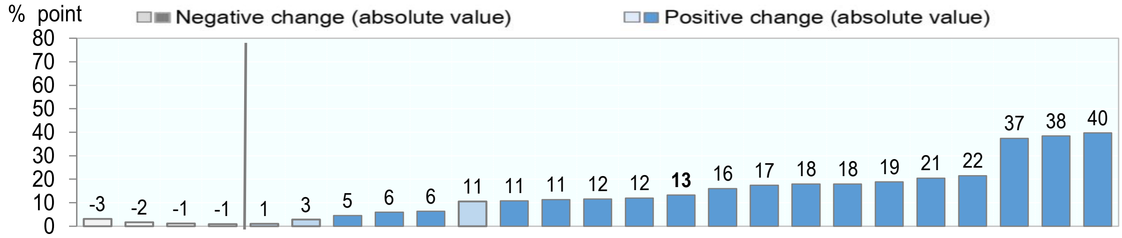
All OECD countries covered experienced an expansion of this teacher practice among secondary science teachers, resulting in a net increase and absolute change of 15 percentage points between 2007 and 2015. This corresponds to a large absolute effect size of 0.5. This has been a big innovation in this 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



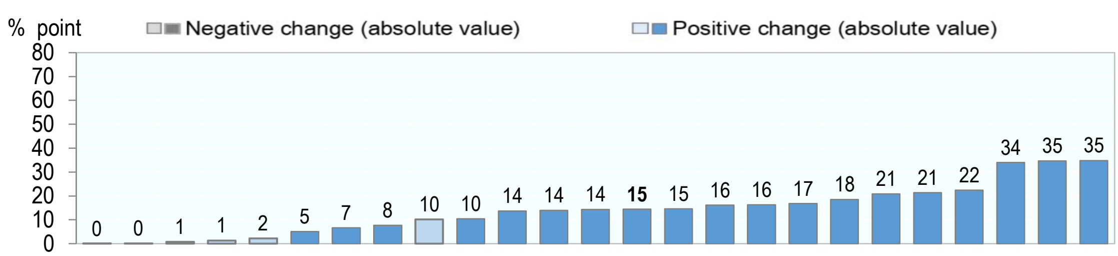
% of students	Massachusetts (USA)*	Chile*	Norway	Minnesota (USA)*	Quebec (CAN)	Sweden	Italy	Slovenia	Ontario (CAN)	Indonesia*	United States	New Zealand*	Japan	Australia	**OECD average**	Lithuania	Hungary	Hong Kong, China	Singapore	Israel	England (UK)	South Africa*	Turkey	Korea	Russian Federation
2015	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.



% of students	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
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).

StatLink https://doi.org/10.1787/888933906500

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).

StatLink https://doi.org/10.1787/888933906519

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

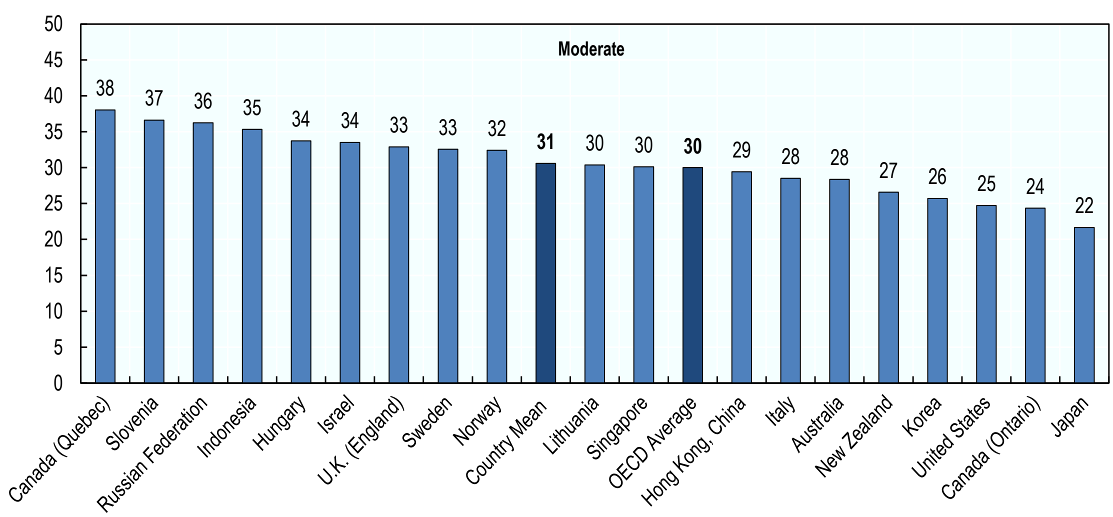
Over the past decade, all countries for which we could compute an innovation index for primary and secondary education had moderate levels of innovation. Students in Quebec (Canada), England (United Kingdom) and Slovenia have experienced the most change, whereas students in Ontario (Canada), Japan and 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.

StatLink https://doi.org/10.1787/888933906538

Innovation in primary education

Innovation in primary education: moderate

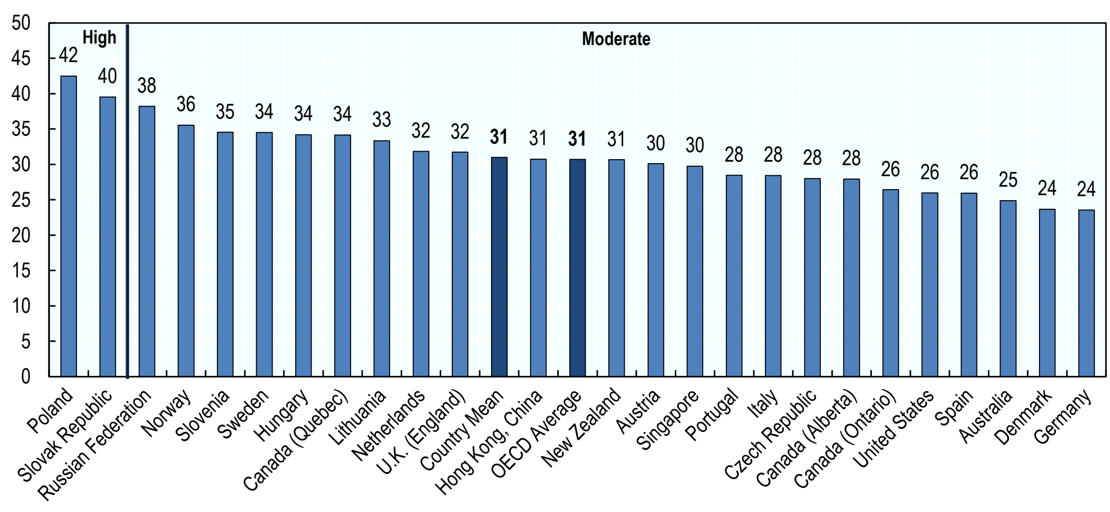
Over the past decades, almost all countries had moderate levels of innovation in primary education. In Germany, Denmark and Australia, students have experienced the least innovation in primary education practices. In Poland, the Slovak Republic and the Russian Federation, students were exposed to the 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.

StatLink https://doi.org/10.1787/888933906557

Innovation in secondary education

Innovation in secondary education: moderate

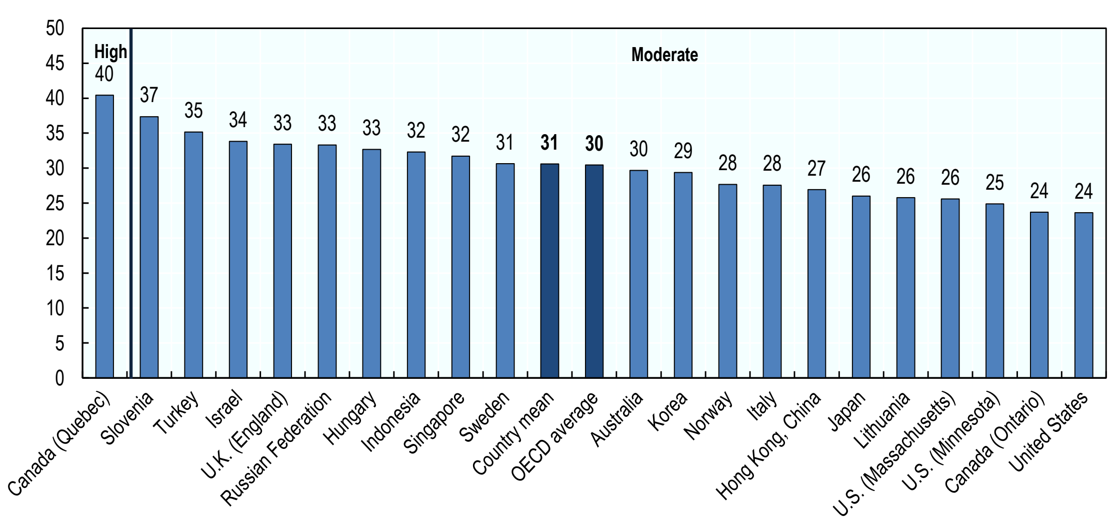
Innovation in educational practices in secondary education has been moderate. Students in Quebec (Canada) have experienced large levels of innovation in secondary education, followed by students Slovenia, Turkey and Israel. On the contrary, in the United States, students experienced a moderate-low level 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.

StatLink https://doi.org/10.1787/888933906576

Innovation in reading education

Innovation in reading education: moderate

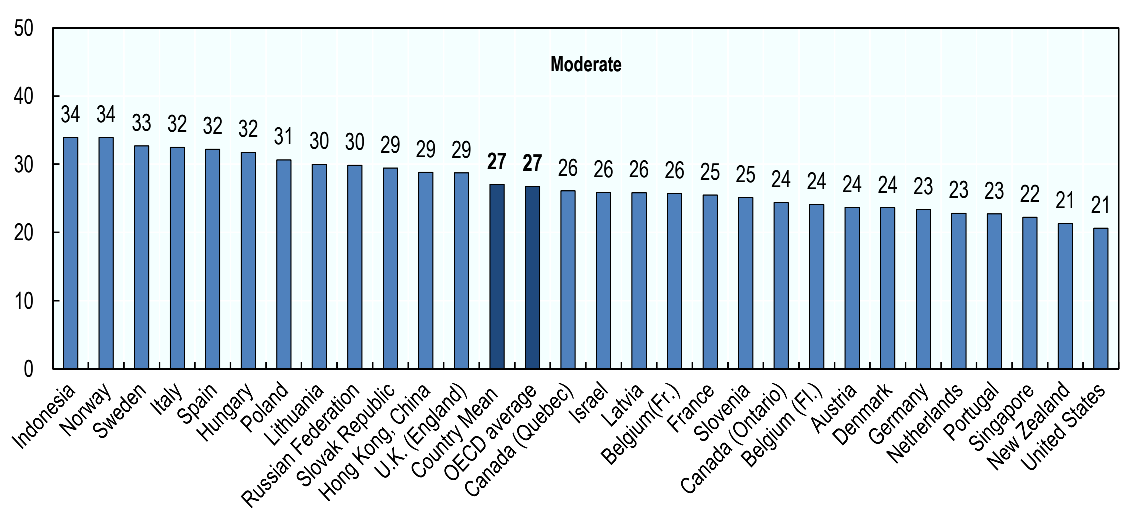
Innovation in reading practices in primary education has been moderate on average, and a bit lower than in maths and science. There was less variation and amplitude in innovation levels across countries compared to science and maths education. Students in Norway, Sweden and Indonesia (albeit over a shorter 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.

StatLink https://doi.org/10.1787/888933906595

Innovation in mathematics education

Innovation in mathematics education: moderate

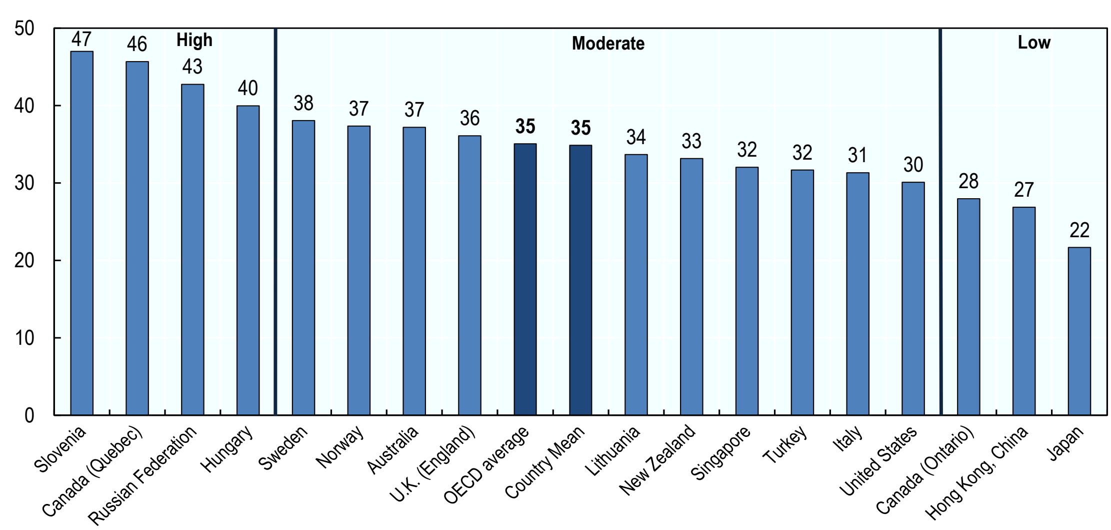
Innovation in maths education practices in primary and secondary education has been moderate on average, but larger than innovation levels in science or reading. This has been the field in which students have experienced the most change in their educational experience in the OECD area over the past decade. 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.

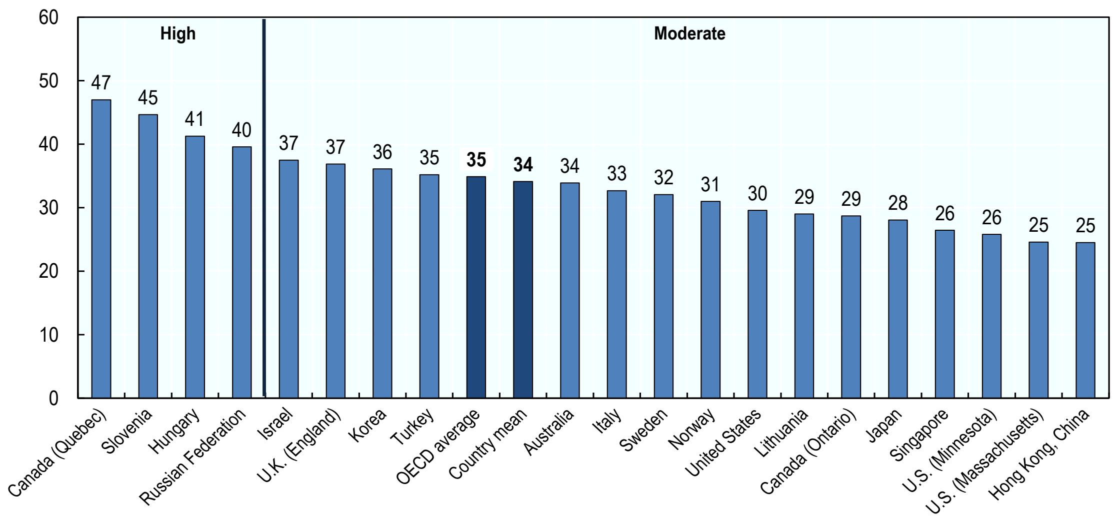
Figure 14.5. Innovation in mathematics education (2007-15)



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.

StatLink https://doi.org/10.1787/888933906614

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.

StatLink https://doi.org/10.1787/888933906633

Innovation in science education

Innovation in science education: moderate

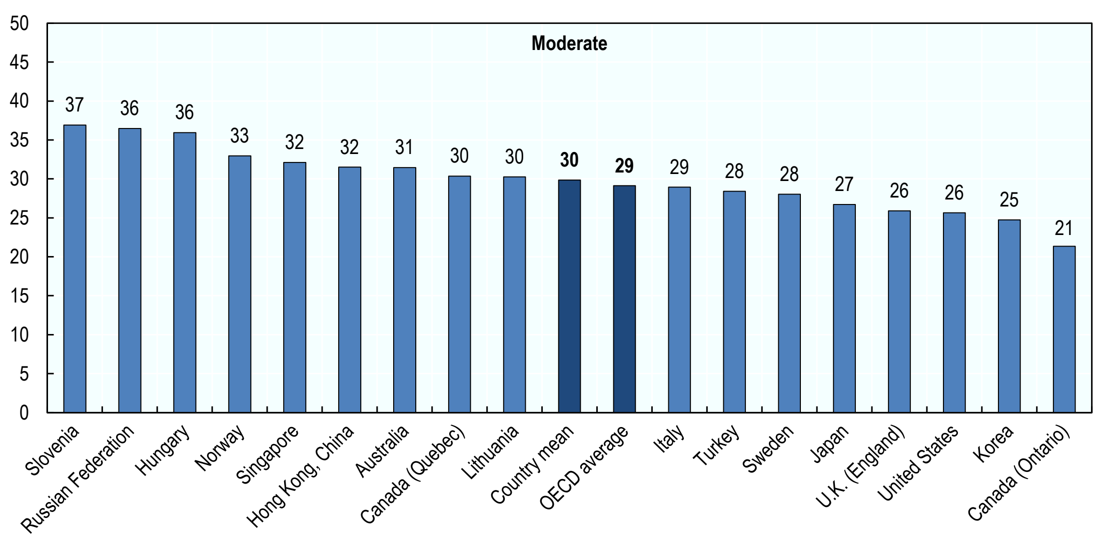
Innovation in science education practices in primary and secondary education has been moderate on average. Students in Slovenia experienced the largest change in science education practices, as was also the case for maths education. Innovation was also relatively large in the Russian Federation and Hungary. 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.

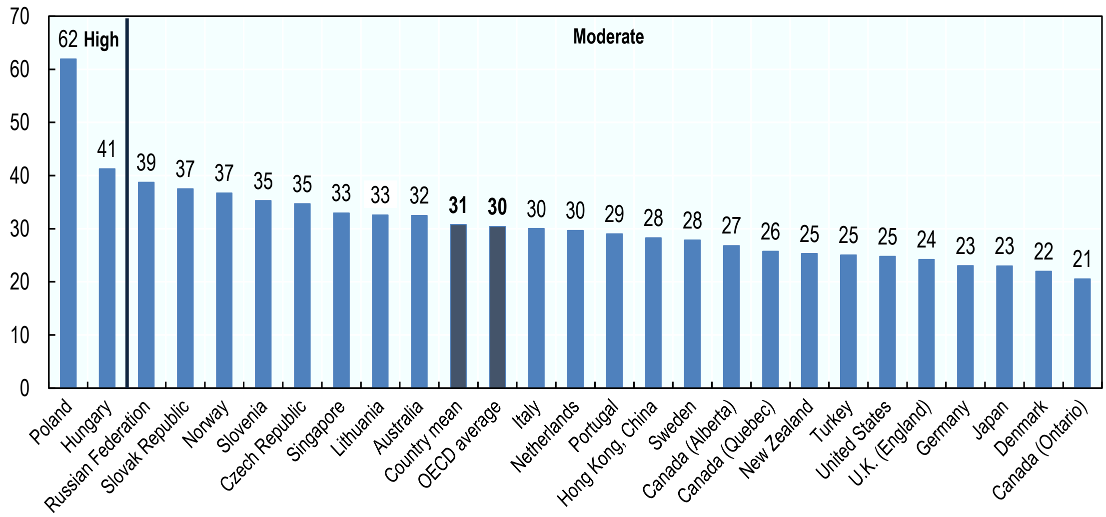
Figure 14.7. Innovation in science education (2006-15)



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

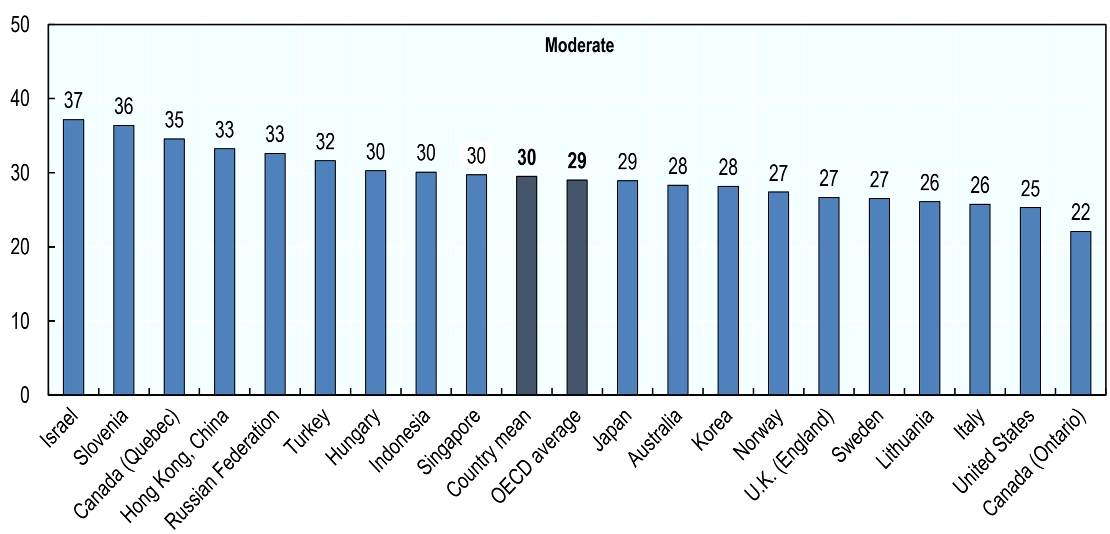
Figure 14.8. Innovation in primary science education (2007-15)



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.

StatLink https://doi.org/10.1787/888933906671

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.

StatLink https://doi.org/10.1787/888933906690

Innovation in the availability of computers in schools

Innovation in the availability of computers in schools: large

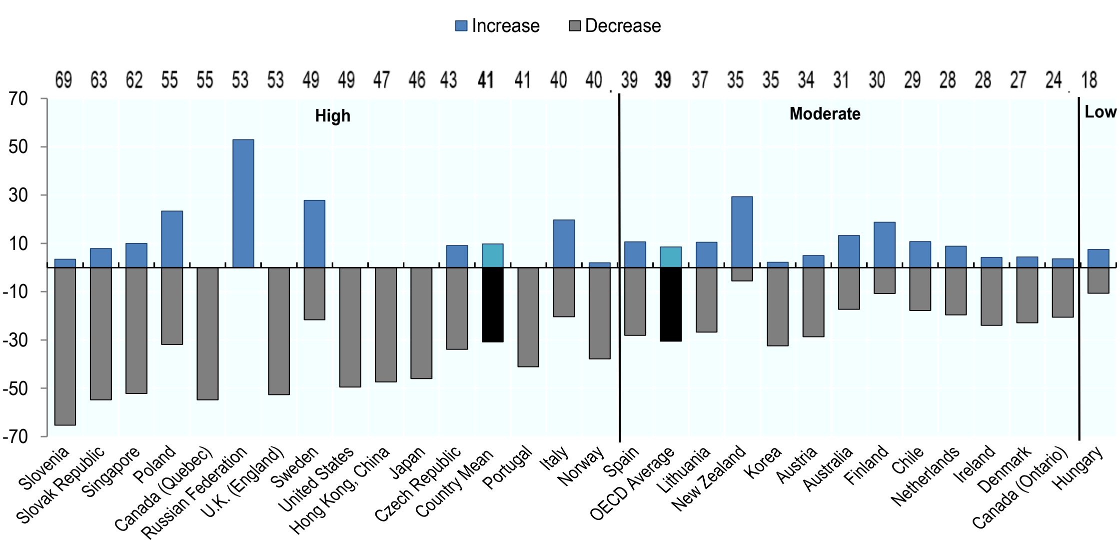
Students have experienced large innovation in the availability of computers (including tablets) for use in primary and secondary school lessons over the past decade. As digitalisation has made ICT ubiquitous, this may appear paradoxical. The levels of availability remain high (at about 80% of students 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.

StatLink https://doi.org/10.1787/888933906709

Innovation in the use of ICT in schools

Innovation in the use of ICT in schools: moderate

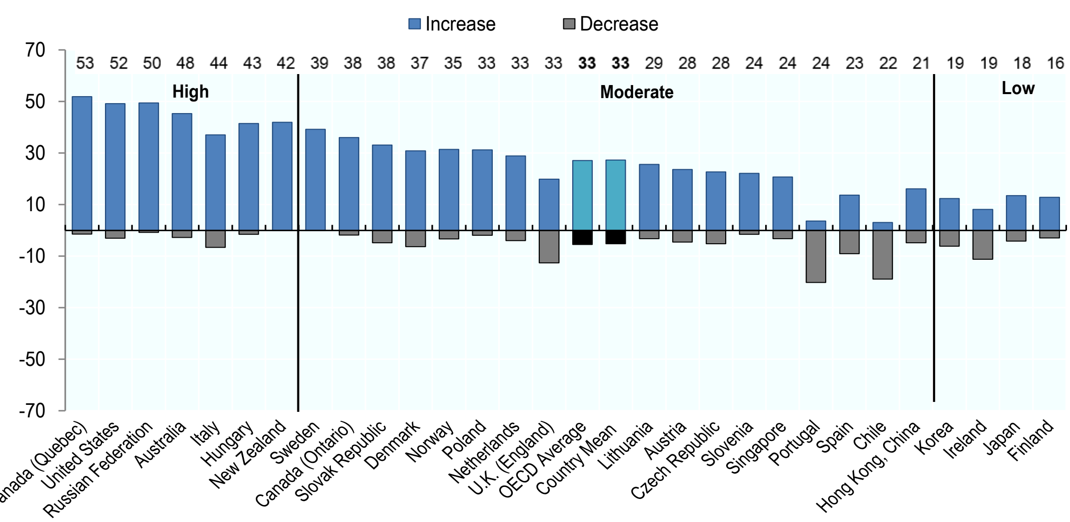
Where computers are available, more students have used them in their lesson or in schools over the past decades than in the past. Computers were used for multiple uses: practising maths, science or foreign languages, simulations, writing, or just looking for information. The use of ICT can enhance knowledge 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

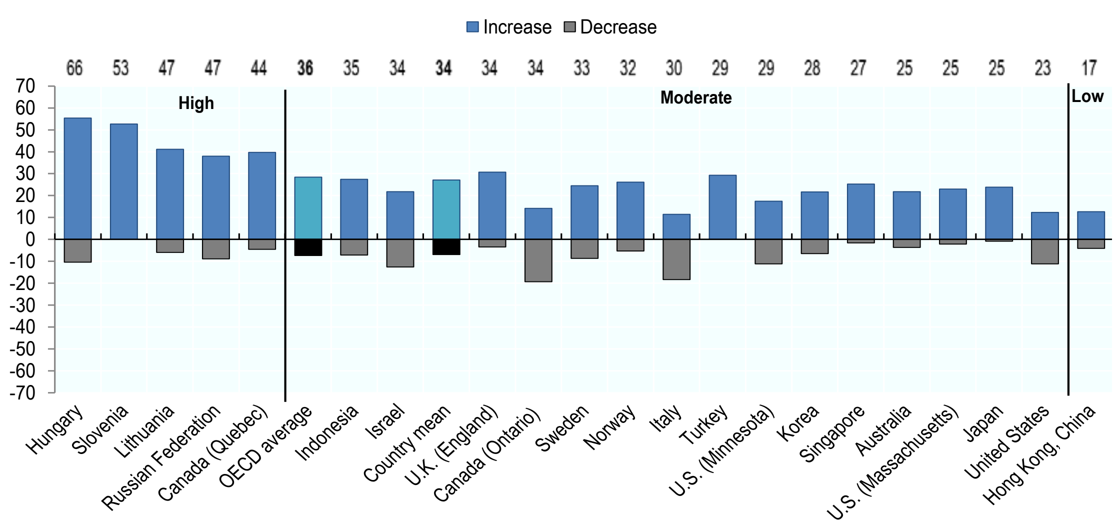
Innovation in the frequency, assessment and monitoring of homework in secondary education has been moderate in the past decade, but moderate-high. The practices covered include the frequency of homework, how homework is corrected, whether it is discussed in class, etc.

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.

StatLink https://doi.org/10.1787/888933906747

Innovation in assessment practices

Innovation in assessment practices: moderate

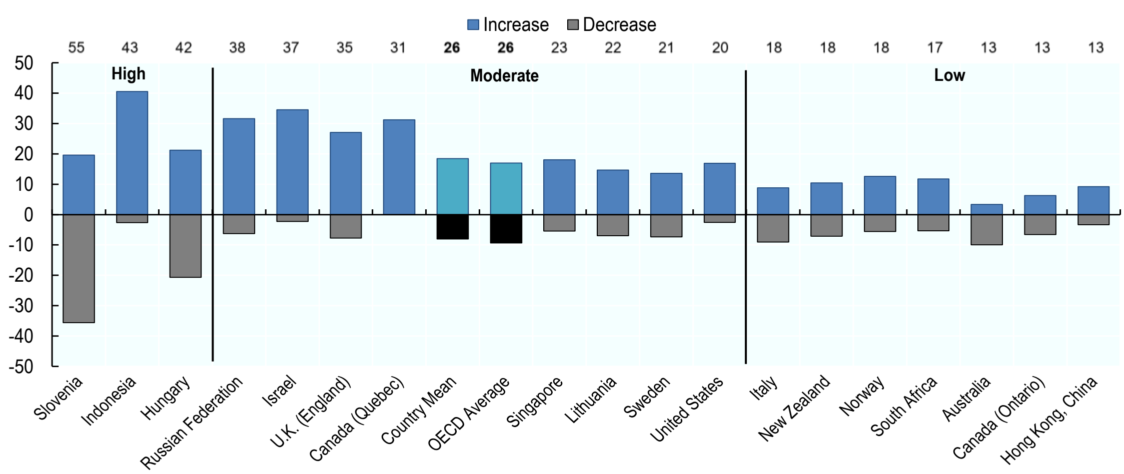
Assessment practices are an integral part of pedagogy, and increasingly of the monitoring of education systems. The assessment practices covered in this index include the frequency of feedback and correction of assignment, the importance of classroom tests, the emphasis on national or regional achievement 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.

StatLink https://doi.org/10.1787/888933906766

Innovation in active learning practices in science education

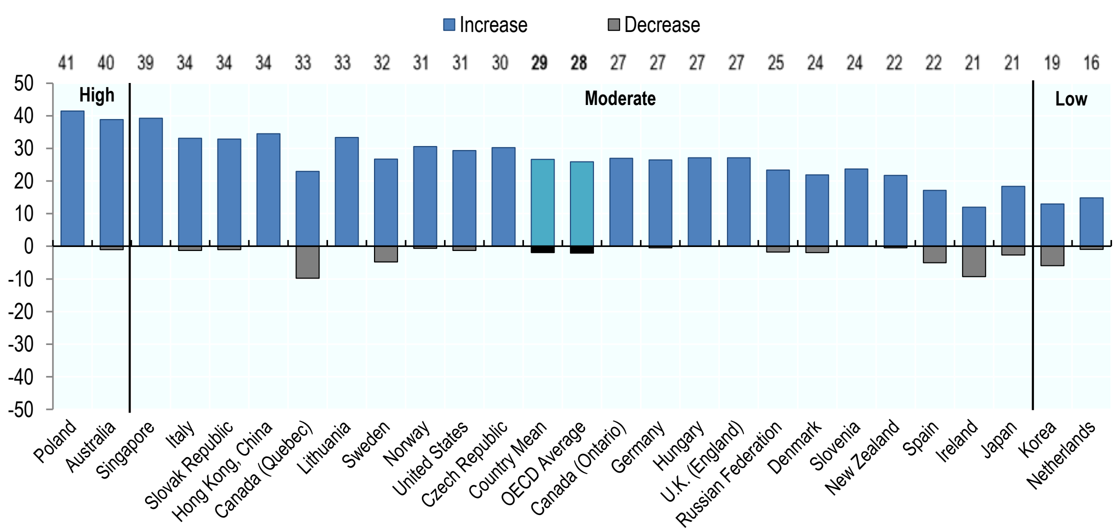
Innovation in active learning in science education: moderate

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.

StatLink https://doi.org/10.1787/888933906785

Innovation in practices fostering higher order skills

Innovation in practices fostering higher order skills: moderate

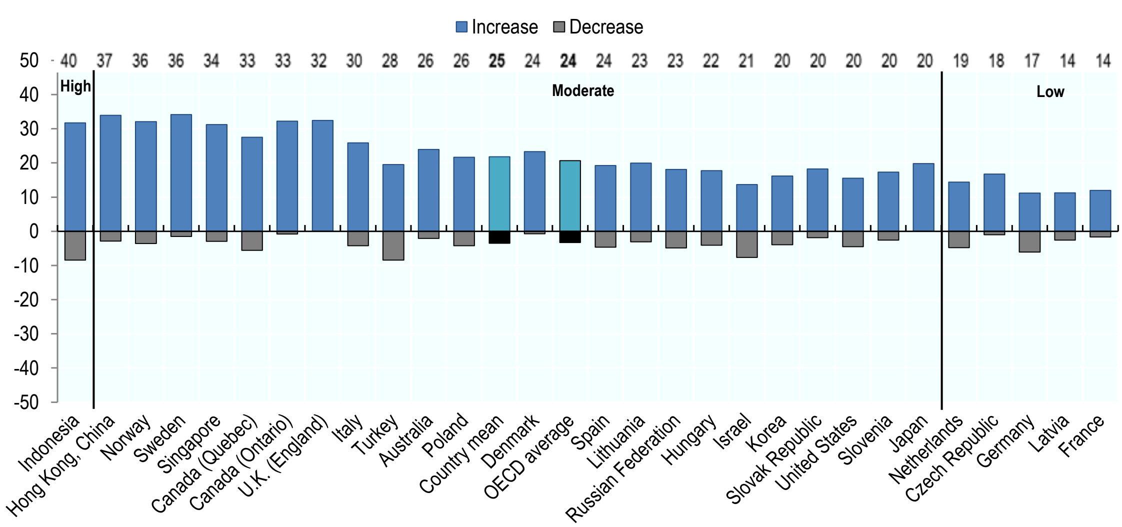
Many systems have put more emphasis in their curricula and policy discourse on the fostering of higher order skills, involving a deeper understanding of read texts or scientific phenomena, the development of critical thinking, the ability to draw inferences, to solve more complex problems, to be more 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.

StatLink https://doi.org/10.1787/888933906804

Innovation in rote learning practices

Innovation in rote learning practices: moderate

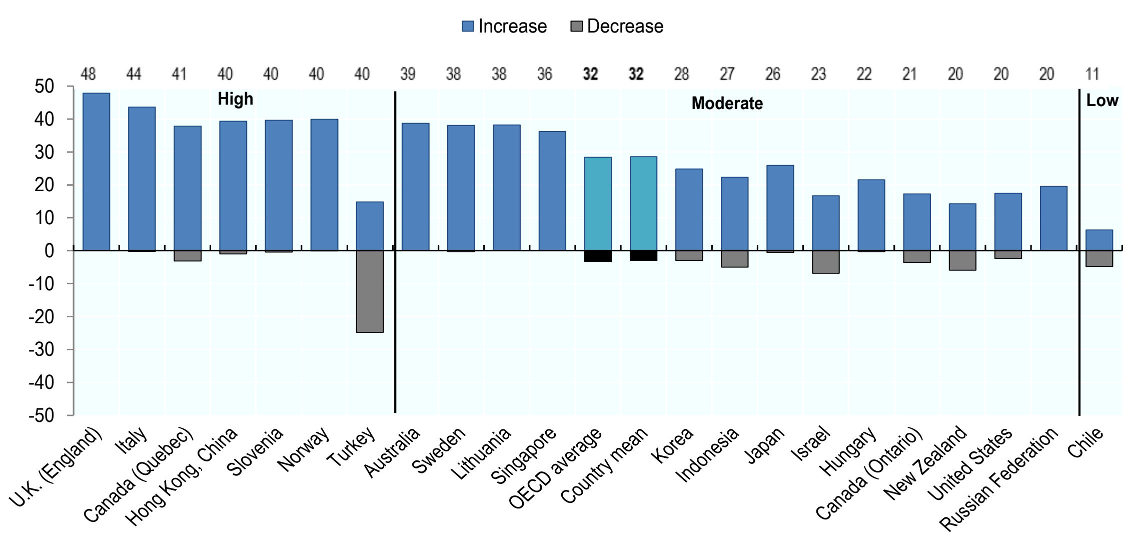
Rote learning has its strong critiques and promoters. While there should be some balance with other types of learning strategies, memorising rules, procedures and facts, reproducing procedures or learning new vocabulary systematically remain key learning practices.

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.

StatLink https://doi.org/10.1787/888933906823

Innovation in independent knowledge acquisition practices

Innovation in independent knowledge acquisition: large

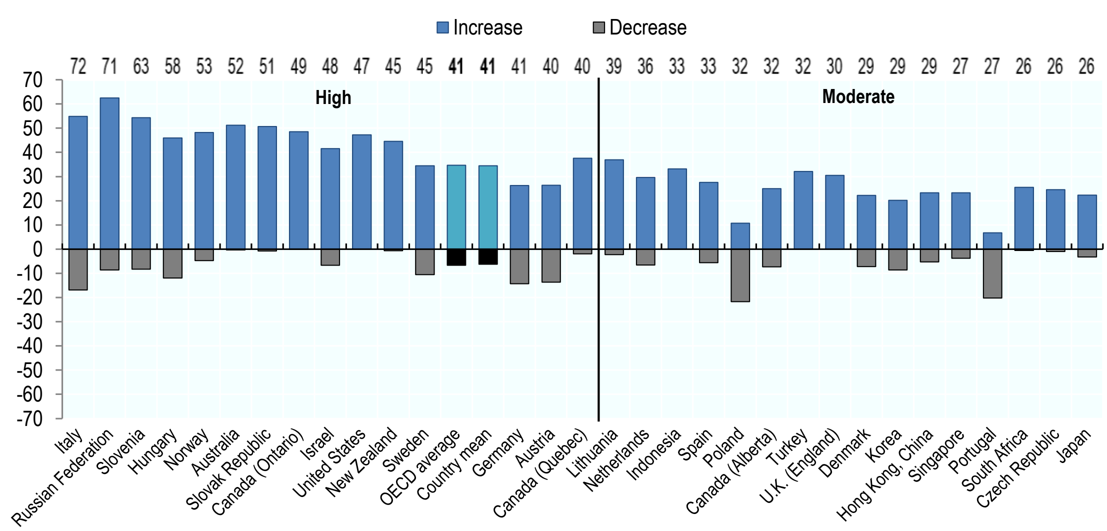
As part of the learning process, students are often asked to read books, textbooks and other resources or to look up for information and ideas on the Internet during class. This is what we call "independent knowledge acquisition".

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.

StatLink https://doi.org/10.1787/888933906842

Innovation in the availability of school learning resources

Innovation in the availability of school learning resources: moderate

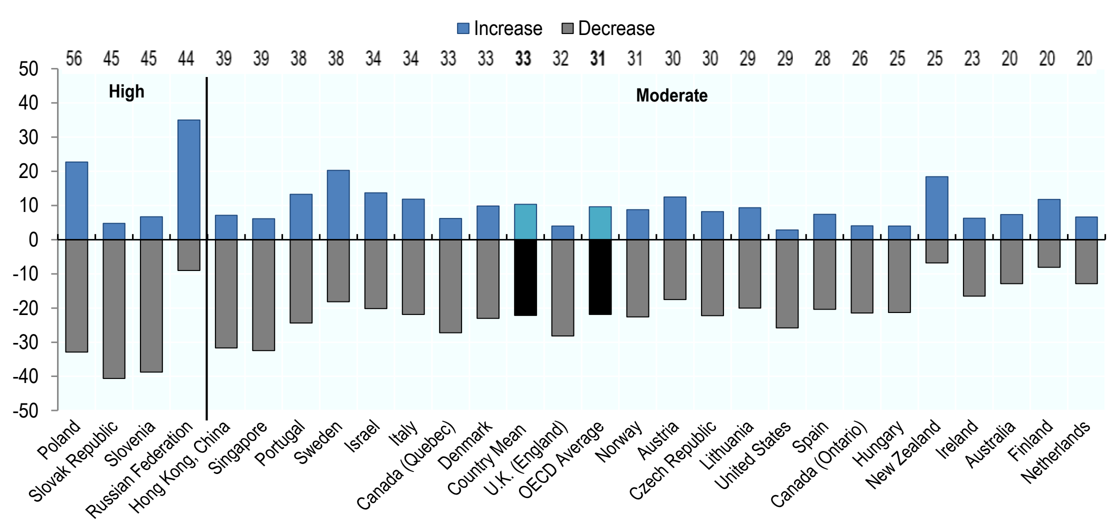
Learning resources available at school cover mainly two big areas in this report: the availability of reading resources (a library in the school or reading corners in classrooms) and the availability of computers in school or in class (including laptops or tablets). These learning resources available 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.

StatLink https://doi.org/10.1787/888933906861

Innovation in formal teacher training

Innovation in teacher training: moderate

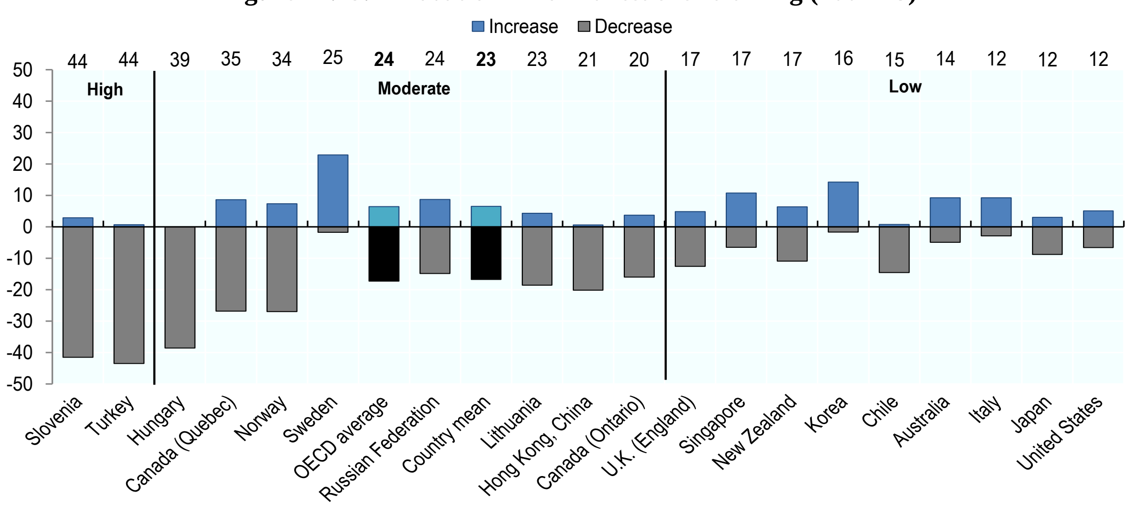
Innovation in upgrading and updating teachers' skills through formal training has been moderate over the past decade, in fact moderate-low: fewer students have been taught by teachers who had taken teacher training in their content area or in teaching their content in the past decade. Whether this is 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.

StatLink https://doi.org/10.1787/888933906880

Innovation in teachers' peer learning

Innovation in teachers' peer learning: large

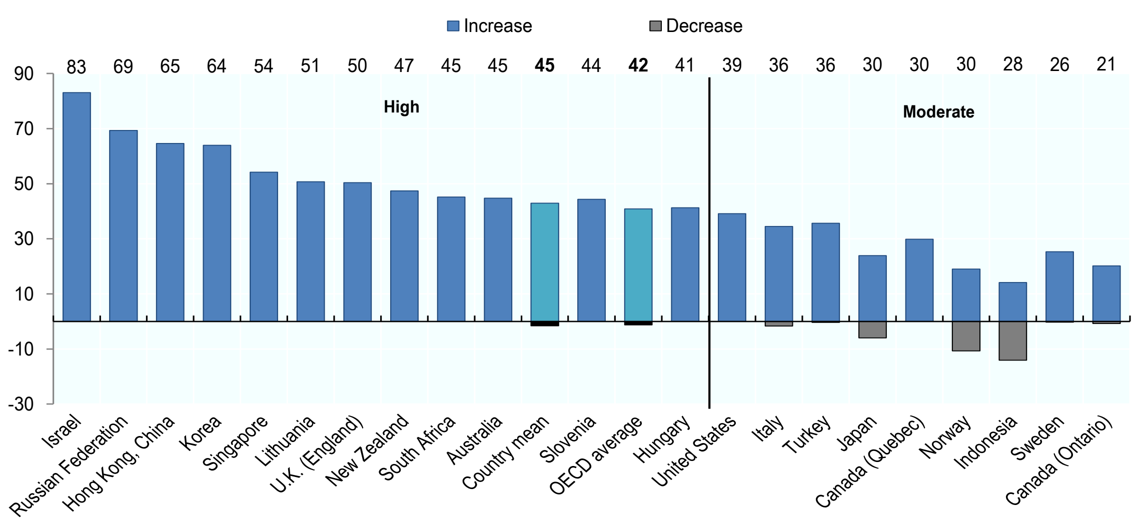
Peer learning is a strong form of professional development for teachers, often considered as more effective than formal training, partly because it is more strongly connected to teachers' needs. By coming together with their peers to discuss, collaborate or observe each other's practices, teachers develop 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.

StatLink https://doi.org/10.1787/888933906899

Innovation in school external relations and human resource management (HRM)

Innovation in school external relations and HRM: moderate

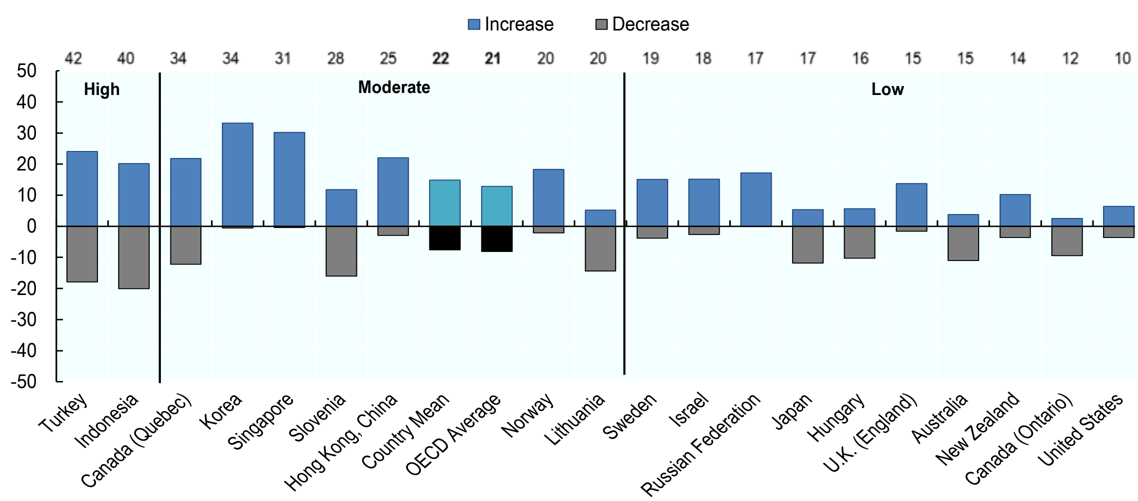
Innovation in education does not only concern pedagogical practices and resources, but also how schools relate to external stakeholders (such as parents) and their teachers. School external relations and HRM practices refer here to parental engagement (parental involvement in school activities, in helping 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.

StatLink https://doi.org/10.1787/888933906918

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

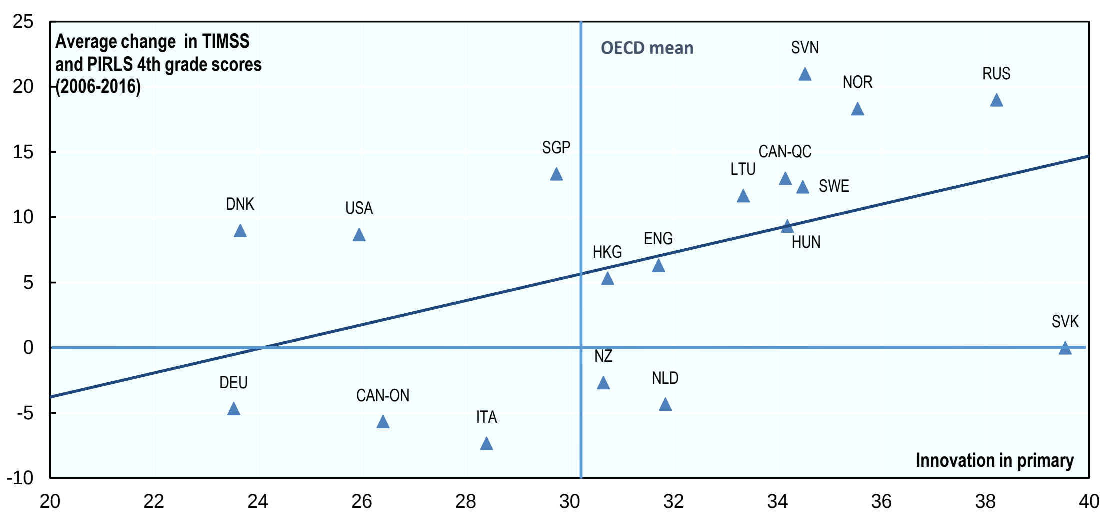
Is innovation in primary education associated with an improvement of academic learning outcomes? This is what one would hope. Although innovations may sometimes have other objectives (for example budget savings), one would expect innovation in mainly pedagogical practices to be associated with an improvement 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.

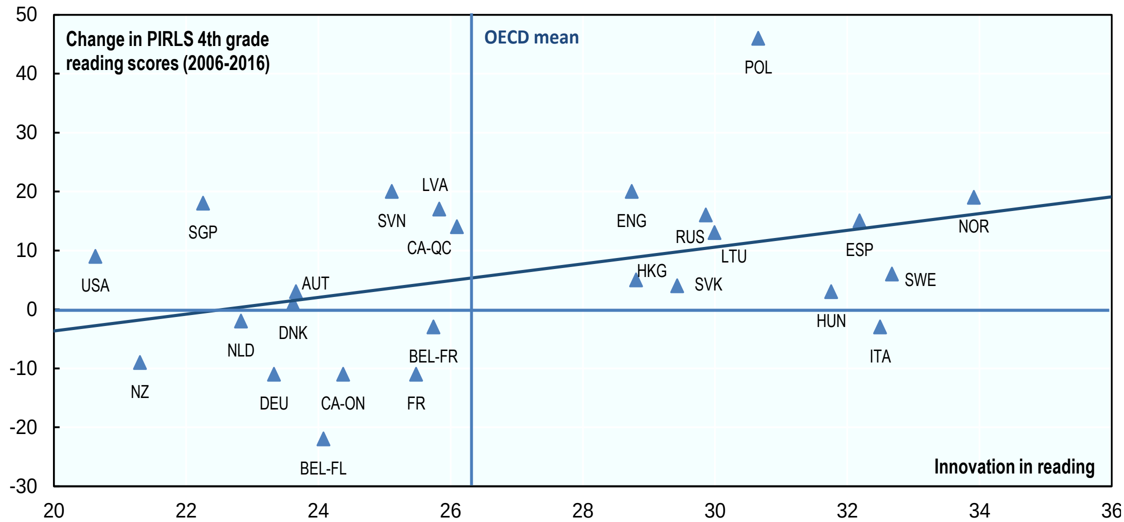
Figure 15.1. Innovation in primary education and average change in primary science, maths and reading learning outcomes (2006-2016)



Note: The correlation coefficient is equal to 0.47.
Source: Authors' calculations based on TIMSS and PIRLS Databases.

StatLink https://doi.org/10.1787/888933906937

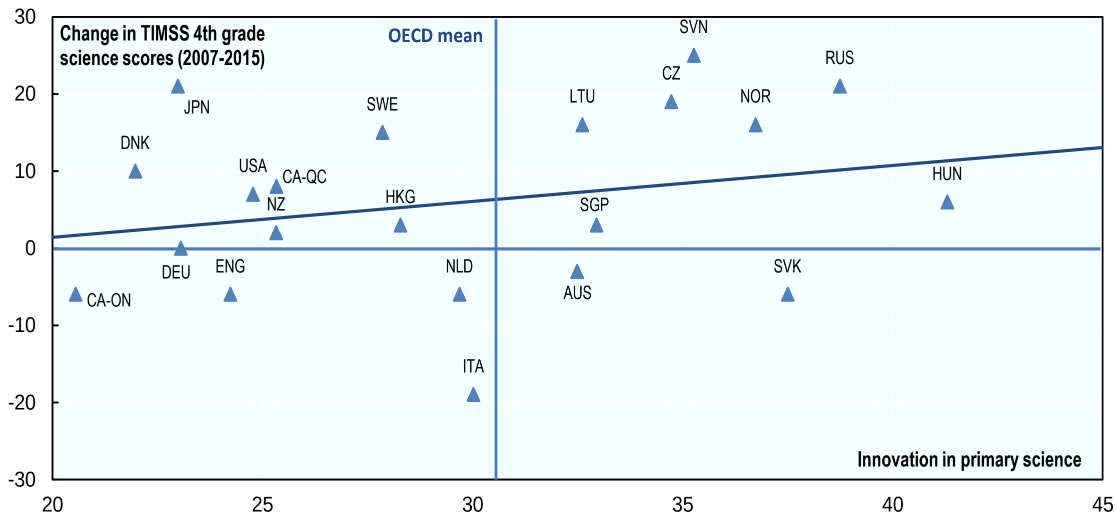
Figure 15.2. Innovation in primary reading education and change in reading learning outcomes (2006-2016)



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

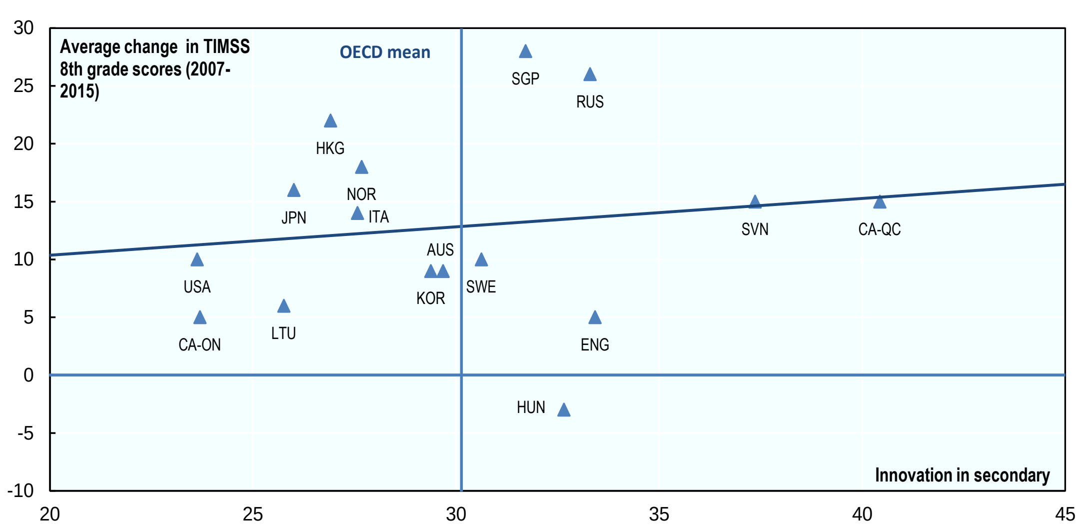
Is innovation in secondary education associated with improved academic learning outcomes? This is one what would hope, especially when innovation is mainly pedagogical. Innovation may sometimes have other objectives than the improvement of learning outcomes though, and even when it is their objective, 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.

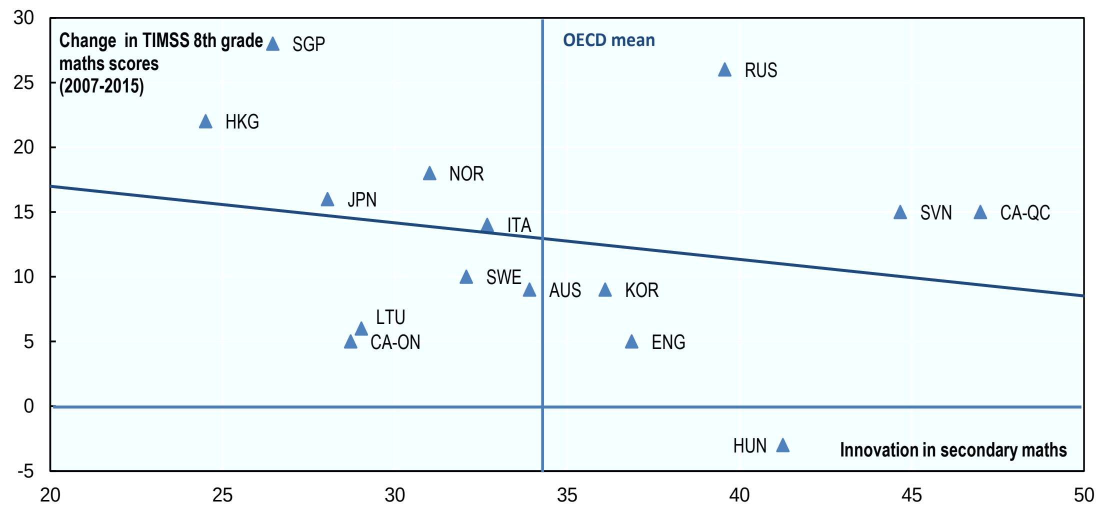
Figure 15.4. Innovation in secondary education and average change in science and maths learning outcomes (2007-2015)



Note: The correlation coefficient is equal to 0.22.
Source: Authors' calculations based on TIMSS Databases.

StatLink https://doi.org/10.1787/888933906994

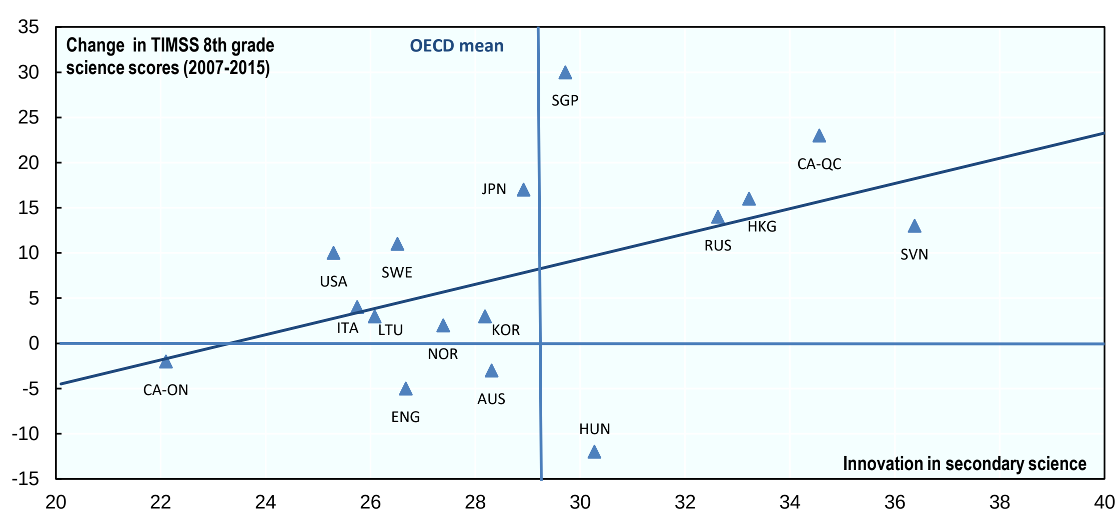
Figure 15.5. Innovation in secondary maths education and change in maths learning outcomes (2007-2015)



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?

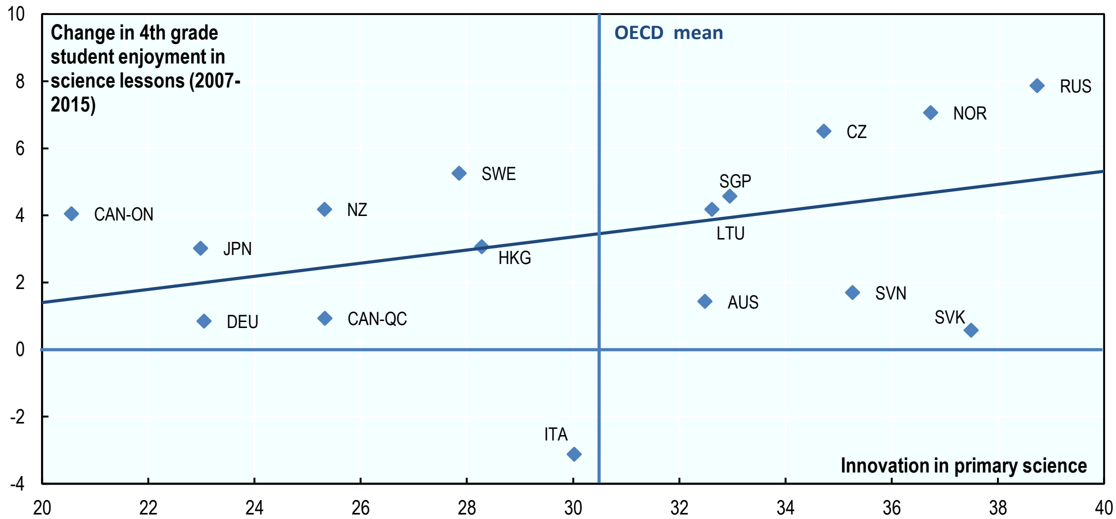
From another perspective, the emotional nature of learning has become more strongly acknowledged, and many teachers realise that the enjoyment of learning need not be an oxymoron. It also contributes to students' wellbeing. One would thus expect or hope that innovation in educational practices lead to 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.

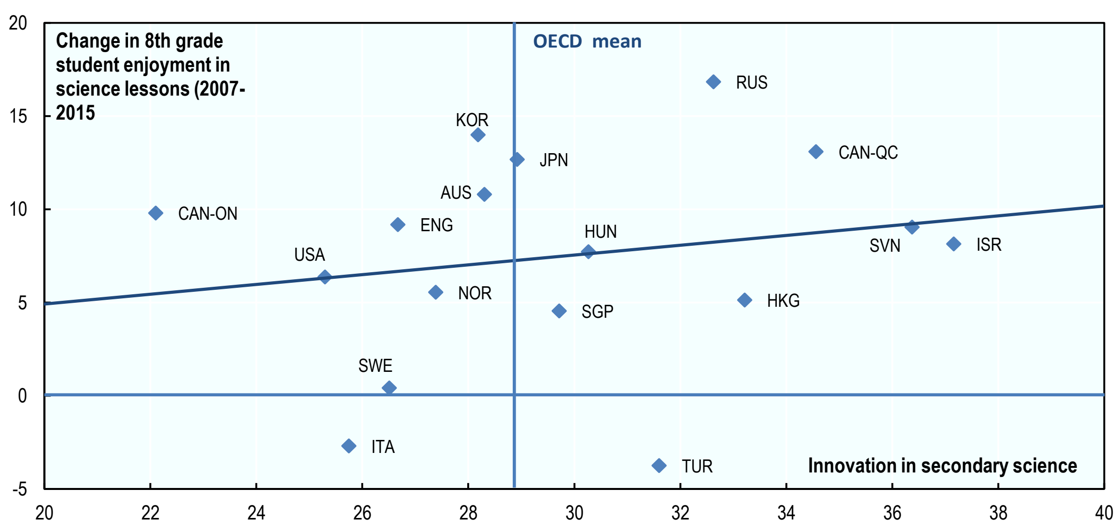
Figure 15.7. Innovation in science education and change in student enjoyment of science lessons in primary education (2007-2015)



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.

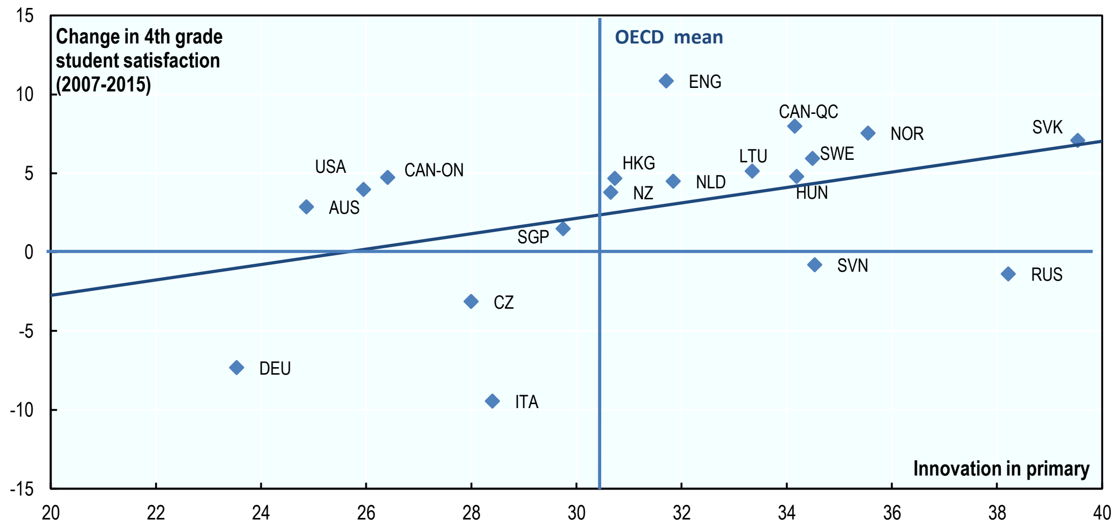
As innovation is not necessarily an improvement, it can also happen that learning conditions become worse than before, or that students enjoy less their learning environment. In that respect, policy makers and practitioners should be interested in how specific educational changes affect students' wellbeing 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.

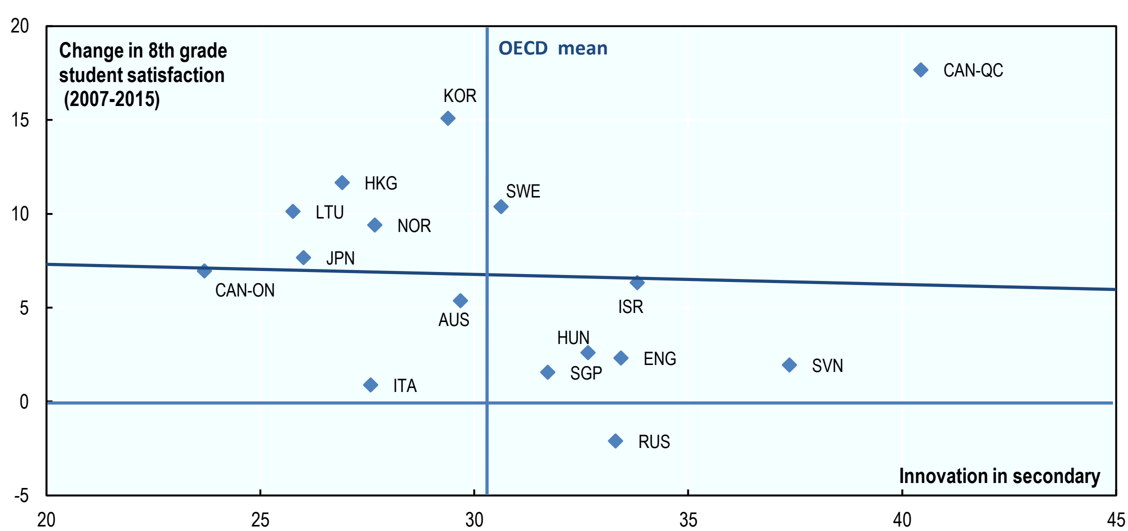
Figure 15.9. Innovation in primary education and change in 4th grade student satisfaction (2007-2015)



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.

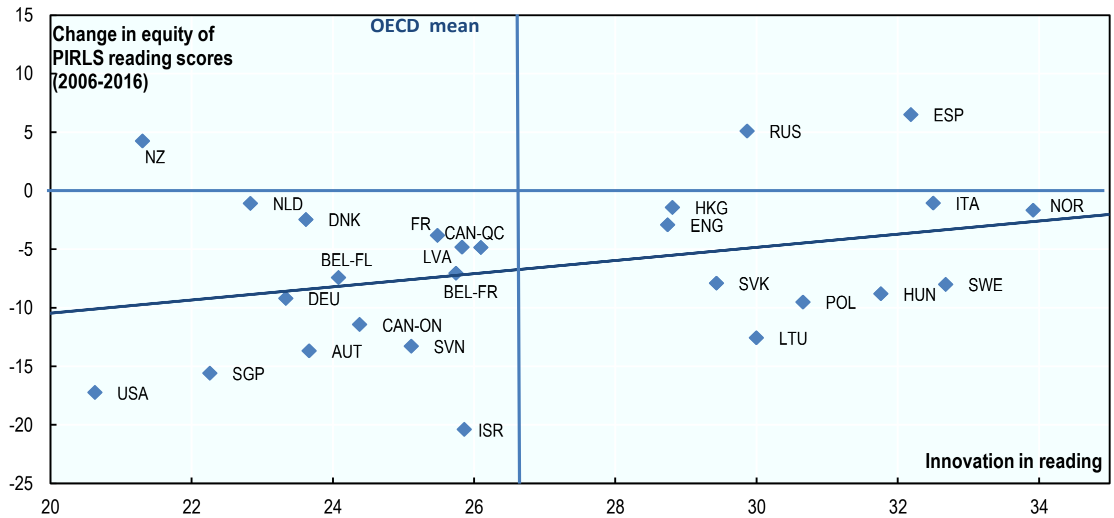
On the other hand, one can also hope that innovation will close the achievement gap and decrease inequity in education. In fact, this could only happen through innovation given that existing practices are still associated with relatively high levels of inequity (even though inequity has decreased in 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.

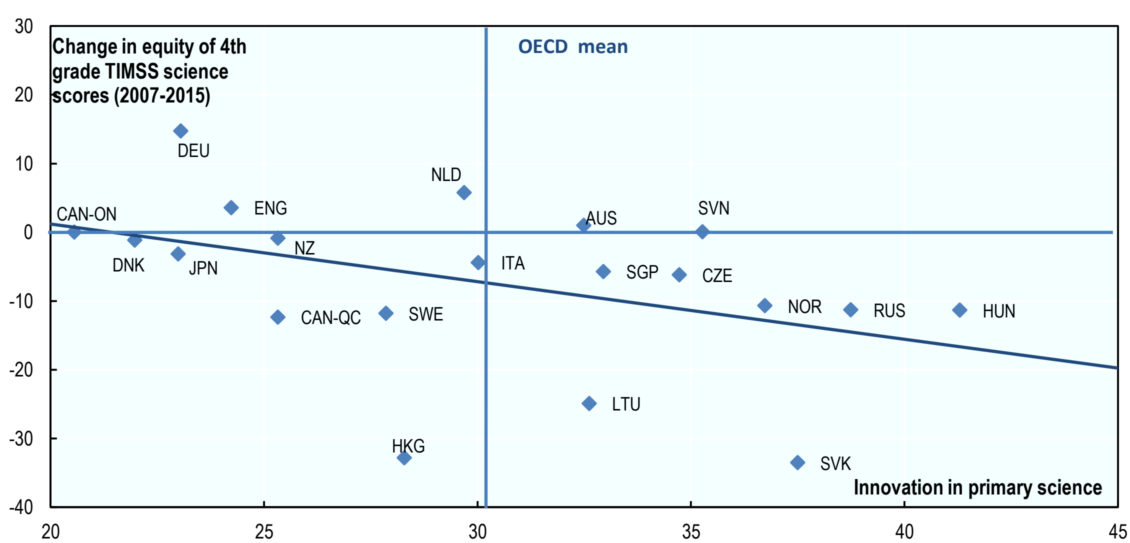
Figure 15.11. Innovation in primary reading education and trends in equity of primary reading scores (2006-2016)



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.

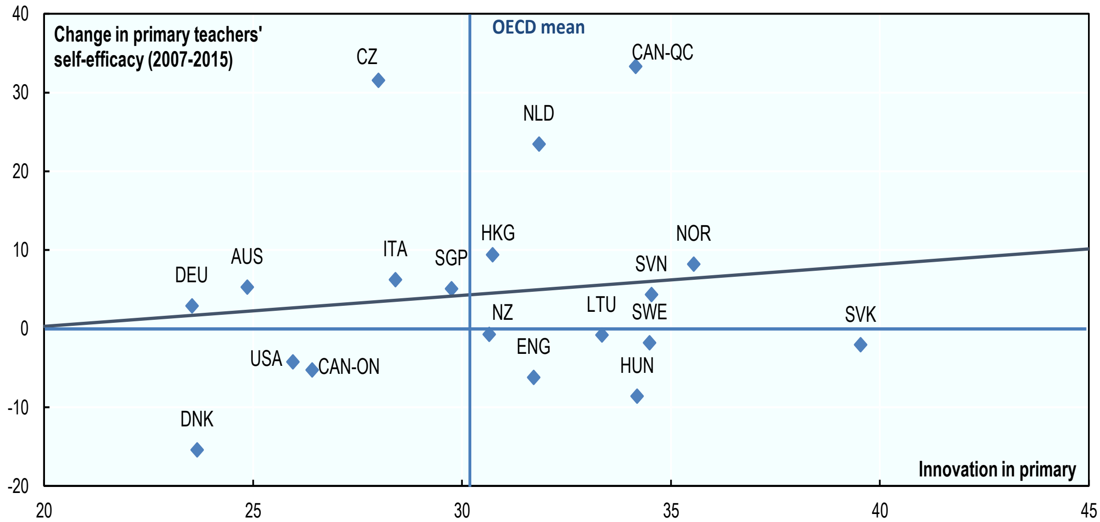
When it is implemented at scale, one should hope that, beyond individual learning, innovation leads to collective learning at the school level. Facing similar challenges at the same time conducts teachers to work collaboratively and reflectively with their peers. In that case, innovation both results 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.

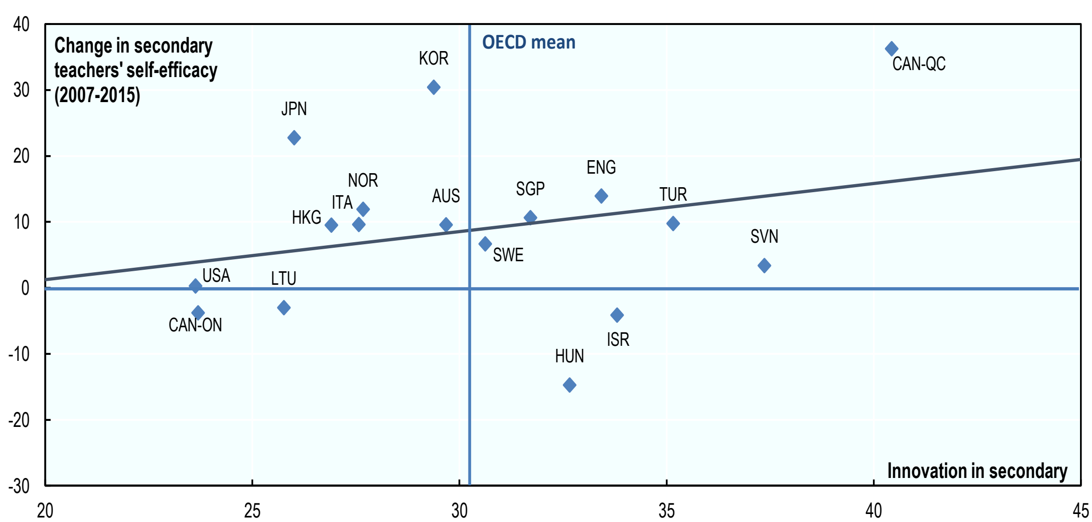
Figure 15.13. Innovation and change in teachers' collective self-efficacy at the primary level (2007-2015)



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.

StatLink https://doi.org/10.1787/888933907184

Innovation and teachers' collective ambition for their students

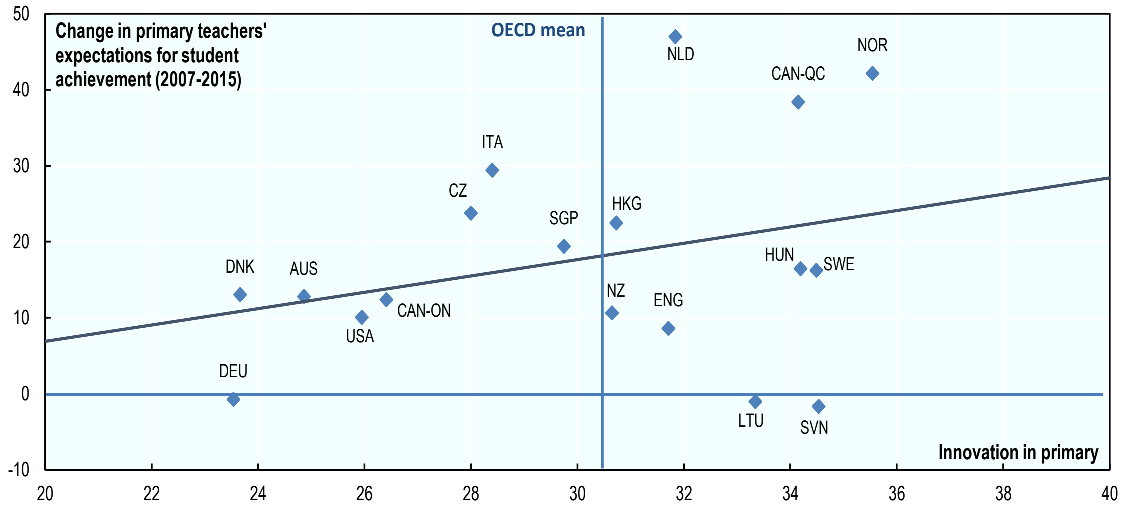
Innovation can be driven by many different objectives. A search for improving students' learning outcomes, a quest for reducing inequity or achieving collective wellbeing, a response to budget cuts (or increases), an adjustment to parental or social demand, an answer to individual or collective learning, 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.

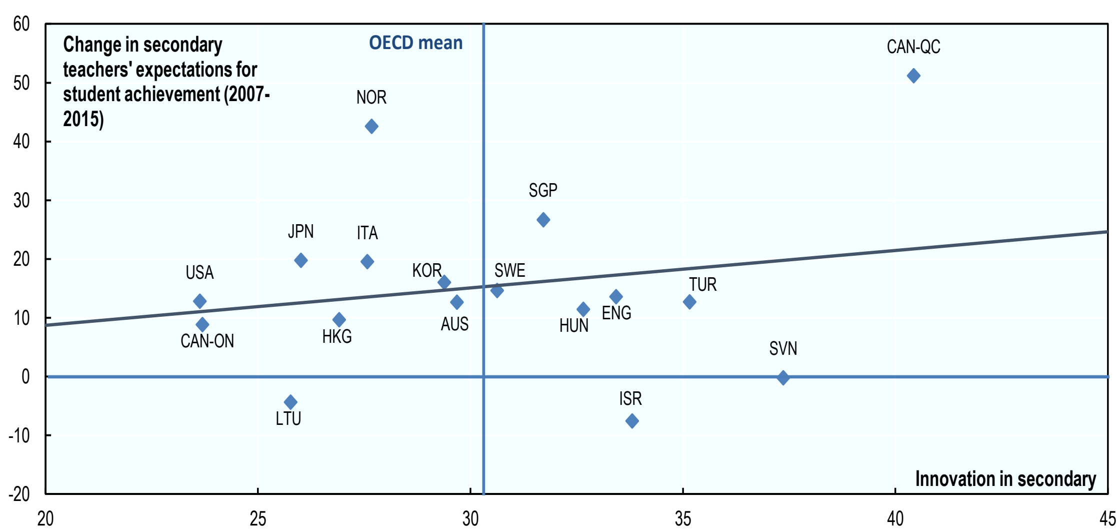
Figure 15.15. Innovation and change in teachers' expectations for student achievement at the primary level (2007-2015)



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.

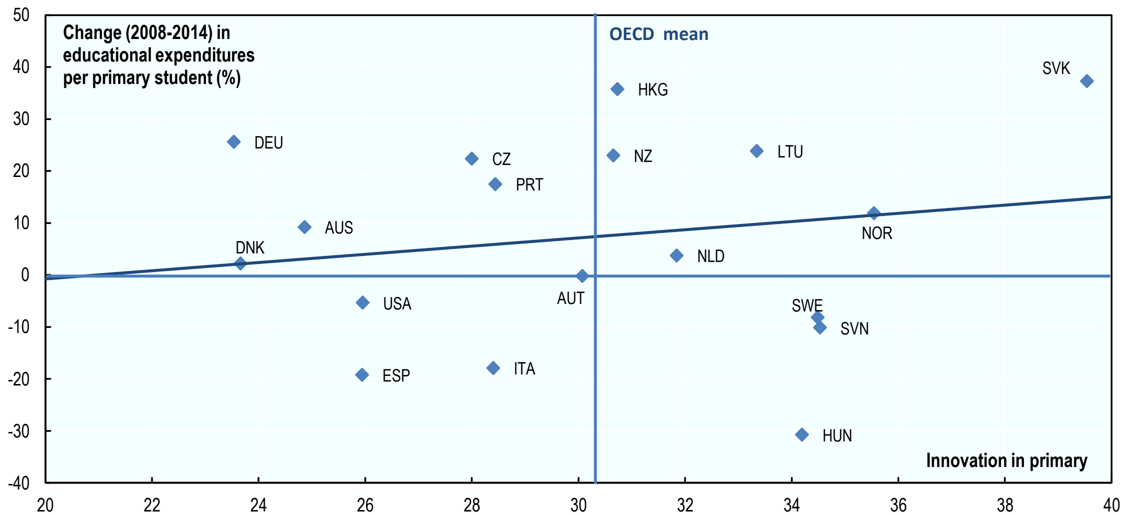
Innovation in education may be frugal or expensive. Some pedagogical innovations require budget. Enhanced access to ICT and sometimes proper use of ICT during class rely on a certain level of equipment and infrastructure. The mere maintenance of ICT has a cost; including the support of technical staff. 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.

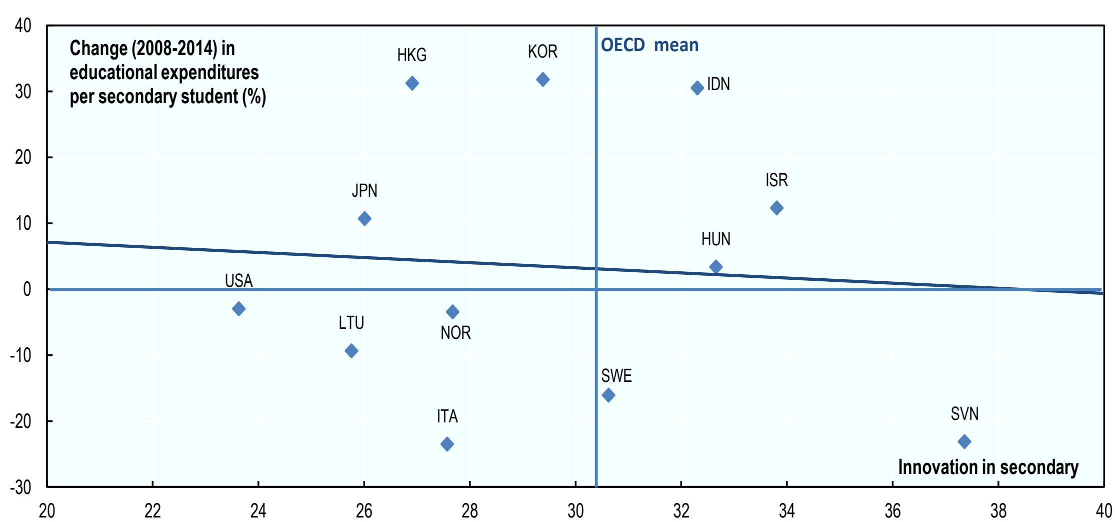
Figure 15.17. Innovation and change in educational expenditures at the primary level (2008-2014)



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.

StatLink https://doi.org/10.1787/888933907260

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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Australia 28
OECD average 30
Education Innovation Index

Innovation in education by category

Category	Australia	OECD average
Primary	25	31
Secondary	30	30
Maths	37	35
Science	31	29

Innovation in education by type of practice

Practice	Australia	Australia (negative)	Australia (positive)	OECD (negative)	OECD (positive)	OECD average
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

Practice	Australia	Australia (negative)	Australia (positive)	OECD (negative)	OECD (positive)	OECD average
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

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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

Category	Ontario (CA)	OECD average
Primary	26	31
Secondary	24	30
Maths	28	35
Science	21	29
Reading	24	27

Innovation in education by type of practice

Practice	Ontario (CA) index	Ontario (CA) contraction	Ontario (CA) expansion	OECD average contraction	OECD average expansion	OECD average index
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

Practice	Ontario (CA) index	Ontario (CA) contraction	Ontario (CA) expansion	OECD average contraction	OECD average expansion	OECD average index
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

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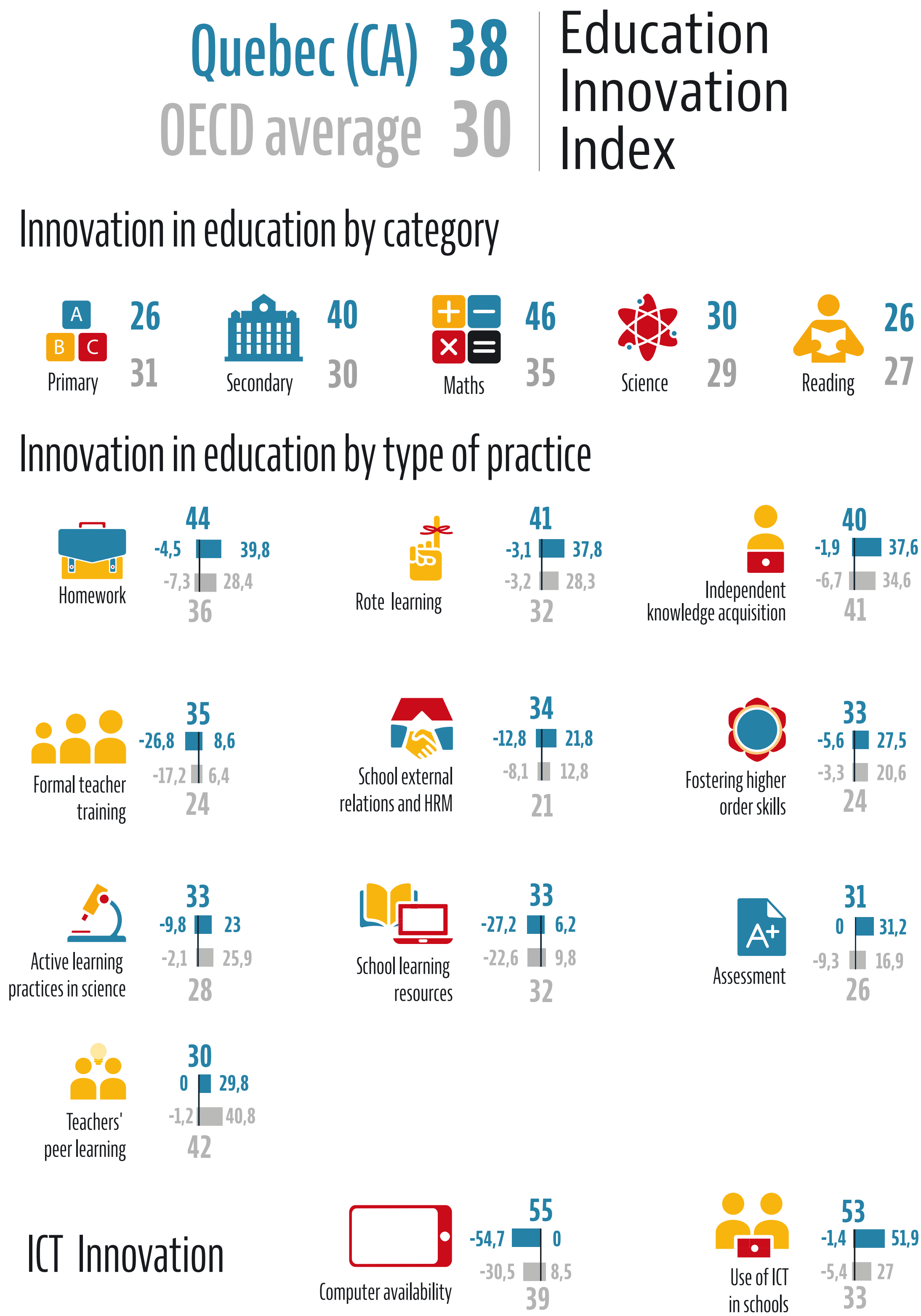
Academic outcome in primary reading



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

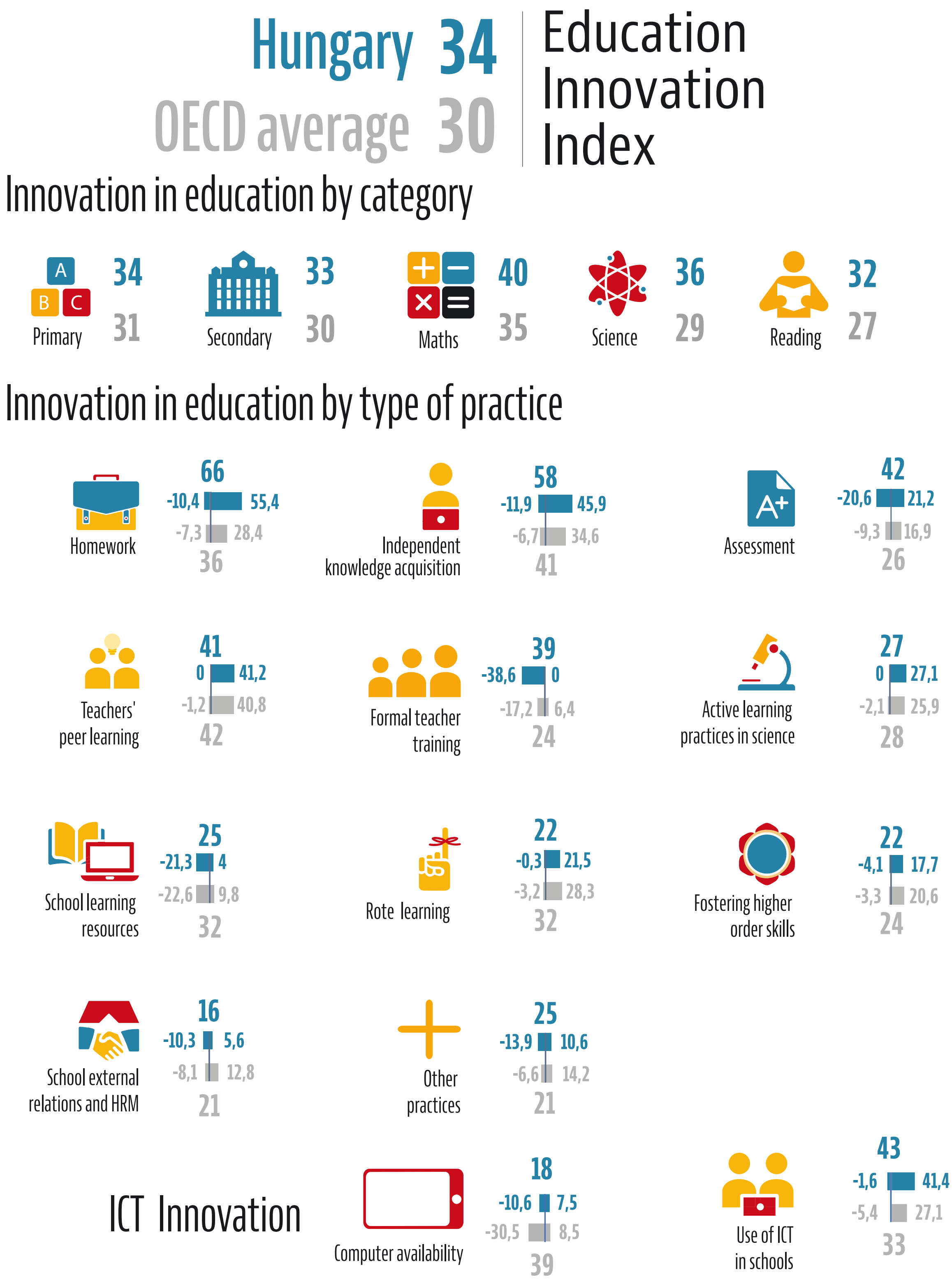
Some trends in educational outcomes

+

- 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



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

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- 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

Category	Israel	OECD average
Secondary	34	30
Reading	26	27

Innovation in education by type of practice

Type of practice	Israel	Israel contraction	Israel expansion	OECD contraction	OECD expansion	OECD average
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

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- 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.

Italy 28
OECD average 30
Education Innovation Index

Innovation in education by category

Category	Italy	OECD average
Primary	28	31
Secondary	28	30
Maths	31	35
Science	29	29
Reading	32	27

Innovation in education by type of practice

Practice	Italy	Italy contraction	Italy expansion	OECD contraction	OECD expansion	OECD average
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

Practice	Italy	Italy contraction	Italy expansion	OECD contraction	OECD expansion	OECD average
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

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- Academic outcome in secondary maths
- Teachers' collective ambition for their students in primary and secondary education

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- 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

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- 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

Japan 22 / OECD average 30 — Education Innovation Index

Innovation in education by category

Category	Japan	OECD average
Secondary	26	30
Maths	22	35
Science	27	29

Innovation in education by type of practice

Practice	Japan	Japan (negative)	Japan (positive)	OECD (negative)	OECD (positive)	OECD average
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

Practice	Japan	Japan (negative)	Japan (positive)	OECD (negative)	OECD (positive)	OECD average
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

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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

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Equity of academic outcome in secondary maths

Korea 26 | Education Innovation Index

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

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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

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- 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

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- Equity of academic outcomes in primary maths

New Zealand 27 | OECD average 30 — Education Innovation Index

Innovation in education by category

	New Zealand	OECD average
Primary	31	31
Maths	33	35
Science	36	29
Reading	21	27

Innovation in education by type of practice

	New Zealand	NZ contraction	NZ expansion	OECD contraction	OECD expansion	OECD average
Independent knowledge acquisition	45	-0,6	44,5	-6,7	34,6	41
Teachers' peer learning	47	0	47,3	-1,2	40,8	42
School learning resources	25	-6,7	18,4	-22,6	9,8	32
Active learning practices in science	22	-0,4	21,7	-2,1	25,9	28
Rote learning	20	-5,9	14,2	-3,2	28,3	32
Assessment	18	-7,1	10,4	-9,3	16,9	26
Formal teacher training	17	-10,9	6,3	-17,2	6,4	24
School external relations and HRM	14	-3,6	10,2	-8,1	12,8	21
Other practices	22	-5,1	16,6	-6,6	14,2	21

ICT Innovation

	New Zealand	NZ contraction	NZ expansion	OECD contraction	OECD expansion	OECD average
Computer availability	35	-5,4	29,41	-30,5	8,5	39
Use of ICT in schools	42	0	41,9	-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.

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

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- Academic outcome in primary reading

Norway 32 | OECD average 30 — Education Innovation Index

Innovation in education by category

Category	Norway	OECD average
Primary	36	31
Secondary	28	30
Maths	37	35
Science	33	29
Reading	34	27

Innovation in education by type of practice

Practice	Norway	Norway change (-)	Norway change (+)	OECD change (-)	OECD change (+)	OECD average
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

Practice	Norway	Norway change (-)	Norway change (+)	OECD change (-)	OECD change (+)	OECD average
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

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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

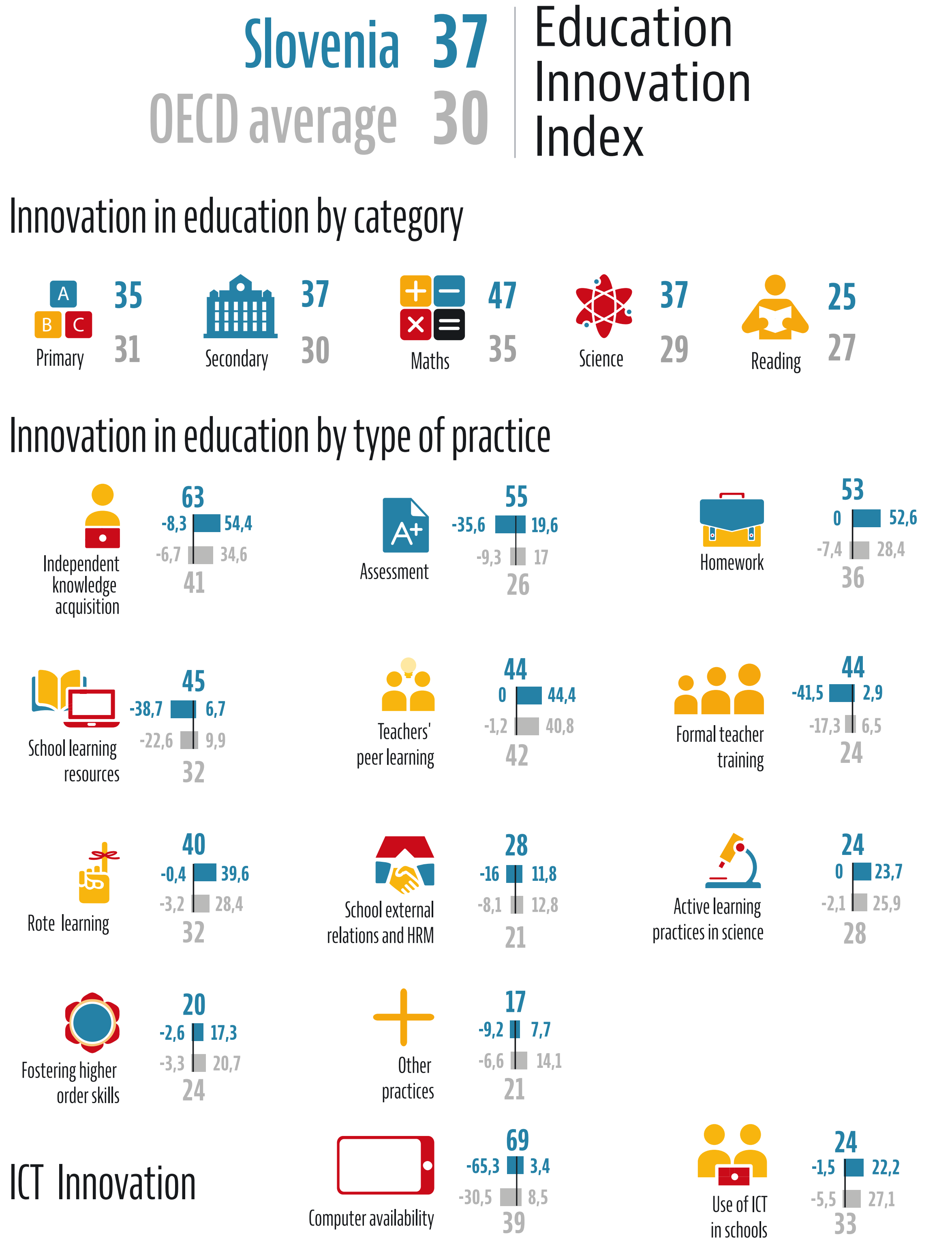
Equity of academic outcomes in primary reading

Equity of academic outcomes in primary and secondary science

Equity of academic outcomes in secondary maths

–

Equity of academic outcomes in primary maths



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

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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

Primary 34 31

Secondary 31 30

Maths 38 35

Science 28 29

Reading 33 27

Innovation in education by type of practice

Independent knowledge acquisition
45
-10,6 34,5
-6,7 34,6
41

School learning resources
38
-18,1 20,3
-22,6 9,8
32

Rote learning
38
-0,4 38
-3,2 28,3
32

Fostering higher order skills
36
-1,5 34,2
-3,3 20,6
24

Homework
33
-8,7 24,5
-7,3 28,4
36

Active learning practices in science
32
-4,8 26,8
-2,1 25,9
28

Teachers' peer learning
26
-0,3 25,3
-1,2 40,8
42

Formal teacher training
25
-1,7 22,9
-17,2 6,4
24

Assessment
21
-7,1 13,6
-9,3 16,9
26

School external relations and HRM
19
-3,9 15,1
-8,1 12,8
21

Other practices
18
-4,5 13,6
-6,6 14,1
21

ICT Innovation

Computer availability
49
-21,6 27,1
-30 8,5
39

Use of ICT in schools
39
0 39,2
-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.

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

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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

	England (UK)	OECD average
Primary	32	31
Secondary	33	30
Maths	36	35
Science	26	29
Reading	29	27

Innovation in education by type of practice

Practice	England (UK) index	England (UK) contraction	England (UK) expansion	OECD contraction	OECD expansion	OECD average index
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

Practice	England (UK) index	England (UK) contraction	England (UK) expansion	OECD contraction	OECD expansion	OECD average index
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

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- 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

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- 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

Education Innovation Index

United States 25

OECD average 30

Innovation in education by category

Category	United States	OECD average
Primary	26	31
Secondary	24	30
Maths	30	35
Science	26	29
Reading	21	27

Innovation in education by type of practice

Practice	United States	Contraction	Expansion	OECD contraction	OECD expansion	OECD average
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

Practice	United States	Contraction	Expansion	OECD contraction	OECD expansion	OECD average
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 31
- Secondary 30
- Maths 35
- Science 29
- Reading 27

Innovation in education by type of practice

Practice	Negative	Positive	Index
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

Practice	Negative	Positive	Index
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.

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

Some trends in educational outcomes

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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

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Academic outcome in primary and secondary science

Academic outcome in secondary maths

Academic outcome in primary reading

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

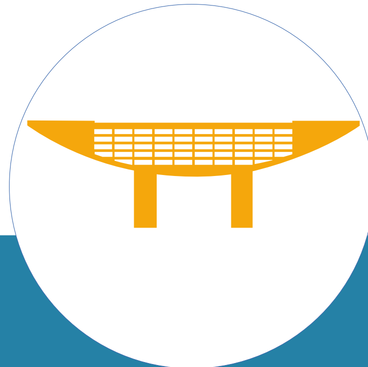
Other practices
23
-1,9 20,6
-6,6 14,2
21

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

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- 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

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- 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

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- Equity of academic outcomes in primary maths

Education Innovation Index

Indonesia 35

OECD average 30

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	Secondary	Maths	Science	Reading
Singapore	30	32	32	32	22
OECD average	31	30	35	29	27

Innovation in education by type of practice

Practice	Singapore index	Singapore contraction	Singapore expansion	OECD contraction	OECD expansion	OECD average index
Teachers' peer learning	54	0	54,2	-1,2	40,8	42
Active learning practices in science	39	0	39,2	-2,1	25,9	28
School learning resources	39	-32,5	6,1	-22,6	9,9	32
Rote learning	36	0	36,2	-3,2	28,4	32
Fostering higher order skills	34	-3	31,2	-3,3	20,7	24
School external relations and HRM	31	-0,4	30,2	-8,1	12,8	21
Independent knowledge acquisition	27	-3,8	23,3	-6,7	34,6	41
Homework	27	-1,6	25,2	-7,3	28,4	35
Assessment	23	-5,3	18	-9,3	16,9	26
Formal teacher training	17	-6,5	10,8	-17,3	6,5	24

ICT Innovation

Practice	Singapore index	Singapore contraction	Singapore expansion	OECD contraction	OECD expansion	OECD average index
Computer availability	62	-52,1	10	-30,5	8,5	39
Use of ICT in schools	24	-3,2	20,7	-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.

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 Teachers Students	4th grade 8th grade
PIRLS	Principals Teachers Students	4th grade 8th grade
PISA	Principals 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

StatLink https://doi.org/10.1787/888933907317

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

StatLink https://doi.org/10.1787/888933907336

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

StatLink https://doi.org/10.1787/888933907355

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
43	7.7	4th grade students discussing read text with peers in reading lessons
44	7.8	4th grade students using computers to work and communicate with peers
45	7.9	Same-ability class grouping in 4th grade reading lessons
46	7.10	Mixed-ability class grouping in 4th grade reading lessons

StatLink https://doi.org/10.1787/888933907374

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
48	8.3	8th grade students being monitored for homework completion in maths
48	8.4	8th grade students being monitored for homework completion in science
49	8.5	8th grade students correcting their own homework in maths
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

StatLink https://doi.org/10.1787/888933907393

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
54	9.7	4th grade students taking written tests in reading
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

StatLink https://doi.org/10.1787/888933907412

Table C.9. Innovation in learning scaffolding practices in reading

Indicator no.	Figure no.	Indicator name
57	10.1	Availability of an aide for 4th grade students who have reading difficulty
58	10.2	Waiting for maturation to improve performance in 4th grade reading
59	10.3	Spending more time on 4th grade students beginning to fall behind in reading
60	10.4	Parental help for 4th grade students beginning to fall behind in reading

StatLink https://doi.org/10.1787/888933907431

Table C.10. Innovation in access and use of learning resources

Indicator no.	Figure no.	Indicator name
61	11.1	4th grade students with access to a science laboratory at school
61	11.2	8th grade students with access to a science laboratory at school
62	11.3	4th grade students with access to a school library
63	11.4	4th grade students with access to a library or reading corner in the classroom
64	11.5	4th grade students borrowing books from the classroom library
65	11.6	4th grade students using computers at school
66	11.7	4th grade students visiting a library other than the classroom library
67	11.8	15 year old students with access to desktop computers at school
68	11.9	15 year old students with access to laptops or notebooks at school
69	11.10	4th grade students with computers or tablets available during maths lessons
69	11.11	8th grade students with computers or tablets available during maths lessons
70	11.12	4th grade students with computers or tablets available during science lessons
70	11.13	8th grade students with computers or tablets available during science lessons
71	11.14	4th grade students with computers or tablets available during reading lessons

StatLink https://doi.org/10.1787/888933907450

Table C.11. Innovation in various school-level practices

Indicator no.	Figure no.	Indicator name
72	12.1	15 year old students grouped by ability into different classes
73	12.2	15 year old students grouped by ability within classes
74	12.3	Tracking achievement data over time by an administrative authority for 15 year old students
75	12.4	Public posting of school achievement data for 15 year old students
76	12.5	Incentives to recruit or retain 8th grade maths teachers
76	12.6	Incentives to recruit or retain 8th grade science teachers
76	12.7	Incentives to recruit and retain 8th grade teachers besides maths and science
77	12.8	Parental involvement in 4th grade school activities
77	12.9	Parental involvement in 8th grade school activities

StatLink https://doi.org/10.1787/888933907469

Table C.12. Innovation in teacher professional development and collaborative practices

Indicator no.	Figure no.	Indicator name
78	13.1	4th grade teacher participation in a programme on mathematics content
78	13.2	8th grade teacher participation in a programme on mathematics content
78	13.3	4th grade teacher participation in a programme on science content
78	13.4	8th grade teacher participation in a programme on science content
79	13.5	4th grade maths teacher participation in programmes on pedagogy
79	13.6	8th grade maths teacher participation in programmes on pedagogy
79	13.7	4th grade science teacher participation in programmes on pedagogy
79	13.8	8th grade science teacher participation in programmes on pedagogy
80	13.9	4th grade maths teacher participation in programmes on curriculum
80	13.10	8th grade maths teacher participation in programmes on curriculum
80	13.11	4th grade science teacher participation in programmes on curriculum
80	13.12	8th grade science teacher participation in programmes on curriculum
81	13.13	4th grade teacher participation in programmes to integrate IT into maths
81	13.14	8th grade teacher participation in programmes to integrate IT into maths
81	13.15	4th grade teacher participation in programmes to integrate IT into science
81	13.16	8th grade teacher participation in programmes to integrate IT into science
82	13.17	4th grade maths teacher participation in programmes for improving students' creativity and critical thinking skills
82	13.18	8th grade maths teacher participation in programmes for improving students' creativity and critical thinking skills
83	13.23	4th grade science teacher participation in programmes on assessment
83	13.24	8th grade science teacher participation in programmes on assessment
84	13.25	4th grade teachers with assistance when students are conducting experiments
84	13.26	8th grade teachers with assistance when students are conducting experiments
85	13.27	4th grade teachers discussing how to teach a particular topic
85	13.28	8th grade maths teachers discussing how to teach a particular topic
85	13.29	8th grade science teachers discussing how to teach a particular topic
86	13.30	4th grade teachers collaborating in planning and preparing lessons
86	13.31	8th grade maths teachers collaborating in planning and preparing lessons
86	13.32	8th grade science teachers collaborating in planning and preparing lessons
87	13.33	4th grade teachers visiting a colleague's classroom to learn about teaching
87	13.34	8th grade maths teachers visiting a colleague's classroom to learn about teaching
87	13.35	8th grade science teachers visiting a colleague's classroom to learn about teaching

StatLink https://doi.org/10.1787/888933907488

Country index

Countries, systems and regions	Chapter in which they appear
OECD countries	
Australia	2,3,4,5,6,7,8,9,10,11,12,13
Austria	2,3,4,5,6,7,9,10,11,1213
Belgium	2,3,6,11,12
Belgium (Fl.)	2,3,4,5,6,7,9,10,11,12,13
Belgium (Fr.)	4,5,6,7,9,10,11
Canada	3,4,5,6,7,9,10,11,12
Canada (Alberta)	2,3,4,5,6,7,9,10,11,12,13
Canada (Ontario)	2,3,4,5,6,7,8,9,10,11,12,13
Canada (Quebec)	2,3,4,5,6,7,8,9,10,11,12,13
Colombia	3,6,12
Chile	2,3,4,5,6,8,9,11,12,13
Czech Republic	2,3,5,6,7,9,10,11,12,13
Denmark	2,3,4,5,6,7,9,10,11,12,13
Estonia	2,3,6,11,12
Finland	2,3,4,5,6,7,9,10,11,12,13
France	4,5,6,7,9,10,11
Germany	2,3,4,5,6,7,9,10,11,12,13
Greece	2,3,6,11,12
Hungary	2,3,4,5,6,7,8,9,10,11,12,13
Iceland	2,3,6,7,11,12
Ireland	2,3,4,5,6,7,8,9,10,11,12,13
Israel	2,3,4,5,6,7,8,9,10,11,12,13
Italy	2,3,4,5,6,7,8,9,10,11,12,13
Japan	2,3,5,6,7,8,9,11,12,13
Korea	2,3,5,6,7,8,9,11,12,13
Latvia	2,3,4,5,6,7,9,10,11,12
Lithuania	2,3,4,5,6,7,8,9,10,11,12,13
Luxembourg	3,6,12
Mexico	3,6,12
Netherlands	2,3,4,5,6,7,9,10,11,12,13
New Zealand	2,3,4,5,6,7,8,9,10,11,12,13
Norway	2,3,4,5,6,7,8,9,10,11,12,13
Poland	2,3,4,5,6,7,9,10,11,12,13
Portugal	2,3,4,5,6,7,9,10,11,12,13
Slovak Republic	2,3,4,5,6,7,9,10,11,12,13
Slovenia	2,3,4,5,6,7,8,9,10,11,12,13
Spain	2,3,4,5,6,7,9,10,11,12,13
Spain (Andalusia)	2,3,4,5,6,7,9,10,11
Sweden	2,3,4,5,6,7,8,9,10,11,12,13
Switzerland	2,3,6,7,9,11,12
Turkey	2,3,5,6,8,9,11,12,13
United Kingdom	3,6,12
U.K. (England)	2,3,4,5,6,7,8,9,10,11,12,13
U.K. (Northern Ireland)	2,3,4,5,6,7,9,10,11,13
United States	2,3,4,5,6,7,8,9,10,11,12,13
U.S. (Massachusetts)	2,3,5,6,8,9,11,12,13
U.S. (Minnesota)	2,3,5,6,8,9,11,12,13
Non-OECD countries	
Brazil	3,6,12
Hong Kong, China	2,3,4,5,6,7,8,9,10,11,12,13
Indonesia	2,3,4,5,6,7,8,9,10,11,12,13
Russian Federation	2,3,4,5,6,7,8,9,10,11,12,13
Singapore	2,3,4,5,6,7,8,9,10,11,12,13
South Africa	2,3,4,5,6,8,9,10,11,12,13

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OECD PUBLISHING, 2, rue André-Pascal, 75775 PARIS CEDEX 16
(96 2019 01 1 P) ISBN 978-92-64-31166-4 – 2019

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.

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Co-funded by the European Union

ISBN 978-92-64-31166-4
96 2019 01 1 P

9 789264 311664