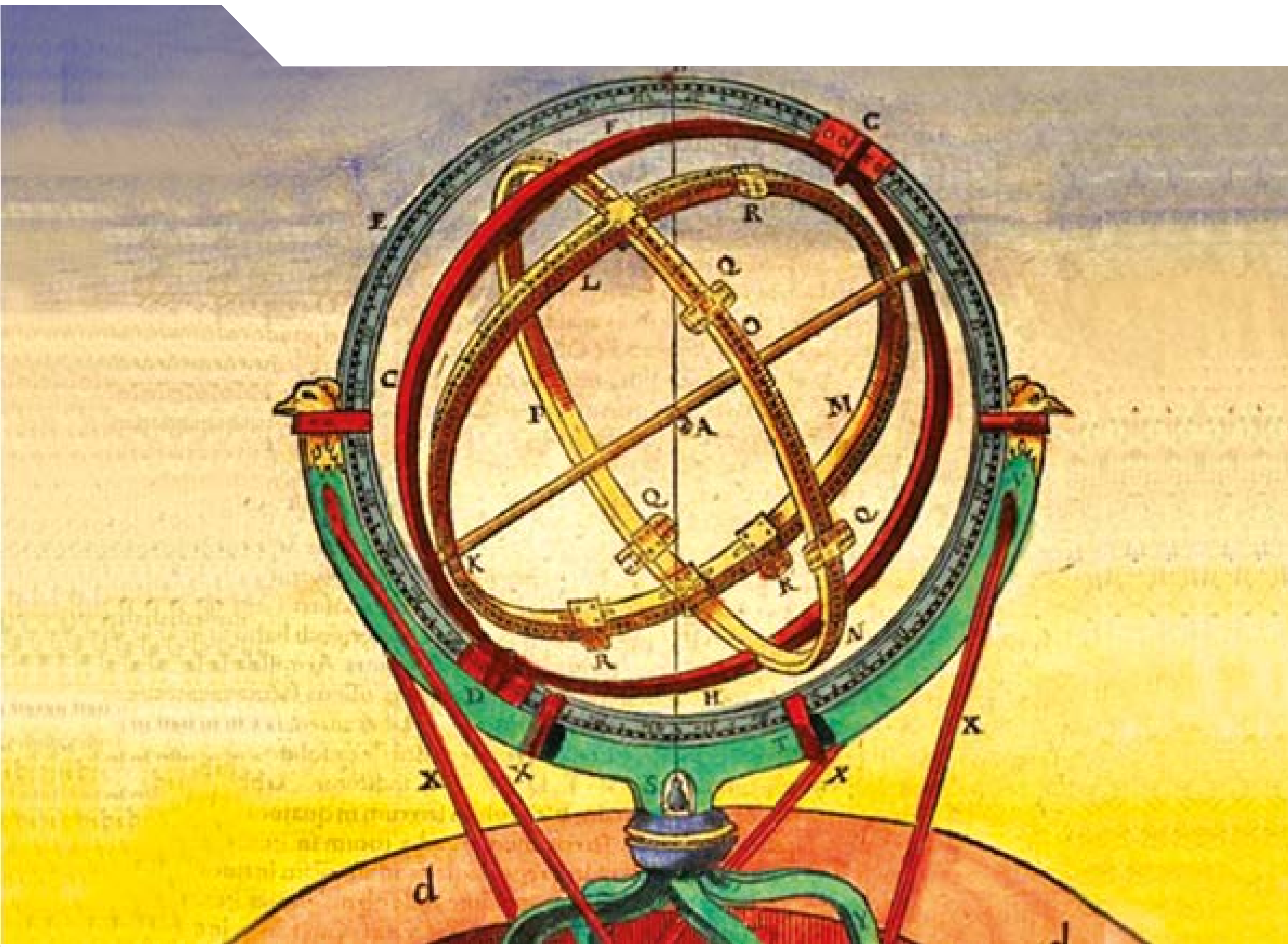
Educational Research and Innovation

Measuring Innovation in Education

A NEW PERSPECTIVE



Centre for Educational Research and Innovation

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Stéphan Vincent-Lancrin, Kiira Kärkkäinen,
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and Michele Rimini

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BETTER POLICIES FOR BETTER LIVES

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Please cite this publication as:
OECD (2014), *Measuring Innovation in Education: A New Perspective*, Educational Research and Innovation, OECD Publishing.
http://dx.doi.org/10.1787/9789264215696-en

ISBN 978-92-64-21568-9 (print)
ISBN 978-92-64-21569-6 (PDF)

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

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Foreword

Innovation drives improvement, either incrementally by advancing existing processes or more radically by introducing new practices. Improving people's life and education requires to better document and understand what is (and will) change in education, a central mission of the OECD Centre for Educational Research and Innovation.

While we have made tremendous progress over the past two decades in developing international measures and indicators in education, measuring innovation in the education sector has long been elusive. *Measuring innovation in education*, a first international compendium of measures of innovation in education, makes a start and also opens perspectives for improved measures of innovation in the education sector.

A commonly held belief is that education is not as innovative as other sectors of human activity. One interesting result of the book is that this may be a myth. Another important feature of the book is that it shows not only the volume of changes which countries have introduced in their primary and secondary education systems over the past decade, but also what these changes or innovations have been. This makes it a useful resource for policy makers wishing to explore to what extent their intended policy reforms have had the expected impact on school and teacher practices.

Without observation, simulation and measurement, advances in knowledge and practice are limited. Before becoming a pedagogic device, the armillary sphere on the cover of the book was designed and improved to take new measures and make simulations that led to a dramatic shift in understanding the complex movements of the universe. Now that we know that innovation in education can be measured, and that having such measures can improve education policy and practice, we should weigh the associated costs and benefits of the exercise. Measurement is indeed a key element of any educational innovation strategy.

Andreas Schleicher
Director for Education and Skills

Acknowledgements

This book was authored by Stéphan Vincent-Lancrin (OECD), Kiira Kärkkäinen (OECD), Sebastian Pfotenhauer (Massachussets Institute of Technology), Adele Atkinson (OECD), Gwénaël Jacotin (OECD) and Michele Rimini (OECD), with the help of Michael Beeman during his internship at the OECD. The book is an output of the Innovation Strategy for Education and Training by the OECD Centre for Educational Research and Innovation (CERI), a project led and conceptualised by Stéphan Vincent-Lancrin (OECD).

Vincent-Lancrin, Kärkkäinen and Pfotenhauer designed the initial overall concept of the book, and Vincent-Lancrin, Atkinson and Rimini subsequently designed the composite innovation indices and Part 3. Vincent-Lancrin led the process and drafted the Overview; Kärkkäinen drafted most of Part I with Rimini; Rimini, Atkinson and Karkkäinen drafted Part II; Atkinson and Rimini drafted Part III and Annexes; Jacotin did the statistical work and prepared the graphs. At different stages of the process, Francesco Avvisati, Beñat Bilbao-Osario, Alfonso Echazarra, Carlos Gonzalez-Sancho, Francisco Martinez Toro and Richard Scott made helpful comments as members of the CERI Innovation Strategy team. Dirk Van Damme, Head of the Innovation and Measuring Progress division at the OECD Directorate for Education and Skills, supported the project from the beginning and is thankfully acknowledged for his continued encouragements.

Within the OECD, colleagues from the Directorate for Science, Technology and Industry (STI), notably Alessandra Colecchia, Fernando Galindo-Rueda and Vladimir Lopez-Bassols, gave helpful feedback on a previous version of the report. Fred Gault (Merit University), Nathalie Greenan (Centre d'Etude de l'Emploi) and Edward Lorenz (University of Nice) are also gratefully acknowledged for enriching discussions with Vincent-Lancrin on innovation in the public sector and on the measurement of innovation.

Colleagues from the Publications and Communication Directorate made helpful comments on graph design and titles and are thankfully acknowledged. Lynda Hawe and Anne-Lise Prigent were in charge of the publication process. RosZ did the layout of the book.

Last but not least, members of the CERI governing board are thanked for their comments and input at different phases of the project. Rien Rouw (the Netherlands) made helpful comments on a previous version of the draft. During the initial development phases of the project, several experts and country representatives participated in two expert meetings held in Paris to discuss different avenues to develop new instruments for the measurement of innovation in education. Three countries (Denmark, France and the Netherlands) accepted to pilot a survey instrument. Even though this initial project had to be abandoned, it was instrumental for the progress of the project. It is indeed as the development of this project faced difficulties that the idea of a compendium of measures of innovation in education based on existing data emerged. These three countries and their representatives are thankfully acknowledged for supporting the project, notably Jørn Skovsgaard (Denmark), Claude Sauvageot (France), and Hans Burgman (the Netherlands).

The book is dedicated to the memory of Claude Sauvageot.

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Executive summary

The ability to measure innovation is essential to an improvement strategy in education. Knowing whether, and how much, practices are changing within classrooms and educational organisations, how teachers develop and use their pedagogical resources, and to what extent change can be linked to improvements would provide a substantial increase in the international education knowledge base.

Measuring Innovation in Education offers new perspectives to address this need for measurement in educational innovation through a comparison of innovation in education to innovation in other sectors, identification of specific innovations across educational systems, and construction of metrics to examine the relationship between educational innovation and changes in educational outcomes.

Key findings on innovation in the education sector

Some of the innovation indicators are derived from a survey covering tertiary graduates in 19 European countries, and casting light on several dimensions of innovation in education and other sectors of the economy (or society). Here are some key findings:

- Contrary to common belief, there is a fair level of innovation in the education sector, both relative to other sectors of society and in absolute terms. 70% of graduates employed in the education sector consider their establishments as highly innovative, on par with the economy average (69%).
- Within education, innovation intensity is greatest in higher education, with secondary and primary education approximately equal.
- Compared to other sectors, knowledge and method innovation is above average in education, product and service innovation is below average, and technology innovation is at the average sectorial level.
- Education is at or below the average in terms of the speed of adoption of innovation: 38% of graduates reported that their educational establishment was mostly at the forefront in adopting innovations, new knowledge or methods (against 41% on average in the economy).
- Higher education stands out in terms of speed of adopting innovation, above the economy average, and well above the rate in primary and secondary education.
- The education sector has significantly higher levels of innovation than the public administration on all our indicators and is at least as innovative as the health sector on each measure.

Key findings on innovation in primary and secondary education

Another approach to measuring innovation in education is based on assessing significant changes in key practices in educational establishments, be they pedagogic or organisational. This approach was implemented using international surveys such as PISA, TIMSS and PIRLS. Some of the key findings are as follows:

- There have been large increases in innovative pedagogic practices across all countries covered in areas such as relating lessons to real life, higher order skills, data and text interpretation and personalisation of teaching.
- In their pedagogic practice, teachers have innovated in their use of assessments and in the accessibility and use of support resources for instruction.
- Educational organisations have innovated in the areas of special education, creation of professional learning communities for teachers, evaluation and analytics and relationship building with external stakeholders, such as parents.
- In general, countries with greater levels of innovation see increases in certain educational outcomes, including higher (and improving) 8th grade mathematics performance, more equitable learning outcomes across ability and more satisfied teachers.
- Innovative educational systems generally have higher expenditures than non-innovative systems; however, their students are no more satisfied than those in less innovative systems.
- Overall, innovation has been higher with regards to classroom practices than school practices between 2000 and 2011.
- Taking all practices together in an overall composite innovation index, countries in which there has been the most innovation at the classroom and school levels in primary and secondary education include Denmark (37 points), Indonesia (36 points), Korea (32 points) and the Netherlands (30 points). Countries where there has been the least innovation include the Czech Republic (15 points), Austria (16 points), New Zealand and the United States (both 17 points). The OECD average is at 22 points. (These points can be read as an average effect size multiplied by 100.)

Towards surveys on innovation in education?

While this report uses existing international datasets, improved measures 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, 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.

Overview

Why and how to measure innovation in education

This Overview highlights the importance of measuring innovation in education, presents the methodology, objectives and findings of the book, and proposes new ways to improve measures of educational innovation in the future.

Objectives of the book

The OECD *Innovation* Strategy called for new perspectives on the measurement of innovation (OECD, 2010a, 2010b). In particular, it called for measures of innovation in the public sector, including in the education sector. *Measuring innovation in education* responds to this call, offering new perspectives on measuring innovation in education. It pursues several objectives.

The first objective is *informative*. The book gives readers new international comparative information about innovation in education compared to other sectors, and documents change in a variety of dimensions of school practices between 1999 and 2011. It is a key resource for readers interested in educational innovation, but given the variety of practices covered, it also provides material of interest to a wider audience. The main substantive findings of the book are summarised below.

The second objective is *methodological*. The book illustrates two basic but very different methods of measuring innovation in education, along with their advantages and disadvantages. It identifies the breadth of relevant data that can be incorporated within such measures, and makes visible the type of information that new data collections based on the two broad measurement approaches would yield. In particular, it shows how the publication of indicators about innovation in education based on two different definitions would enable innovation to be viewed in more objective, factual terms that are not conditioned solely by expert opinion.

The third objective is *heuristic*. *Measuring innovation in education* is a large scale pilot on the measurement of innovation. It proves that such measurement is possible within the education sector, shows what the production of such information could offer educational policy makers and illustrates how it could place discussion of innovation in education on a firmer footing. What kind of knowledge would we gain if we had better data on innovation? Which questions could we answer?

The fourth objective is *prospective*. The increasing wealth of educational data at the international level has made this pilot possible, but the lessons drawn from this effort should lead to improved measures and inform the development of targeted data collection on innovation in education. We propose below new approaches to measuring innovation in education in the future.

This book is thus the beginning of a new journey and calls for innovations in the field of measurement – and not just of education.

Why measure innovation in education: context and rationales

Before presenting how innovation in education is measured in this book, let us start by recalling why measuring innovation in education matters.

In the last few decades, innovation has been increasingly regarded as a crucial factor in maintaining competitiveness in a globalised economy. Innovation can breathe new life into slowing stagnant markets, and act as a mechanism to enhance any organisation's ability to adapt to changing environments (Damanpour and Gopalakrishnan, 1998; Hargadon and Sutton, 2000). Both innovation policies and theory have mainly focused on the business sector (Lekhi, 2007). Businesses need to innovate in order to keep up with competition by introducing new products or services, improving the efficiency of their production processes and organisational arrangements, or enhancing the marketing of their activities in order to guarantee their survival.

Much more recently, policy interest has extended this "innovation imperative" from private organisations to the provision of public services. Although public services, including education, tend neither to operate within competitive markets nor have the same incentives to innovate as businesses do (Lekhi, 2007), there are important arguments to push for innovation in education as a means to maximise the value of public investment. Several recent national innovation strategies include provisions for more innovation in the public sector (e.g. Australia, Finland, the Netherlands, Norway and the United Kingdom). Demographic pressures, burgeoning demand for government services, higher public expectations and ever-tighter fiscal constraints mean that the public sector needs innovative solutions to enhance productivity, contain costs and boost public satisfaction.

Innovation in the public sector in general, and in education in particular, could be a major driver for significant welfare gains. Governments provide a large number of services in OECD countries and the share of these services as a proportion of national income is considerable. Government expenditure in OECD countries represents above 40% of GDP on average (48% in 2011), and in some cases corresponds to more than half of the national GDP. Education is a major component of government services: in 2010, public expenditure on educational institutions accounted for 5.5% of the national income on average for OECD countries. Innovations improving the effectiveness and efficiency of such a large area of government spending could yield important benefits.

Why innovation in education matters

How could innovation add value in the case of education?

First of all, educational innovations can *improve learning outcomes* and the quality of education provision. For example, changes in the educational system or in pedagogies can help customise the educational process. New trends in personalised learning rely heavily on new school organisations and the use of ICT.

Second, education is perceived in most countries as a means to *enhance equity and equality*. Innovations could also help enhance equity in the access to and use of education, as well as equality in learning outcomes.

Third, public organisations are often under as much pressure as businesses to *improve efficiency*, minimise costs and maximise the "bang for the buck". Mulgan and Albury (2003) argue that there has been a tendency for costs in all public services to rise faster than those in the rest of the economy, and education is no exception. While this could be attributed to Baumol's cost disease, i.e. to the nature of the public service provision (which faces ever-rising labour costs and limited scope for transformative productivity gains), this may also be due to a lack of innovation (e.g. Foray and Raffo, 2012). Innovation, then, is regarded as a stimulus for a more efficient provision of these services.

Finally, education should remain relevant in the face of rapid changes to society and the national economy (Barrett, 1998:288). The education sector therefore should *introduce the necessary changes* that permit it to adapt to societal needs. Education systems, for example, face a need to adopt teaching, learning or organisational practices that have been identified as beneficial to fostering "skills for innovation" (Dumont et al., 2010; Schleicher, 2012; Winner et al., 2013). The results of the Programme for International Student Assessment (PISA), Trends in International Mathematics and Science Study (TIMSS), Progress in International Reading Literacy Study (PIRLS) and of the OECD Survey on adult skills point to the need for innovation to improve results in literacy, numeracy or scientific literacy in many countries.

The book proposes an exploration of the association between school innovation and different measures related to these educational objectives.

Why a measurement agenda

Evidence-based policy requires reliable measurement. Policies supporting innovation in the private and public sectors need relevant and reliable indicators that help monitor the innovation process, and evaluate the success of innovation policies. Moreover, comparable international data and benchmarking facilitate international policy learning.

A measurement agenda is essential to an innovation and improvement strategy in education. Knowing whether and to what extent practices are changing within classrooms and educational organisations, how teachers develop and use their pedagogical resources, and to what extent this change can be linked to improvements would allow for a substantial increase in the international knowledge base. We still lack too much information on actual classroom and school practices and resource use as well as how these factors are changing over time. Developing indicators that allow us to identify changes within classrooms and schools, and to what extent and for whom they are an amelioration, is key to the improvement of education. Such indicators are also a key for policy makers to understand the impacts of policy reforms in the classroom.

At the international level, the OECD PISA and Teaching and Learning International Survey (TALIS) programmes have started to meet the need for measurement, as have TIMSS and PIRLS (conducted by the International Association for the Evaluation of Educational Achievement [IEA]). However, further efforts to collect precise data are still necessary. Key knowledge gaps include: the state of teaching; the introduction of new or improved educational resources; how policy-driven or user-driven innovations actually change learning and teaching within classrooms as well as organisational efficiency within educational establishments. In addition, there is currently no international data collection comparable to the above-mentioned surveys at the higher education level or in vocational education and training establishments.

An important first step for a measurement agenda is to agree on operational definitions. This is necessary before we can better understand the drivers of innovation in education and refine our understanding of the effects of innovation policy levers in the education sector, an objective that goes well beyond the scope of this book. Understanding the limitations of existing measures will help improve the future measurement of the most important dimensions of innovation in education.

How innovation in education is measured in this publication

There has been a long-standing effort to develop innovation indicators for the private sector. Indicators derived from research and development (R&D) statistics and innovation surveys, for example, have gained collective support. National innovation surveys, such as the EU Community Innovation Survey (CIS), have, for example, been harmonised internationally since 1992.

However, the measurement of innovation and its effectiveness in the public sector, and in education in particular, is in its infancy. Despite the relative wealth of indicators in education, we still lack data that measure the innovation performance of education systems or that link innovations in classroom and school practices to actual improvement. This lack of available data could jeopardise our understanding and monitoring capacity of innovations in education, and thus hinder improvement.

The nature of the indicators to measure educational innovation may be different from those developed for the business sector. Given some of the specificities of the innovation process in education, better understanding both the amount and quality of innovation in education, as well as of the process leading to it, may require different forms of measurement.

Defining innovation in education

Many definitions of innovation are used in different contexts and disciplines, though, for statistical purposes, the most widely accepted definition of innovation comes from the Oslo Manual (OECD/Eurostat, 2005). It defines innovation as "the implementation of a new or significantly improved product (good or service) or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations." In this definition, implementation is used to refer to the *introduction* of a product to the market, whilst it refers to the actual use of processes, marketing methods and organisational methods. The use of the word "new" indicates that innovation contains a degree of novelty at the level of the organisation, the market, or the world.

This definition has been widely applied to the private sector and can also be applied to education with small modifications. Educational organisations (e.g. schools, universities, training centres, education publishers) introduce (1) new products and services, e.g. new syllabi, textbooks or educational resources (2) new processes for delivering their services, e.g. use of ICT in e-learning services, (3) new ways of organising their activities, e.g. ICT to communicate with students and parents, and (4) new marketing techniques, e.g. differential pricing of postgraduate courses. These new practices are intended to improve the provision of education in one way or another, and therefore, innovations in education should be regarded as "improvements".

However, the notion of "improvement" in many public services, including education, can be elusive and the use of this definition has been challenged. The perception of improvement depends on the perspective of the stakeholders, who may wear several hats: consumer, citizen and tax-payer (Parston, 2007). Assessing the success of companies in the private sector by profit, sales or growth is widely accepted: whatever their objectives, ultimately they have a single bottom line which prevails over their other objectives. By contrast, whether public organisations stay in business or close is usually bound to a political decision (rather than a market sanction). Public organisations are assessed on a multiplicity of objectives, such as increased quality, equity, coverage and efficiency, which are less commensurable and can even conflict.

As a result, improvements in education can be perceived differently depending on which objective is examined or on the point of view of the observer. Moreover, cultural values, social policies and political goals can lead to differing prioritisation of these different objectives across countries. Prioritisation can also change over time as the result of shifts in circumstances and citizens' expectations. This has consequences for the validity and limitations of the information gathered.

This implies that, ideally, innovation indicators in the education sector should be linked to specific social and educational objectives (e.g. learning outcomes, cost efficiency, equity, and public satisfaction). It should also be measured at different levels and, when they cannot be objective, measured according to different stakeholders' perspectives.

Measuring innovation in education: two broad approaches

Available innovation indicators provide an insight into the occurrence of innovation within some sectors of the economy but leave important gaps in our knowledge about innovations happening within the public sector. A number of recent initiatives have aimed at bridging these gaps and exploring the development of indicators better suited to public services in general. These initiatives could potentially be applied specifically to the education sector.

The recent initiatives can be grouped into two broad approaches to measuring innovation: (1) the adaptation of the innovation surveys to the public sector (including education), and (2) the analysis of organisational changes through employer-employee surveys. The two approaches explored are presented in the section below.

Measuring innovation in education is a pioneering attempt to apply these two broad approaches by presenting indicators based on existing international datasets. We thus provide education policy makers with an estimated order of magnitude of innovation and change in education, but also show the types of information that targeted data collections based on these approaches could generate. We also propose new methods to start more systematic collections of reliable measures of innovation in education.

The adaptation of innovation surveys to the education sector

The first approach to measure innovation in the public sector is the adaptation of existing national innovation surveys, such as the EU Community Innovation Survey. Such surveys offer well-established means of measuring innovation, performed over several decades for (selected) parts of the private sector.

Part I takes this approach to measuring innovation in education and presents indicators based on the analysis of two surveys (REFLEX and HEGESCO) in line with the methodology of the Community Innovation Survey. The Community Innovation Survey draws on the Oslo Manual – and its definition of innovation.

REFLEX and HEGESCO survey higher education graduates in European countries and Japan five years after their graduation. Survey questions cover respondents' current employment, including the intensity of innovation in their organisation, the type of innovation (product, process, organisation and marketing), and the extent to which they are involved in the innovation process. The data thus provide an assessment of innovation within different sectors, including education. The data allow for the comparison of innovation by type and level across different sub-sectors of education (primary, secondary, tertiary) and also with the innovation levels observed in other sectors of the economy. Detailed information about the surveys can be found in Appendix I.

There are a few differences between the REFLEX and HEGESCO surveys and national innovation surveys. First, REFLEX and HEGESCO include a small number of questions about innovation, but innovation is not their focus. Second, REFLEX and HEGESCO cover all sectors of the economy while national innovation surveys typically cover a few sectors considered ex ante as "more innovative". Third, the respondents are drawn from different groups: REFLEX and HEGESCO employed tertiary educated individuals, whilst national innovation surveys are answered by a representative answering for the responding firm. As most tertiary education graduates are employees rather than employers, REFLEX-HEGESCO are essentially employee surveys, while national innovation surveys are employer surveys.

Whilst at first glance the innovation categories reported in REFLEX and HEGESCO seem different from those of the Community Innovation Survey (and from the Oslo Manual), there is in fact a direct correspondence between the two. The definition used in the REFLEX and HEGESCO surveys is based on the second (rather than the third) edition of the Oslo Manual (OECD, 1997). The second version of the manual distinguished between two types of "technological innovation" (product or service, and process), and also considered a third type called "non-technological innovation", covering innovation in organisation and method. This definition can easily be reconciled with the definitions of the 3rd edition of the Oslo Manual, whose four types of innovation have been presented above. Product (or service) remains the same; process innovation refers to technology or tools; and organisation and marketing innovations are grouped as innovations of "knowledge or method".

Contrary to innovation surveys, REFLEX and HEGESCO do not include questions about the drivers of and obstacles to innovation. The innovation indicators reported in Part I therefore focus exclusively on innovation levels at a point in time.

The adaptation of organisational change surveys to the education sector

The second approach that has been used to improve the measurement of innovation in the public (and business) sector is based on surveys of organisational change. These surveys have been developed more recently than innovation surveys and have been implemented in national or European surveys (e.g. the "Organisational Change and Computerisation" [COI] survey in France or the "Measuring the Dynamics of Organisation and Work" [MEADOW] project in Europe). These surveys capture innovation with a mix of "subject-based" and "object-based" approaches. They typically measure the dissemination of specific innovations in the economy, for example computers or organisational practices. In terms of method, they implement matched employer-employee surveys, asking workers and employers about their current working conditions or tools compared to those in the past. The difference between the current and past situations makes it possible to determine whether there has been innovation across different dimensions of interest. However, as of 2014, to our knowledge no international database using this approach covers the education sector.

Part II applies the working definition of innovation as the implementation of 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. Given that we cannot directly observe whether these processes, practices and methods are "improved", we have to depart from the Oslo Manual definition and use change as a proxy measure. It can be assumed that change occurs because of a belief that the new version is an improvement of some educational goal. The book thus presents a range of indicators based on an approximation of the traditional innovation definition. It captures innovation as a significant change in some key practices in educational establishments by drawing on the PISA, TIMSS and PIRLS databases. Further information about these data sources can be found in Appendix I of the book. Whilst these studies are designed to measure student outcomes, they also collect information about educational and teaching practices at a point in time. The repeated cross-sectional nature of the studies makes it possible to map trends over time. Our indicators are therefore based on the analysis of responses to questions that have been asked in at least two waves of the study in order to identify changes in professional practices or in classroom or school resources.

In contrast to innovation surveys, the proposed indicators are "object-based"; they do not only give a level of innovation by country, but also identify what these innovations or practices are. The indicators report information about which practices have changed and which have remained constant. They also report on the direction of the observed changes: one can innovate by doing significantly less of something, or significantly more. (This is also true in the business sector: a device can be significantly improved by reducing its inputs (such as power use) or its outputs (such as gas emission) whilst maintaining the same functionality.) Moreover, in this section we focus on the school sector, which does typically not introduce products to a market. Gault (2012) has suggested that this potential issue in the definition can be overcome by introducing the explanation that a product is implemented when it is "made available to potential users". In the case of education, this would typically be students.

How much change counts as a significant change? One difficult question with this methodology is to determine how much a variable needs to change before we consider that we are observing an innovation, that is, what constitutes a significant (or noteworthy) change. There is no definitive answer to this question, which requires, in any case, some subjective judgment. 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. In this publication, summary tables providing *effect sizes* assist the reader in making this judgment. Effect sizes give a standardised measure of these changes and help interpret the relative magnitude of the change: the greater the effect size, the higher the magnitude (and likely "significance") of change over time.

The practices presented have been selected and grouped in two categories: classroom and school changes (or innovations).

Classroom practices (i.e. teaching and learning) are often the most difficult practices of education to change, and the literature on research and innovation shows that classroom practices are often left unaffected by educational reform. An important reason to measure change in classroom practices is precisely to see whether the intended effects of reform, professional development efforts, advocacy or educational research do materialise in changed practices. We look at three dimensions: instructional practices (Chapters 5, 6, 7, 9), use of educational resources (Chapters 8, 11) and availability of resources for teaching (Chapter 10). In the frame of the Oslo Manual, noteworthy changes in any of these dimensions would correspond to a process innovation.

School practices are more easily influenced by education policy and decision makers, and perhaps also easier to measure. They encompass practices that can affect students directly, for example through the provision of special programmes (Chapter 12), or indirectly, through new organisational and human resource management practices (Chapters 13, 14, 15) and new ways of engaging or relating to parents (Chapter 16). Here again, there is a straightforward correspondence with the types of innovation of the Oslo Manual as changes to school practices cover innovations in organisation and marketing (such as external relations with parents), even though these categories could be broader. In sum, our implementation of the the organisational change approach can easily be related to the innovation framework of the Oslo Manual.

The variety of indicators that can be included in the "organisational change" approach gives us much more information and detail about ongoing innovations than the "innovation survey" approach. It also allows us to accommodate an "expert" view of educational innovation. Because of the lack of innovation measures, many observers and experts have their own opinion about education systems' innovation intensity and about what is "innovative" or not. Some people would consider that an increase in the use of ICT is a sign of innovation. Others would consider some pedagogical practices as innovative – for example "active pedagogies" such as problem-based learning or student-centred pedagogies – because these pedagogies are less common than others, an impression that they form from school visits or knowledge of the field. The indicators compiled in this book also provide information on whether practices subjectively perceived as "innovative" (in a different meaning from the Oslo manual) are becoming more common or not – and also the extent to which they are "mainstream".

One downside of applying the organisational change method through the use of international databases not purposely designed to measure innovation is that the data do not give us a synthetic measure of innovation. While innovation is often made up of many small changes, it is important to get a synthetic idea of the magnitude of overall innovation and of different dimensions of innovation.

To that purpose, in each chapter of this publication we provide a visual representation of aggregated change across the different dimensions covered in the chapter. While this aggregate indicator cannot be compared across chapters (given the diversity of the format of the questions), it helps the reader to spot where there has been more change in the broad category that we examine across countries.

We also compute a composite "innovation index" and several other sub-indices (Chapter 17), which synthesise the information captured throughout the "organisational change" part of the publication. We present aggregate estimates of innovation in schools and classrooms and more focused detail of its location in terms of grade and subject. The construction of the indices and the reasons to interpret them with caution are explained in Appendix II.

Better understanding the role of innovation in education

Innovation may or may not achieve its stated goals of improvement. The same is true of policy reform. One possible reason is that the changes necessary (or expected) to reach the goal do not occur. For this reason, monitoring innovation and change is important, irrespective of whether or not we can prove the effect of innovation (or noteworthy changes in practices and resources) on valued outcomes in the education sector. Such monitoring allows education policy makers and other education stakeholders to know whether their decisions and actions have led to the anticipated level of innovation. This would help better understand the issue at stake, as captured by the title of a recent book: *So much reform, so little change* (Payne, 2010). In turn, regardless of reform, understanding what is changing in the educational landscape is a key to informed decision-making.

One could also hope that measuring innovation will help to better understand the effects of specific types of innovation on educational outcomes. Part III of this publication explores how innovation in primary and secondary schools is associated with a variety of educational outcomes related to student performance, equality and equity, expenditure per student, and teacher and student satisfaction. The analysis is descriptive in nature, and cannot explain the direction of any observed relationship or be used to infer causality, but it kick-starts a discussion on what more is needed in order to measure the impact of innovation and to cast light on the contexts that make innovation more likely to succeed.

Summary of the main findings

Different pictures of innovation in education can be drawn from the indicators presented in this book, depending on readers' interests. In this section we propose one possible picture with a high level summary of some key findings.

Innovation intensity in the education sector

Contrary to what is often believed, there is a fair level of innovation in the education sector, both relative to other sectors and in absolute terms. Innovation intensity is greater in higher education, with secondary and primary education approximately equal. Compared to other sectors, knowledge and method innovation is above average in education; product and service innovation is below average, while technology innovation is at the average sectorial level.

A first dimension of innovation concerns the prevalence of highly innovative organisations, as reported by the tertiary education graduates they employ.

- 70% of graduates employed in the education sector consider their establishments as highly innovative, on par with the economy average (69%).
- Educational establishments are however slightly less likely than average to combine high levels of innovation across all types of innovation (product, technology, and knowledge/method).
- In higher education, 80% of professionals in Europe were employed in highly innovative organisations in relation to at least one type of innovation. That is similar to the manufacturing sector (79%) and the highest share of all sectors of the economy.

A second dimension is whether organisations adopt innovations, new knowledge or new methods quickly. Rapid adoption is a sign of being a lead innovator.

- Education is at or below the average in terms of the speed of adoption of innovation: 38% of graduates reported that their educational establishment was mostly at the forefront in adopting innovations, new knowledge or methods (against 41% on average in the economy).
- Higher education stands out in terms of speed of adopting innovation, above the economy average, and well above the rate in primary and secondary education. Overall, 46% of higher education professionals reported that their educational establishment was mostly at the forefront in adopting innovations and new knowledge, compared to 31% in primary education and 30% in secondary education.

A third dimension of innovation lies in the prevalence of highly innovative jobs in the sector, a criterion that is more selective than the prevalence of highly innovative organisations. We define "highly innovative jobs" as those in highly innovative organisations regarding at least one type of innovation and where the employee plays a role in introducing those kinds of innovations.

- 58% of tertiary graduates indicated that they had "highly innovative" jobs (against 55% on average in the economy).
- Highly innovative jobs in education were more likely to concern knowledge and methods innovation (47%); this was the most common type of innovation in the education sector in all countries covered.
- Only the manufacturing sector (64%) had significantly more highly innovative jobs than the education sector across the countries analysed.
- 68% of graduates working in the higher education sector in Europe had highly innovative jobs in 2005 or 2008. This figure was 53% for secondary and 55% for primary education, while the likelihood of graduates having highly innovative jobs was nearly twice as high for those working in higher education as in secondary or primary education.

There are big variations across countries in the reported levels of innovation. Interestingly, the education sector has significantly higher levels of innovation than the public administration on all our indicators and is at least as innovative as the health sector on each measure. On average, education thus seems to have higher levels of innovation than the other public sectors for which we have information.

Pedagogic and organisational innovation in primary and secondary education

Our analysis of the magnitude of change at the classroom and school levels in primary and secondary education gives us an idea of what some of the innovations measured above may look like at these levels.

Many observers of educational innovation in primary and secondary education are interested in pedagogic innovation because teaching (rather than teachers) is the closest factor to the learner allowing learning improvement in formal settings. It is often believed that pedagogic practices in the classroom change little, and that teachers are reluctant to adopt "active pedagogies" that give a more central role to students in directing their own learning or that motivate them more for learning (Dumont et al., 2010). Our indicators confirm this overall impression to some extent but also highlight important nuances.

- Very little change has occurred in terms of prevalence of lecture-style presentations at 8^{th} grade between 2003 and 2007. While this is a more contentious pedagogic practice, the use of instructional time for student independent work (without guidance) has also stayed mostly constant. On average, teaching practices that put teachers at the centre of instruction have thus not diminished. Interestingly, teachers and students disagree on the prevalence of these practices (students perceive them as much more prevalent than teachers do).
- In contrast, between 2001 and 2011, there has been a large increase in other pedagogic practices generally considered as "innovative", with increasing emphasis on: relating lessons to real life; higher order skills (reasoning and leaving discretion to students in solving problems, designing experiments or choosing their reading materials); data and text interpretation; and personalisation of teaching (responsiveness to individual students' needs, individualised instruction). This is true across grades and subjects. Students' group work has also increased on average.
- In a couple of cases, average innovation levels hide a mixed picture across countries or disciplines. Whilst individualised instruction increased on average by 11 percentage points,

it has sharply decreased or increased in a few countries. Whilst students' group work has increased in maths and reading, it has slightly decreased in science.

Student assessment has become a central focus of education policy in many countries (OECD, 2013a). It has also been a major area of pedagogic innovation in primary and secondary education, with considerable change in assessment methods and hopes that more testing will lead to better learning outcomes. Indeed, there seems to have been much more testing of students in the 2000s: the use of all types of tests has either increased or remained stable on average. Even though trends in some countries may give the impression of an increased use of standardised tests by teachers, this does not seem to be an international trend:

- Overall, the use of tests developed by teachers has been the subject of innovation, with an absolute change of 8% points on average. Across countries, though, changes have occurred in both directions: tests developed by teachers were more frequently used in 2009 than in 2003 in six countries, while the opposite was true for four countries.
- There has been an absolute change of 3% points on average in the frequent use of standardised tests in schools, with an average change of only 1% point when all directions of change are taken into account. This practice became less frequent in three countries, and more frequent in eight countries, including countries where the increase has been very large (the Netherlands, Indonesia, Poland and the Russian Federation).
- Very large changes in the use of student assessments not based on classroom tests can be observed in some countries between 2003 and 2009, with increases in Poland (by 67% points), Finland (62% points) and Denmark (27% points), and decrease in the United States (25% points).
- Between 2003 and 2009, there was a noteable increase in the use of student portfolios as assessments in schools in Indonesia (by 40% points), Denmark (36% points) and Greece (29% points) and a decrease in this practice in Norway (29% points).

Pedagogic innovation is often related to the accessibility and use of support resources for instruction, such as textbooks and computers. Knowing to what extent teachers use different pedagogic resources is critical to find the best ways to support their teaching and empower them (Kärkkäinen, 2012; Avvisati et al., 2013; OECD, 2012). Among these resources, many observers attach particular importance and interest in the use of information and communication technology (ICT) – sometimes even merely assimilating innovation to the use of ICT in school.

- Teachers have significantly increased their use of textbooks as a basis of instruction for science and maths classes between 2003 and 2011. Consistent with this, as textbooks became a primary resource for instruction, there was a reduction in the extent to which textbooks were used as supplementary resources. Only for reading instruction has the increase in the use of textbooks been modest: the three countries exhibiting an increase in textbook use equalised those countries with diminishing use.
- Whilst availability of computers has increased on average in 4th grade classrooms between 2003 and 2011, it has slightly decreased in 8th grade classrooms (and computers are not available for use by all 4th or 8th grade maths and science students). There have been increases in some countries and decreases in other countries. In New Zealand, for example, computer availability increased in maths at 4th grade but decreased in maths at 8th grade level between 2003 and 2011. There may be several explanations for the unexpected direction of these changes, including the fact that computers have become only one ICT device among others. As "mobile learning" becomes more prevalent, tablets, e-readers, mobile phones, clickers and other portable devices may displace computers from classrooms, at least at the upper levels of schooling in OECD countries.

- Inevitably, there is overlap between the percentage of classrooms with a computer and those with access to the Internet. Similarly, there is overlap with classrooms using computers to practice skills and procedures, search information, analyse data, undertake experimentation, or for reading or writing. Large changes in both directions were observed, and were typically more pronounced and positive at 4th grade than at 8th grade. The Russian Federation is the only country exhibiting consistent increases in computer use across pedagogical purposes, disciplines and levels between 2003 and 2011.

The analyses also capture another type of innovation in primary and secondary education: organisational innovation at the school level. Organisational changes typically aim at improving learning in the classroom by changing the supporting environment offered by the school to students or staff. These changes can correspond to a new pedagogic offer, to new professional practices of teachers, such as collaboration or teacher evaluation.

- In terms of educational offer proposed by schools, innovation in special education has mostly resulted in more remedial and enrichment education at 8th grade level between 1999 and 2007. However, there are important exceptions: for example, large decreases in enrichment education for 8th grade science took place in the Russian Federation (by 50% points), Israel (30% points) and Hong Kong (25% points); and for mathematics, notable decreases took place in the Russian Federation (43% points) and Ontario (26% points).
- The constitution of "professional learning communities" entailing more collaboration and peer learning among teachers is often considered to be a critical driver of innovation and improvement in teaching practices (OECD, 2013b; Vieluf et al., 2012). Two key related practices are teacher collaboration and more intensive patterns of class observation, for both of which there is evidence of innovation. Peer discussions about instruction have increased on average, and regular classroom observation has increased as well, but to a much lesser extent. Collaboration in preparing instructional materials has decreased, perhaps as a result of the more intensive use of textbooks as a basis for instruction. Interestingly, innovation related to these professional learning communities has not been uniform across countries and has moved in both directions (more or less of these practices) between 2003 and 2011. There has been more change in this area at 8th grade than 4th grade across OECD countries in absolute terms.
- Thanks to new avenues opened by data analytics, educational data are being used for comparing and giving feedback to schools or teachers, and for accountability purposes. While student assessment data have clearly increasingly been used for district or national benchmarking in secondary education and for monitoring yearly school progress, there has been a strong reduction in their use for comparing schools. The administrative tracking of achievement data has remained constant on average, but has sharply increased in some countries (Korea, Denmark, Norway, Poland, Israel) and decreased in others (the Netherlands, Germany).
- Teacher evaluation has also shown signs of innovation, with the use of assessment data, external evaluation and peer evaluation typically increasing across grades and subjects. Direction of innovation in recruiting and retaining practices differed across education systems with regard to incentives use, with little overall change concerning OECD average level.

Finally, organisational innovation can be focused on new relationships with "external" stakeholders such as parents, employers, funders or the public at large. This type of innovation could also be characterised as marketing innovation. The analyses notably capture innovation in relationships with parents, which are highly important given the importance of family involvement for student achievement.

- Assessment data are extensively used as tools to inform parents, though there has been little change between 2000 and 2009. Similarly, parental perception regarding school provision of regular information on students' performance did not change significantly between 2006 and 2009. The United States (21% points) registered the largest increase in the use of assessment data to inform parents about their child's performance.

- More schools asked for parental involvement in schools between 2003 and 2007. Principal and school engagement in public relations and fundraising activities slightly decreased across OECD countries in the timeframe between 2001 and 2009.

Overall, innovation has been higher with regards to classroom practices than school practices between 2000 and 2011. Taking all practices together in an overall composite innovation index, 13 out of 28 education systems are seen to be above the OECD mean (22 points) in terms of the extent of change across school and classroom practices. Countries in which there has been the most innovation at the classroom and school levels in primary and secondary education include Denmark (37 points), Indonesia (36 points), Korea (32 points) and the Netherlands (30 points). Countries where there has been the least innovation include the Czech Republic (15 points), Austria (16 points), New Zealand and the United States (both 17 points). The points of the indices are based on (and can be interpreted as) effect sizes (multiplied by 100).

While some practices have changed (generally increased) in the same direction across countries (e.g. relating lessons to real life and reasoning, using text books and involving parents), there are still many practices that exhibit no clear international direction of change. Innovation concerning these practices corresponded to large moves in both directions across countries (as with methods of assessment) or by subject/grade (as with network accessibility in New Zealand, which increased in 4th grade maths but decreased in 8th grade maths between 2003 and 2011). Some practices have also changed significantly in a few countries (such as the increased extent to which parents in the United States have been informed about their child's performance), but not seen widespread variation. While there may be an international consensus about the adoption of some practices, this is clearly not the case for all.

Composite innovation indices, and the association between these and outcomes

The overall extent of innovation in primary and secondary education in a country is correlated (usually positively) with certain educational outcomes. In particular, more innovative countries have higher – and improving – maths performance at 8th grade, more equitable learning outcomes across ability, and more satisfied teachers. However, they have typically increased their expenditure more, and their students are no more satisfied than those in less innovative countries.

- Whilst there is considerable variation, education systems that have experienced more change in school and classroom practice, as indicated by a higher position on the overall composite innovation index, typically have higher maths scores than those with a lower position.

- Analysis of the association between innovation and improvement in maths performance between 2003 and 2011 indicates a positive association between overall innovation and trends in 8th grade mathematics outcomes. There is no association between school-level innovation and trends in maths scores.

- There is a positive association between innovation and equality in learning outcomes: education systems that have innovated the most are also the most equitable in terms of students' learning outcomes. However, the correlations between innovation and equity of learning opportunities are weak.

- Most of the education systems included in the analysis have increased their level of educational expenditure per student between 2000 and 2010 by similar amounts, regardless of their level of overall innovation. Among the education systems registering the largest increases in educational expenditure per student, Korea and the Czech Republic exhibit two opposite behaviours regarding educational innovation, where the former is above average in terms of innovation whilst the latter is near the bottom of the innovation index.

- Analysis of the relationship between overall innovation and changes in 8th grade maths teacher satisfaction shows a strong positive correlation, indicating that teachers in more innovative education systems have become more satisfied over time whilst satisfaction has fallen in less innovative places. The finding is even stronger when looking at classroom innovation.
- In contrast with the previous finding, classroom level innovation appears to have no association with student satisfaction, although this is in part driven by the slight reduction in satisfaction amongst students in Indonesia. Israel and Korea stand out as countries that have innovated at the classroom level and seen an improvement in student satisfaction.

At this stage, no conclusion can be drawn about the direction of any causality underlying these associations. Further work, both qualitative and quantitative, should investigate the complex interplay between innovation in general, specific innovations and various educational outcomes. More systematic and targeted data collections about innovation in education should be a key aspect of this policy research agenda.

How to improve the measurement of innovation in education

Measuring Innovation in Education allows us to explore the potential of two different methods to measure innovation in the education sector: an “innovation survey” approach and an “organisational change” approach. Both approaches yield valuable information. Their implementation has enabled better understanding of the limits of each method. In this final section, we translate what we have learned during this exercise into a proposal for developing new, improved measures of innovation in education. We then discuss how it could be complemented by other measurement initiatives.

Designing a new survey on innovation in education

Our preferred approach to measuring innovation in education would be to develop a dedicated international survey – or at least survey instrument. Adopting and adapting the organisational change approach using matched employer-employee-user surveys appears as the most fruitful way forward for the education community. Such a survey could be administered to the central educational administration (ministries, relevant local authorities) and to educational establishments in primary, secondary and tertiary education, targeting three levels of stakeholders: principal/president, teachers/faculty and students. The survey would question the three different stakeholders about the state and changes in their work practices and work environment. Innovation would be inferred 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. The survey would also 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). Like in traditional innovation surveys, questions to employers could allow one to capture the sources and objectives of planned innovations, while questions to other stakeholders would enable capturing to what extent these planned improvements are implemented and perceived on the ground, and the extent of unplanned innovations.

As for practices, the survey would cover the broad innovation areas highlighted by the Oslo Manual: 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). Information about the broader environment in which these practices take place should also be collected, such as information about size of establishment and classrooms, number of classes, competition with other schools in the neighbourhood, regulation and regulatory changes.

Advantages of a new survey

A new matched employer-employee organisational change survey has at least three principal advantages for education stakeholders.

First, it allows identifying the main areas of innovation (and even specific innovations) in the education sector and not only measuring the intensity of overall innovation. This is one advantage of "object-based" surveys, which collect more specific information because they tend to focus on one type of social activity. For example, the second part of the report is "object-based" in that it tells us what the innovations are at the system level: a different way to involve parents, the increased use of a pedagogic practice. Their disadvantage is that comparison with other sectors becomes difficult, if not impossible. Surveys covering several sectors generally need to be "subject-based" and capture different types of innovation in a generic way so that they can be relevant for different types of activities. Or they need to focus on a specific type of innovation that cuts across different activities, for example ICT innovation.

Second, this approach avoids the ambiguities of the "innovation" concept, a term that, even when defined, can be understood in different ways by respondents across different countries. Here, innovation is mainly inferred from factual questions about work or learning practices.

Third, asking the views of several stakeholders gives a rich picture about current practices, about innovations and about their perceived impact. Innovation surveys typically report innovations from the viewpoint of the employers (firms), which gives a high-level view covering the entire establishment. This viewpoint is important in order to understand the intended practices. Surveying employees and users provides additional understanding of whether these innovations are implemented, or perceived as innovative by employees (regarding organisational innovation for example) or by end users or consumers (regarding new products, services or processes). There are also innovations that are not intended by employers or (or not perceived as innovation), and employees and users are much better placed to report on those. A matched survey would thus provide us with a multiplicity of perspectives on different types of innovations.

Challenges of a new survey

A matched organisational survey approach to measuring educational innovation presents (at least) three big intellectual and practical challenges: identifying the major relevant practices and innovations that matter the most in the education sector, which can prove difficult at the international level; getting accurate reporting of pedagogical practices and resource use; and linking the changes to observed and perceived outcomes.

Identifying the major relevant educational practices and innovations internationally can be challenging. As documented in our report, innovations in pedagogic and school practices are neither similar nor synchronous in all countries: from one country to the other, innovations may concern different types of practices over a specific period of time. As a survey can only cover a limited number of practices, the selection of the most relevant practices can prove difficult internationally. Even within a single country, innovation can in principle concern any product, process or practice. The lack of representativeness of the surveyed practices can thus be worrisome. However, this does not imply that we cannot agree on core practices that deserve to be monitored in all countries and on some other practices that are important or interesting to cover from an innovation perspective, even though their prevalence differs a lot from one country to the other. The second kind of practices could be emerging practices or practices considered to have a high transformational potential for education.

Within the broad areas of innovations and practices mentioned above, we could select major practices of interest by building on three different types of inputs: teachers/faculty and employers could be asked in a pre-survey about the practices they see as the most important to cover in such a survey; educational innovation and improvement experts could be asked the same, using for example the Delphi method; and a literature review of practices that are known (or believed) to have an important impact on key educational goals could be a third input. The challenge and objective of the final questionnaire would be to identify a small but relevant number of core educational practices, but also emerging or promising practices of interest that would be balanced and interesting to both stakeholders and countries. Should the survey be repeated, modules focusing on specific dimensions of interest (for example the use of specific organisational routines or of tools such as learning management systems) could allow a more in-depth analysis of the uptake of specific practices.

The second main difficulty lies in the appropriate reporting of pedagogic practices and of their occurrence given that teaching and learning involves a mix of so many different types of activities. If we decided that we would like to know whether teachers use more of, say, metacognitive instruction or problem-based pedagogies, how would we collect accurate information? Ideally, this would be done through observations rather than self-reported responses by stakeholders, as these responses are subject to discretionary interpretation. In that respect, large-scale video studies could be seen as an ideal option: they would allow us to capture teachers' teaching practices in an objective manner. The Measures of Effective Teaching (MET) project, a USD 52 million study sponsored by the Bill & Melinda Gates Foundation, has partnered and tested different tools with 3 000 US teacher volunteers, including tools to measure the effectiveness of instruction as observed by students and by peers (see http://www.metproject.org). These tools or similar ones could possibly be used to cover some aspects of the classroom environment and instruction. Most of them tend to focus on an assessment of teaching effectiveness rather than a description of pedagogic practice, and their model may also be prone to cultural variability. For example, being "caring" or "managing student behaviour" may well be interpreted differently in, say, the United States and in Japan. One could however develop different coding tools to describe the pedagogic practice as well as to assess the quality of their implementation.

Even though it is routinely done in many surveys, another underestimated challenge is to collect accurately the frequency or amount of time teachers or pupils spend on specific practices. One way to capture different types of pedagogic practices more objectively than a traditional questionnaire would be to use the experience sampling method developed by Larson and Csikszentmihalyi (1983), i.e., asking different stakeholders to describe in real time what activity they are doing (e.g. via mobile phone or other mobile device). Csikszentmihalyi and Schneider (2001) use this method in an educational setting to assess how much time is devoted to different learning or teaching activities. Although it is a declarative method, in principle it gives a more accurate picture of time spent on different activities than questions about retrospective use of time would typically do.

The third challenge in our method is to link change (innovation) and outcomes in a satisfactory way. It is the impact of innovation (or of the innovation process) that matters. Moreover, innovation does not necessarily have the positive impact it seeks. Ideally, we would thus like impacts to be measured objectively at the establishment level. This is difficult in practice, but the rise of longitudinal data systems that follow students from kindergarten to their transition to the labour market will make this possible in the near future (OECD, 2010c). Our questionnaires matched organisational change survey instruments should ideally be used within countries or jurisdictions as part of these educational longitudinal information systems that track student, teacher and school characteristics and outcomes over time. This link would allow us to identify whether observed changes led to improvements in specific outcomes, all other (observed) things being equal. At the aggregate level, establishing such a causal link is very difficult, even though a dedicated survey could easily improve our understanding of the associations between outcomes and observed changes compared to what could be done in this report. Asking different surveyed stakeholders about their perception of impact is for example useful. First, because their perception may be accurate. Second, and perhaps more importantly, because their subjective answers could also help understand why some changes are embraced or resisted, regardless of their "objective" effects.

Measuring innovation in education following the "organisational change" methodology would thus give the educational community a picture of current pedagogical and organisational practices, of how they have changed or are changing, and would lead to identify some important innovations. The accuracy of these measures would of course increase over time as they are repeated. While computing a composite innovation index could be done again, a more straightforward way to capture the overall extent of innovation would be to include a few questions using the subject-based approach of innovation surveys, which ask directly about innovation according to some defined categories (product, process, organisation, marketing; new to the world, to the sector, to the company/organisation). The two approaches could indeed be mixed and, as the present report demonstrates, provide complementary types of innovations. A few questions could, for example, help capture the main sources of innovation in education, as well as identify some important barriers. In our multilevel approach, the employer questionnaire could investigate many of the dimensions that commonly form part of innovation surveys (for example the intended impact of innovations).

The development of a specific survey or survey instrument on innovation in education along the lines proposed above is feasible. It has development and implementation cost, like other surveys that are routinely undertaken in many different areas. One objective of Measuring Innovation in Education is to show the value such an innovation survey would have for education decision makers. It could naturally be less ambitious than what is proposed above.

Taking advantage of new efforts to measure public sector innovation

The proposed approach is not exclusive from other measurement approaches. In fact, measuring innovation through several approaches would enrich our stock of knowledge, and also speed up the development of our understanding of innovation in the education sector.

There is rising interest in the measurement of innovation in the public sector, and taking advantage of ongoing efforts should be another means to improve the knowledge base about educational innovation. A number of recent initiatives have explored the development of innovation indicators suited to public services. Innovation in education could be measured as part of these surveys. These approaches follow either the subject-based "innovation survey" or the object-based "organisational change" approach. Any new effort to develop new measures of innovation in the education sector should partly build on the lessons and instruments designed by these initiatives. One big advantage of these initiatives is that they allow one to compare innovation in education and innovation in other sectors (or public sectors).

The adaptation of innovation surveys to the education sector

As of 2014, the OECD Working Party of National Experts on Science and Technology Indicators (NESTI) is conducting work to contribute to the development of a measurement framework for public sector innovation1. The project examines the feasibility of adapting the framework commonly used for measuring business innovation (the Oslo Manual) to a public sector setting and has started developing a questionnaire inspired by traditional innovation surveys. The envisaged survey is largely subject-based but covers not only the types of innovation (goods and service, process, organisational, communication) but also their perceived effects, drivers and strategies, investment in terms of training and funding. One section of the survey could ask respondents to describe the innovation they perceive to be the most important in the last two years, thus bringing some additional object-based information about what some of these innovations look like. One possible option for the administration of the survey would be to target similar units within specific sub-sectors, such as health or education (e.g. schools or universities). Should such a survey be implemented, covering education would be very valuable.

This new effort complements and builds on other attempts to measure innovation in the public sector.

In Australia, the 2011 "Australian State of Service Agency and Employee Surveys" tested a module on innovation covering all agencies (employers) and a sample of employees for all agencies with more than 100 employees (thus using the employer-employee method). The "agency questions" asked about the strategies in place for promoting innovation, the extent of innovation, and their assessment of innovation capability. Employees were also asked about the extent of innovation, about the most significant one, about innovation barriers and also whether the work climate was conducive to innovation (Arundel et al., 2012; Arundel and Huber, 2013). A model questionnaire was developed and may be fully implemented in 2014.

The project "Measuring Public Innovation in the Nordic Countries" (MEPIN) also proposed a methodology and a first pilot for measuring innovation in public services in Denmark, Sweden, Norway, Finland and Iceland. Bloch (2011) presents the framework, methodology and some results of the pilot studies. In the five countries, the pilot study covered public sector institutions at both central and local/regional levels, including ministries and government agencies (central) as well as municipalities, schools and hospitals (local/regional). At the local level, only Denmark covered the education sector (upper secondary schools). Some of the innovations mentioned in the report come from the education sector though, with an example of "interdisciplinary cooperation between administration, nurseries and settling in schools" for organisational innovations, and the mention of the "international marketing of education" for communication innovation.

The EU Innobarometer 2010 (EC, 2010) provided interesting information on innovation in public administration, including education, as well as a questionnaire adapting traditional innovation surveys to the public sector. A 2012 Eurobarometer investigated the perception of public sector innovation by those working in the private sector, while a 2014 Eurobarometer examined the supporting role of the public sector in the commercialisation of innovation (EC, 2012, 2014). Information gathered through the 2010 and 2012 barometers, along with other data sources, feeds a pilot European public sector innovation scoreboard (EC, 2013), which highlights a number of ways through which public sector innovation contributes to a country's overall performance. While the pilot study does not tell apart the variety of activities of the public sector, further efforts may differentiate different types of "public sector" innovation and allow comparing education with other public sector activities.

The Innovation Index developed by the UK National Endowment on Science Technology and the Arts (NESTA) is another example of such efforts, covering the health sector. This could inspire further work in education.

The adaptation of organisational change surveys to the education sector

Given that innovation is defined as positive change (significant improvement or useful novelty), measuring change at the organisation level captures innovation to the extent that the change can be linked to actual positive outcomes. These positive outcomes may be either perceived by stakeholders or directly measurable. Linking organisational change with outcomes can also potentially help identify novelties with no or negative impacts. Organisational innovation and change have thus gained more attention in the past years as a way to capture innovation and some new measurement efforts have started (Greenan and Lorenz, 2013).

Funded by the European Commission and coordinated by the Centre d'Etude de l'Emploi (CEE) and the University of Nice, the MEADOW project (Measuring the Dynamics of Organisation and Work) has built on various European efforts to set out guidelines for collecting and interpreting harmonised data at the European level on organisational changes as well as their social and economic impacts (www.meadow-project.eu). This project has developed survey instruments to inquire about the state and change of the organisation and the work experience of both the employer and the employee. In particular, the survey asks about the drivers, the strategy or policy of the organisation, the use of management practices and ICT, the structure of the organisation, the employer and employee outcome, the work organisation and the working conditions (MEADOW Consortium, 2010). As of 2014, pilot surveys have been carried out in Sweden (Statistics Sweden, 2011) as well as in Finland. As they are meant to cover both the business and the public sectors, the implementation of surveys inspired by these guidelines in the education sector would provide education policy makers with very valuable information.

In France, the 2006 survey on Changements Organisationnels et Informatisation (Organisational Changes and IT diffusion), a linked multi-level employer-employee survey was first designed for the business sector and then adapted to the health sector. The survey was administered at the levels of the central administration and of hospitals. It assessed the changes within health central administration and hospitals as well as their outcomes, focusing on the diffusion of management techniques and practices, the use of IT and other organisational changes and features. It also tried to capture drivers for changes such as new demand, availability of new tools, changes in regulatory control, public service modernisation agenda, etc. The survey identified the current organisational situation as well as changes through retrospective questions. It used a panel survey structure. Bigi et al. (2013) give an example of how it can be used to compare changes in public and private hospitals. Some useful information could also be derived from the coverage of the education sector.

Using existing national or international school-teacher and other educational surveys

A final avenue would be to rely on existing educational surveys, as we have done in this book. A wealth of measures of different aspects of the education systems exist. In recent years, statistical collections and surveys on education have expanded, providing crucial data for understanding and comparing the education sector between countries. System-level information relevant to understand drivers of change at the central administration or regulatory level is already collected. A number of teacher, school or school-teacher surveys also exist at the national level, either run by statistical agencies or by academic researchers (e.g. the London School of Economics (LSE) Survey of Headteachers in England).

International surveys such as PISA, PIRLSS, TIMSS or TALIS are repeated and continuously refine internationally validated questions that allow pedagogic and organisational practices to be captured. These multi-level surveys sometimes collect similar data from several stakeholders (for example teachers and students), therefore allowing the answers to be compared across surveys. One way forward would be to develop core questions for these surveys that would be repeated over their different cycles, as well as some specific modules about new emerging practices. Like for any established survey, the difficulty is to make space for new questions.

Conclusion

Whether ambitious or modest, using either new or using existing surveys, there are several ways to move forward the measurement agenda on educational innovation. Now that we know how this could be done, and what kind of information we would get, and how this could lead to educational improvement, we need to weigh the costs and benefits of investing in specific efforts to better identify what is changing significantly and what the main drivers and effects of these innovations are. A measurement agenda is key to any innovation strategy.

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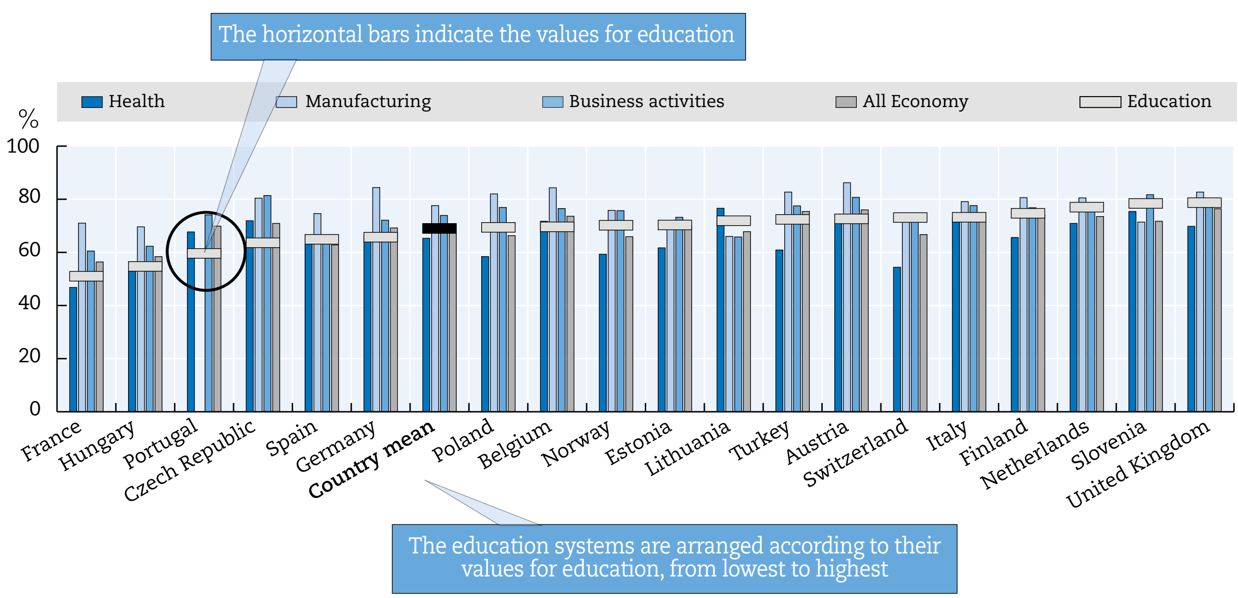
Reader's guide

How to read the figures and tables

Part I of this book presents the levels of innovation across different sectors of the economy. Bar charts are used to display the percentage of graduates employed in each sector who reported that, for example, they played a role in introducing innovation.

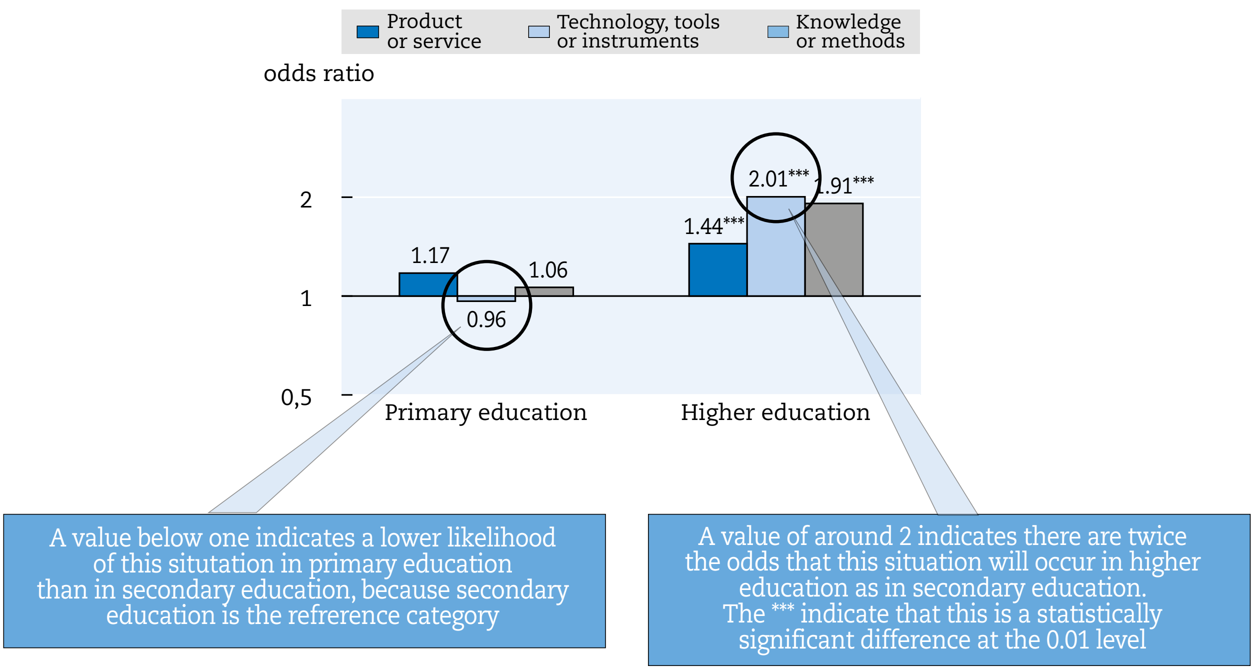
The bar charts show how education (represented by the horizontal bars) compares with health, manufacturing, and business activities (first three bars reading from the left, for each country), as well as how it compares with the economy as a whole (right hand bar for each country) (See Figure 1). The country mean provides an average across the countries surveyed.

Figure 1 **How to read Figures describing innovation in the education sector in Part I**



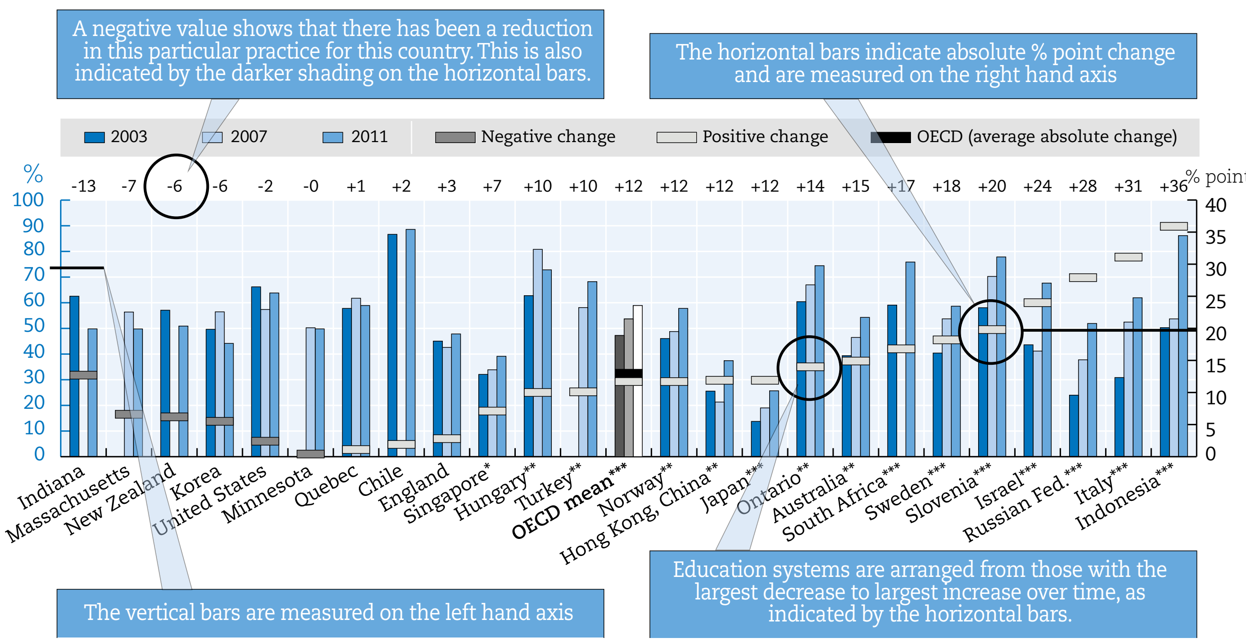
Figures are also used in Part I to depict the odds ratio of a graduate reporting some aspect of innovation (namely product or service, technology, tools or instrument, or knowledge or methods) according to the level of education they are employed in (primary, secondary or tertiary). As shown in Figure 2, secondary education is the reference point for the analysis reported in these Figures. An odds ratio of less than one indicates that there is a lower likelihood of something occurring, whilst a ratio of more than one suggests an increased likelihood. Significance tests have been used to check whether the odds ratio is significantly different from one

Figure 2 **How to read Figures describing innovation in the education sector in Part I**



The Figures in Part II provide graphical representation of changes across time. Horizontal bars indicate the percentage-point change between the first and last measurement for each education system; the right hand axis indicates their absolute values, whilst the direction of change is shown by the colour of the bar and the values displayed above the graph (a negative change implies a decrease in the practice, whilst a positive change implies an increase, see Figure 3). Negative change is represented by a dark bar, and positive change, by a white bar. Vertical bars represent the percentage level of the considered practice in each education system for two or more years measured on the left hand axis.

Figure 3 **How to read change Figures in Part II**



Asterisks are used on the horizontal axis to indicate countries where the difference in the percentages measured on the left hand axis are significantly different from zero. The smaller the significance level, the more confident the reader can be that there is a genuine difference between the two time periods.

*** = significant difference in percentages at the 0.01 level;

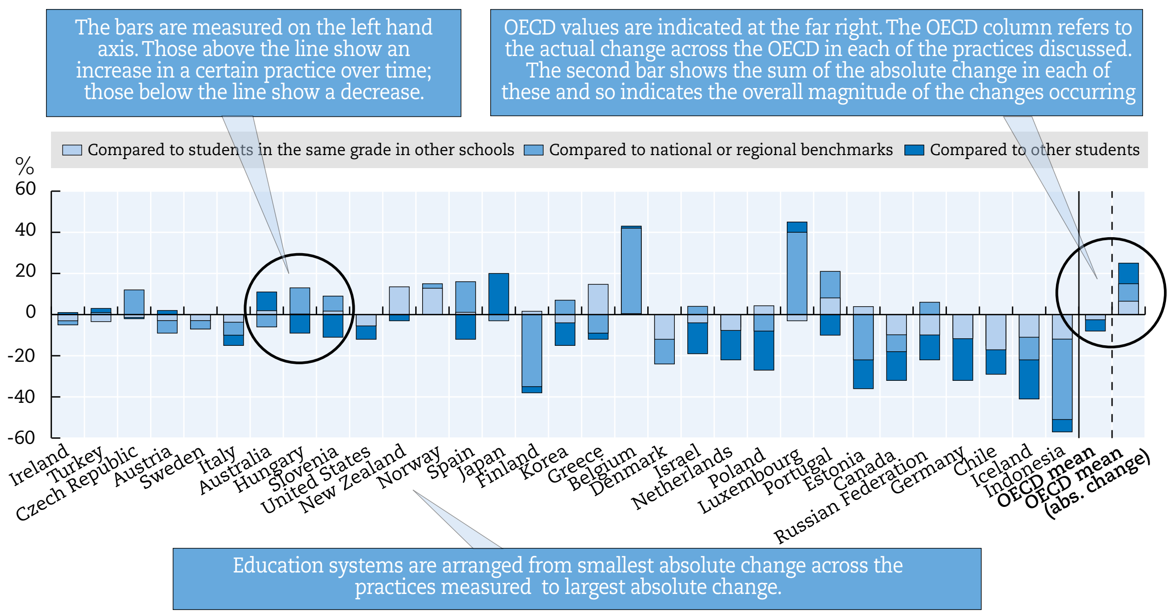
** = significant difference in percentages at the 0.05 level;

* = significant difference in percentages at 0.1 level.

The example Figure presented above shows that there was a decrease by 24% in the practice reported in Hungary (horizontal bars are read on the right axis, and values are given on top of the Figure), and that this decrease was significant at the 0.01 level (i.e., there is 1 chance out of 100 that the change estimate is due to chance). The vertical bars show that this was caused by a decrease from just over 70% to less than 50% between 2003 and 2009.

Summary Figures provide combined information about changes, drawing on the data represented in the module (see Figure 4). They illustrate the typical direction of change for the block of related practices: bars above the zero horizontal axis (intercept) indicate that average changes were positive (i.e. an increase) within that system, whilst bars below the bar indicate negative changes (a reduction). Bars that cross the zero intercept show countries where the direction of change was not consistent across the various categories represented. If the bar is longer above than below the horizontal axis (e.g. for Portugal in the graph below), then it shows that systems have increase these broad categories of practices, even though some related practices were also decreased.

Figure 4 **How to read the summary Figures in Part II**



Effect size tables show the effect size of each change and indicate whether this is small (0.2 to 0.5), medium (0.5 to 0.8) or large (over 0.8). The purpose is to present a standardised measure of the changes over the different indicators presented. It is these effect sizes that have been used in the creation of the composite innovation indices (see below). The letter (m) indicates missing data.

Table 1 **How to read the summary data tables in Part II**

	Change in remedial education					Change in enrichment education				
	8th grade		4th grade			8th grade		4th grade		
	Remedial mathematics	Remedial science	Remedial mathematics	Remedial science	Remedial reading specialist	Enrichment mathematics	Enrichment science	Enrichment mathematics	Enrichment science	Informal reading initiatives
	99-07	99-07	03-07	03-07	01-06	99-07	99-07	03-07	03-07	01-06
Australia	0,06	-0,23	0,04	0,07	m	-0,16	-0,06	-0,07	-0,11	m
Ontario	m	m	-0,46	-0,27	-0,05	m	m	-0,51	-0,11	-0,12
Quebec	m	m	0,37	0,30	-0,33	m	m	0,13	0,39	0,03
Czech Republic	0,08	-0,29	m	m	m	-0,45	-0,33	m	m	m
France	m	m	m	m	-0,01	m	m	m	m	0,05
Germany	m	m	m	m	-0,07	m	m	m	m	0,02
Hungary	0,38	0,44	0,09	0,01	0,07	0,26	-0,13	-0,06	-0,05	0,10
Iceland	m	m	m	m	0,16	m	m	m	m	-0,14
Israel	-0,19	-0,36	m	m	-0,04	0,15	-0,65	m	m	-0,02
Italy	-0,08	-0,46	-0,02	-0,20	-0,15	0,00	0,03	0,13	0,00	0,09
Japan	0,51	0,42	0,12	0,10	m	0,76	0,61	0,53	0,21	m
Korea	1,15	0,34	m	m	m	0,85	0,34	m	m	m
Netherlands	m	m	0,11	-0,04	-0,16	m	m	0,01	-0,14	0,37
New Zealand	m	m	-0,10	-0,11	0,13	m	m	-0,02	-0,32	-0,06
Norway	m	m	m	m	-0,02	m	m	m	m	0,06
Slovak Republic	m	m	m	m	0,45	m	m	m	m	0,29
Slovenia	-0,29	-0,06	0,00	0,02	-0,05	-0,37	-0,25	0,29	0,01	0,00
Sweden	m	m	m	m	-0,32	m	m	m	m	0,15
Turkey	0,56	0,47	m	m	m	-0,42	-0,42	m	m	m
England	0,86	0,78	0,07	-0,04	0,14	0,65	0,70	0,14	0,38	0,09
Scotland	m	m	0,05	0,24	0,02	m	m	0,11	0,02	0,21
United States	0,32	-0,10	-0,02	-0,09	0,13	0,00	0,09	-0,14	-0,30	0,00
OECD (average)	0,30	0,09	0,02	0,00	-0,01	0,24	0,08	0,04	-0,04	0,07
OECD (average absolute)	0,42	0,36	0,12	0,12	0,14	0,36	0,32	0,18	0,17	0,11
Hong Kong, China	0,43	-0,01	-0,13	-0,09	-0,11	-0,07	-0,53	0,09	0,13	0,36
Indonesia	0,15	-0,02	m	m	m	-0,36	-0,49	m	m	m
Russian Federation	0,14	0,03	0,53	0,30	0,32	-0,98	-1,15	0,39	0,19	0,26
Singapore	-0,30	-0,23	-0,15	0,29	-0,06	0,20	0,39	-0,08	-0,01	-0,12

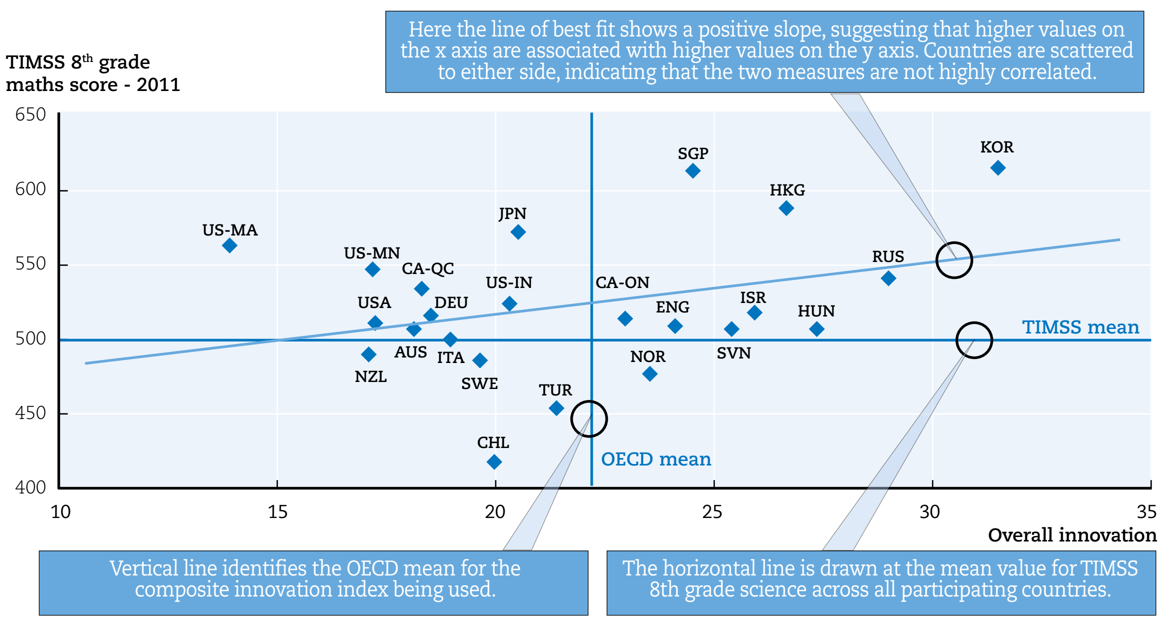
Education systems are arranged by OECD and Partner countries. They are listed alphabetically.

A negative value indicates a decrease in the activity over time. The letter (m) indicates that data is missing.

Light shading indicates small effect sizes. Medium effect sizes are indicated by moderate shading. Dark shading indicates large effect sizes.

The final chapter reports the potential associations between composite innovation indices and various education system outcome measures, including performance and equity. Scatter plots are used to depict the levels of innovation and outcome measures for each country. A line of best fit is added to indicate whether or not there is a trend and the extent to which the points are close to the line (indicating that the two measures are correlated). Quadrants are determined by placing horizontal and vertical lines at the appropriate mean. In the case of innovation measures, this is the mean of available data from OECD countries, while for the outcome measures the mean is drawn from the original data.

Figure 5 **How to read the summary data tables in Part III**



The country codes used in the Figures in part III are:

AUS	Australia	HKG	Hong Kong	KOR	Korea	CA-QC	Quebec
AUT	Austria	HUN	Hungary	US-MA	Massachusetts	RUS	Russian Federation
CHL	Chile	US-IN	Indiana	US-MN	Minnesota	SGP	Singapore
CZE	Czech Republic	IDN	Indonesia	NLD	Netherlands	SVN	Slovenia
DNK	Denmark	ISR	Israel	NZL	New Zealand	SWE	Sweden
ENG	England	ITA	Italy	NOR	Norway	TUR	Turkey
DEU	Germany	JPN	Japan	CA-ON	Ontario	USA	United States

PART I

Comparing innovation in education with other sectors

CHAPTER 1

Highly innovative workplaces in education and other sectors

A proportion of graduate employees have characterised their workplace as having high or very high levels of innovation. These highly innovative workplaces may focus on one type of innovation or incorporate several types. The existence of highly innovative workplaces within the education sector can be compared with other sectors, such as manufacturing or other public services.

Exploring differences in the proportion of such highly innovative workplaces at different levels of education provides insights into how these are spread across primary, secondary and higher education.

Innovation occurrence and types within the education sector

General findings

Highly innovative workplaces within the education sector are very common in Europe (Figure 1.1). On average, 69% of graduates employed in the education sector considered that their organisation was highly innovative regarding at least one type of innovation in 2005. This was the case for at least half of the graduates in all 19 countries reported and for more than 70% of graduates in 11 countries.

Nevertheless, highly innovative workplaces in education do not typically cover each of the different forms of innovation (Figure 1.2). Of graduates working in education, 19% reported that their organisation was highly innovative concerning all three types of innovation. In no country did this figure exceed 35%.

Knowledge or methods innovations are more common than other types of innovation (Figure 1.3). On average 59% of graduates in the education sector worked in organisations that were highly innovative in terms of knowledge or methods. For technology, tools or instruments innovation this was the case for only 36% of graduates and regarding product or service innovation, 38%. Knowledge or method innovation was the most common type of innovation in a large majority of countries, followed by product or service innovation and technology, tools or instruments innovation. However product or service innovation was more common than technology, tools or instruments innovation in five countries, while the opposite was true only in Estonia.

Country specificities

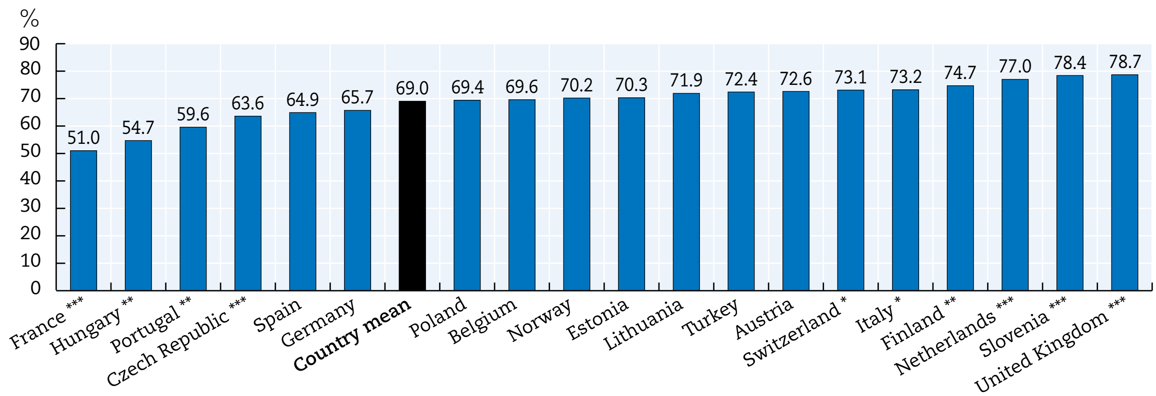
The United Kingdom (followed by Slovenia and Italy) has an above average proportion of highly innovative workplaces in education and exhibits more types of innovation. In 2005, the United Kingdom had the largest share of graduates that considered their workplace to be highly innovative regarding both at least one type of innovation (79%) and all three types of innovation (33%). The United Kingdom also ranked above average across the countries studied for all three types of innovation individually. In terms of both innovation occurrence and type, both Slovenia (78% and 23%) and Italy (73% and 23%) outperformed an average European country. Italy also ranked above average in product or service and technology, tools or instruments innovation, while Slovenia did so in knowledge or methods innovation.

In contrast, the French and Hungarian education sectors seem to contain few highly innovative workplaces. The share of graduates employed in highly innovative workplaces regarding both at least one type of innovation and all three types of innovation was below the European average in France (51% and 9%) and Hungary (55% and 10%). In addition, France ranked below average for all three types of innovation individually, while this was the case for Hungary concerning knowledge or methods and product or service innovation.

The Netherlands and Switzerland show that workplaces in the education sector can be highly innovative regarding certain types of innovation. In 2005, the Dutch education sector outperformed an average country in highly innovative workplaces regarding at least one type of innovation (77%) as well as knowledge or methods and product or service innovation individually. However, the Dutch education sector ranked below European average both regarding the range of types of innovation (16%) and technology, tools or instruments innovation. Although the occurrence of innovation (73%) was high in Switzerland, the country ranked below the average regarding both the range of types of innovation (13%) and product or service innovation.

Figure 1.1 **Education professionals in highly innovative workplaces regarding at least one type of innovation, by country**

Percentage of graduates working in the education sector in highly innovative workplaces, 2005 or 2008



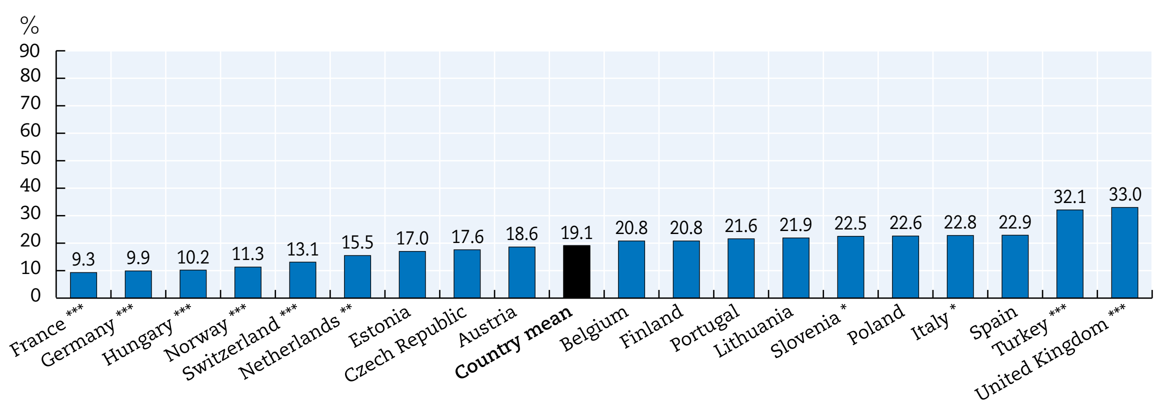
StatLink http://dx.doi.org/10.1787/888933081853

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.2 **Education professionals in highly innovative workplaces across three types of innovation, by country**

Percentage of graduates working in the education sector in highly innovative workplaces, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933081872

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

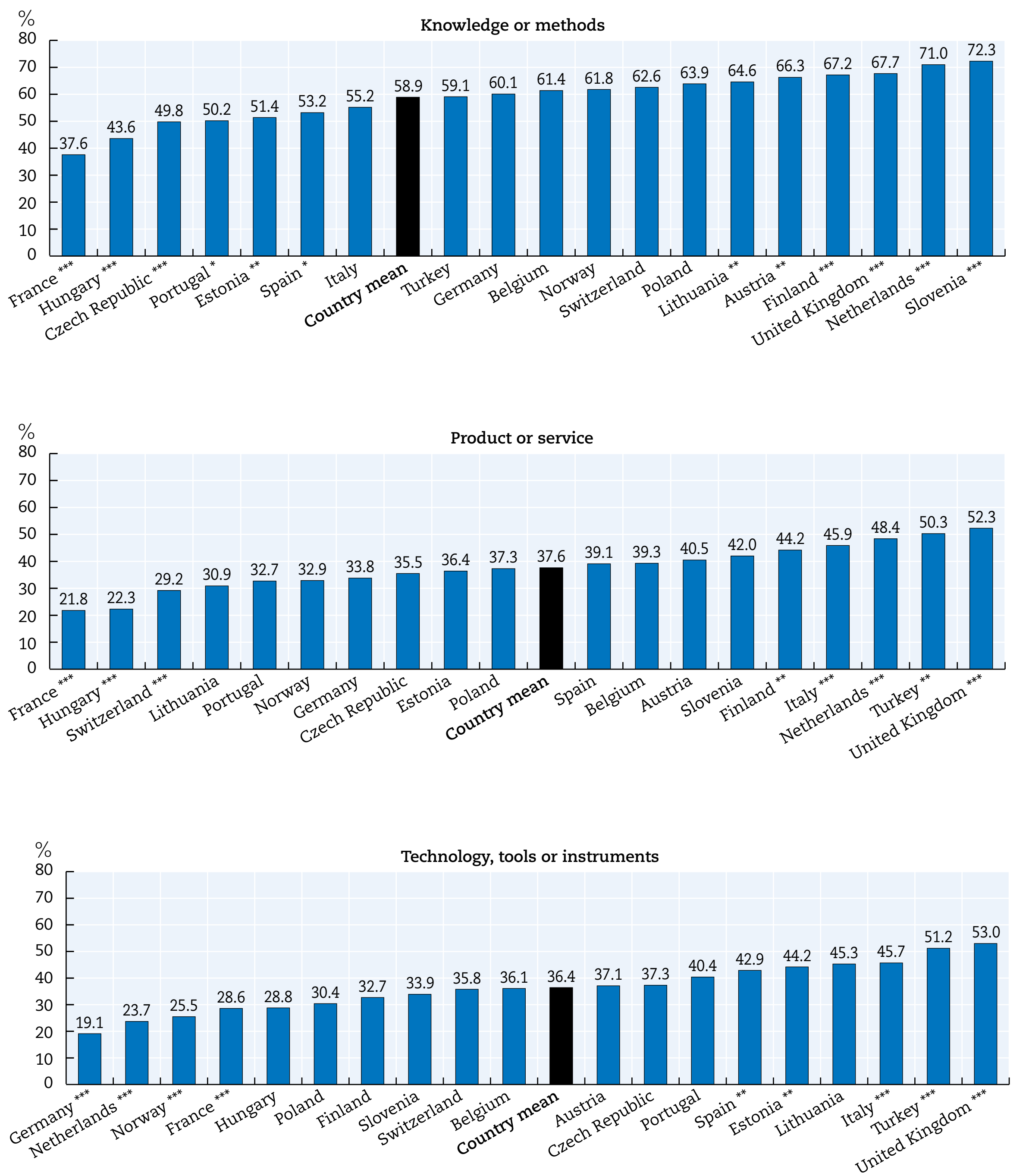
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Box 1.1 **Data source details for Chapter 1**

REFLEX (2005) and HEGESCO (2008) surveys asked higher education graduates five years after their graduation "How would you characterize the extent of innovation in your organization or your work?" regarding "product or service", "technology, tools or instruments" and "knowledge or methods" innovation. High innovation corresponds to values 4 and 5 in the scale from 1 (very low) to 5 (very high). The education sector includes primary, secondary and higher education as well as other non-specified education activities.

Figure 1.3 **Education professionals in highly innovative workplaces, by innovation type and country**

Percentage of graduates working in the education sector in highly innovative workplaces, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933081891

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source : Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation occurrence within the education sector compared with other sectors

General findings

The education sector stands at the average level in terms of innovative workplaces when compared to other sectors of the economy in Europe (Figure 1.4 and Figure 1.5). Similarly to the 69% average across sectors in 2005, 70% of graduates in the education sector considered that they were employed in highly innovative workplaces (excluding Portugal). The proportion of highly innovative workplaces in education was similar to that across sectors in most individual countries, being above in three countries and below only in Portugal and the Czech Republic. The manufacturing sector (79%) had more highly innovative workplaces than the education sector in all countries, with the exception of Slovenia. The education sector ranked below most other sectors of the economy only in the Czech Republic.

The education sector is below average in terms of the presence of three types of innovation (Figure 1.6 and Figure 1.7). In the education sector, 19% of graduates considered that their workplace was highly innovative concerning all three types of innovation compared with the 23% average for the economy. In the majority of individual countries the education sector ranked below the economy as whole. Highly innovative workplaces with regard to the three types of innovation were most common in the manufacturing sector (34%), which outperformed education in the great majority of individual countries – as did business activities.

However, highly innovative workplaces are more common in the education sector than in other public services (Figure 1.4 to Figure 1.7). In 2005, fewer graduates were employed in workplaces that were highly innovative regarding at least one type of innovation in public administration (53%) and health (64%) than in education (70%). In this respect, the health sector ranked below the education sector in five European countries as well as on average – the opposite was true only in the Czech Republic. When looking across types of innovation, the education sector (19%) ranked above the health (17%) and public administration (12%) sectors. This was the case for the health sector across three countries, whereas the case was reverse for the Czech Republic and Slovenia.

Country specificities

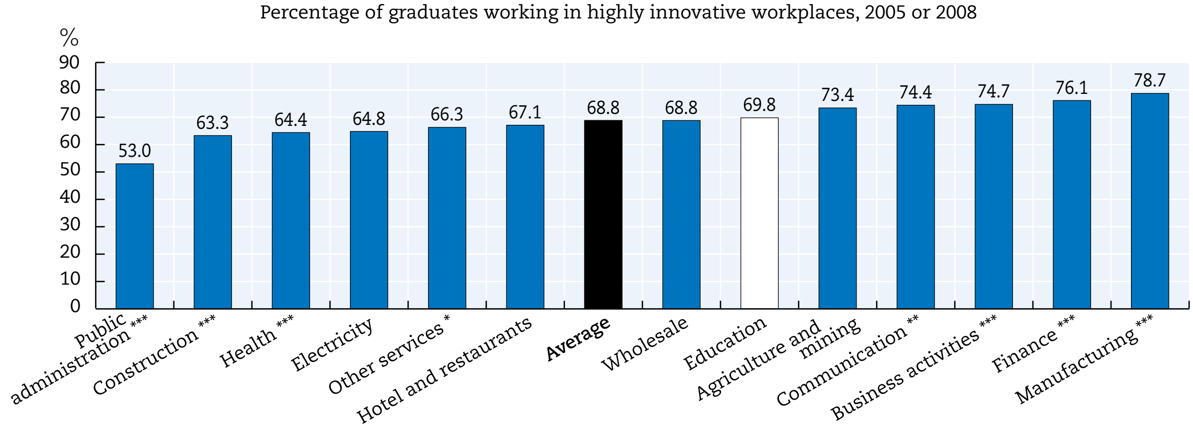
In terms of innovative workplaces, education compares relatively well to other sectors in Switzerland. In 2005, innovative workplaces regarding at least one type of innovation were more common in the Swiss education sector than in the economy as a whole (by 6% points) or the health sector (by 19% points). The Swiss education sector also outperformed the health sector (by 4% points) regarding the occurrence of several types of innovation in workplaces.

In contrast, workplaces in the education sector are less innovative than those in other sectors in the Czech Republic. Most other sectors of the economy – including health, manufacturing and business activities – outperformed the Czech education sector in terms of both occurrence and range of types of innovation.

The case of Slovenia highlights that even less innovative education workplaces can do comparatively well concerning some types of innovation. Although the Slovenian education sector ranked below most other sectors regarding the range of types of innovation in workplaces, it outperformed both the economy as a whole (by 7% points) and the manufacturing sector (by 7% points) for at least one type of innovation.

Figure 1.4 **Professionals in highly innovative workplaces regarding at least one type of innovation, by sector**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



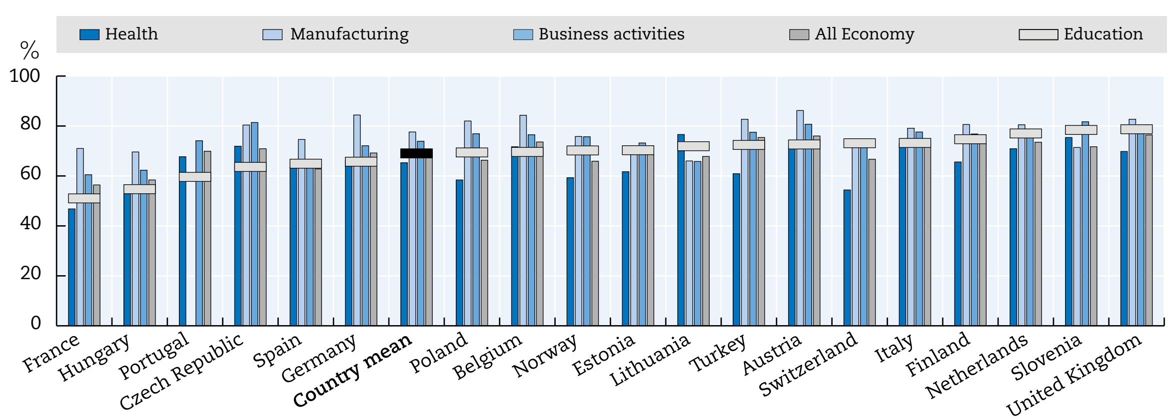
StatLink http://dx.doi.org/10.1787/888933081910

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.5 **Professionals in highly innovative workplaces regarding at least one type of innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



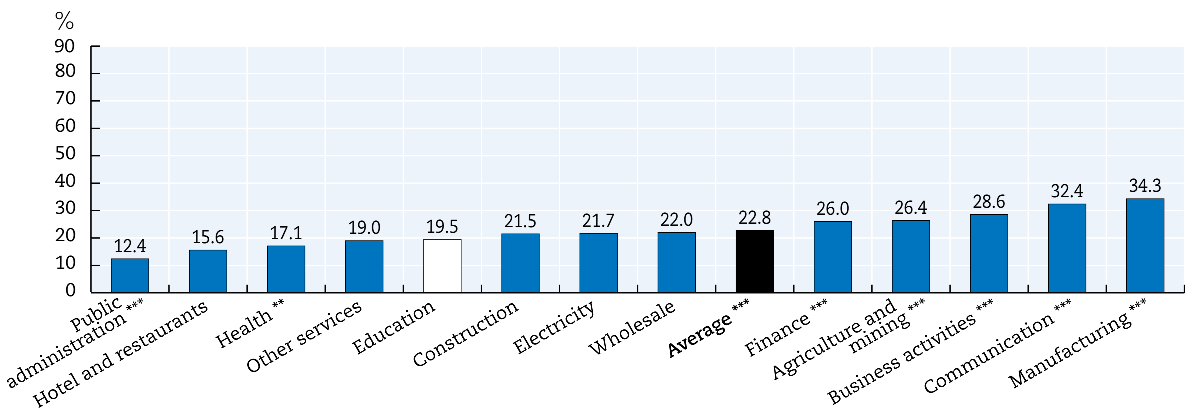
StatLink http://dx.doi.org/10.1787/888933081929

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.6 **Professionals in highly innovative workplaces across three types of innovation, by sector**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



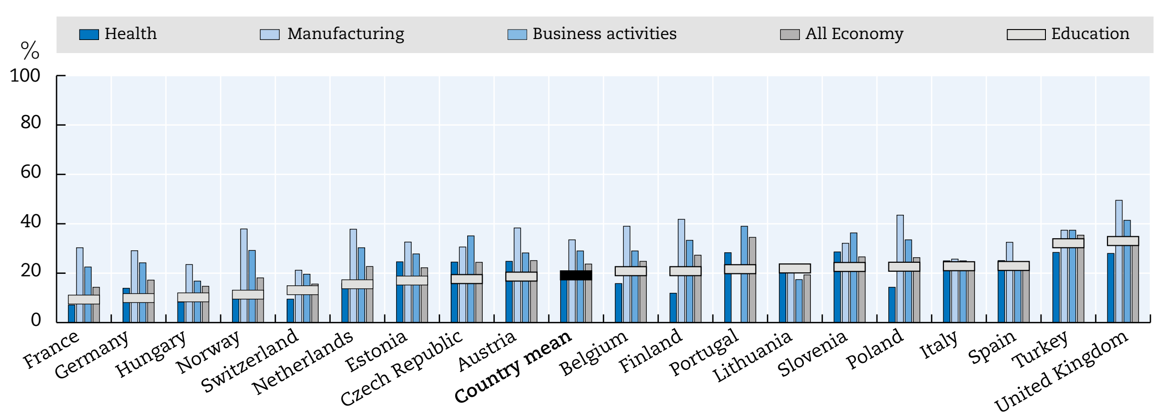
StatLink http://dx.doi.org/10.1787/888933081948

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.7 **Professionals in highly innovative workplaces across three types of innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933081967

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation types within the education sector compared with other sectors

General findings

Education outperforms other sectors of the economy in terms of highly innovative workplaces in knowledge or methods innovation – the most common innovation type among economic sectors across the countries covered (Figure 1.8 and Figure 1.9). Against the average of 49%, and more than in almost any other sector, 60% of graduates in the education sector considered that their workplace was highly innovative with regard to knowledge or methods innovation in 2005. Education surpassed most other sectors in knowledge or methods innovation in Switzerland and the Netherlands and the economy as a whole in nine other countries. As in education, knowledge or methods innovation was the most common innovation type for highly innovative workplaces on average and across five other sectors.

In contrast, highly innovative workplaces in product or service innovation are less common in the education sector than in the rest of the economy in Europe (Figure 1.8 and Figure 1.10). Only 38% of graduates employed in education worked in highly innovative organisations in terms of product or service innovation in 2005. This was below the average (47%) and outperforming only public administration (30%). With regard to the product or service innovation, education was among the sectors with the smallest share of graduates in highly innovative organisations in the vast majority of countries – it only significantly outperformed health in Finland. While product or service innovation was the second most common innovation type characterising workplaces in education, it was the most common type for manufacturing, finance, whole sales and hotels and restaurants.

Also with regard to technology, tools or instruments innovation, highly innovative workplaces are less common in education than in other sectors of the economy (Figure 1.8 and Figure 1.11). In education, 36% of graduates worked in workplaces that were highly innovative in terms of technology, tools or instruments innovation in 2005 – against the average of 42% for the whole economy. Education ranked below seven sectors of the economy, but above public administration (28%) and health (33%). Manufacturing outperformed education in 13 countries, business activities in 10 countries and health in five countries. Health ranked lower than education only in Switzerland and the United Kingdom. Technology, tools or instruments innovation was the least common type of workplace innovation overall and in five individual sectors.

Country specificities

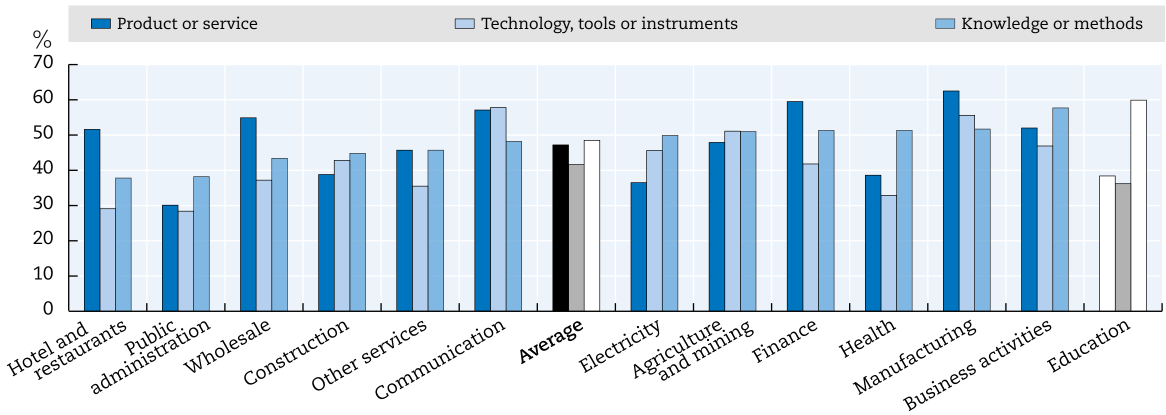
Switzerland, and to a lesser extent, Finland and the Netherlands, are countries where education compares relatively well to other sectors in terms of highly innovative workplaces. In 2005, the Swiss and Dutch education sectors outperformed most other sectors of the economy in terms of knowledge or methods innovation. Outranking health by 11% points, the education sector in Switzerland stood at a similar standing to the economy as a whole regarding technology, tools or instruments innovation. The Finnish education sector ranked above most other sectors in knowledge or methods innovation and – unlike in any other country – outperformed health in product or service innovation (by 8% points).

In contrast, the Czech Republic has few innovative education workplaces. In 2005, the Czech education sector ranked below most other sectors for product or service and technology, tools or instruments innovation. As to knowledge or methods innovation, education was at a similar standing or below the rest of the Czech economy.

Germany provides an example of a country with high occurrences of some, but not all types of innovation. While the German education sector outperformed most other sectors regarding highly innovative workplaces in knowledge or method innovation, it ranked below most other sectors for technology, tools or instruments innovation.

Figure 1.8 Professionals in highly innovative workplaces, by sector and innovation type

Percentage of graduates working in highly innovative workplaces, 2005 or 2008

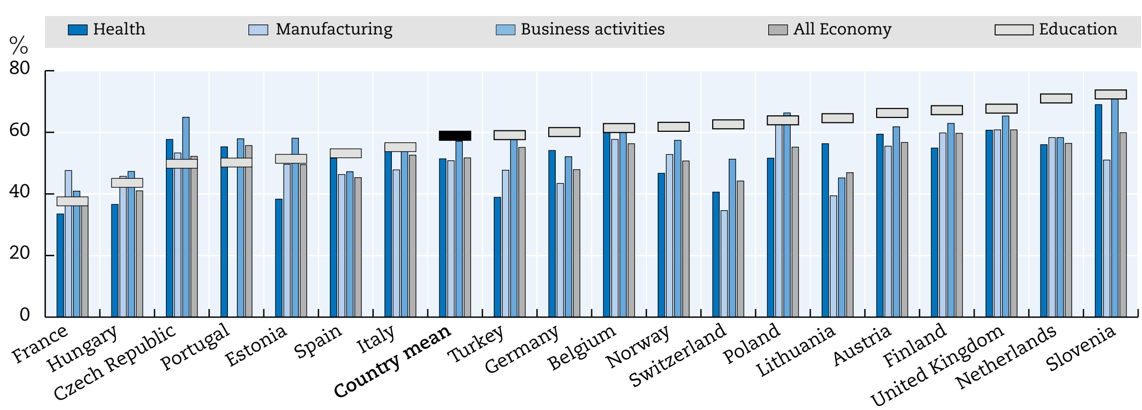


StatLink http://dx.doi.org/10.1787/888933081986

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.9 Professionals in highly innovative workplaces regarding knowledge or methods innovation, by sector and country

Percentage of graduates working in highly innovative workplaces, 2005 or 2008

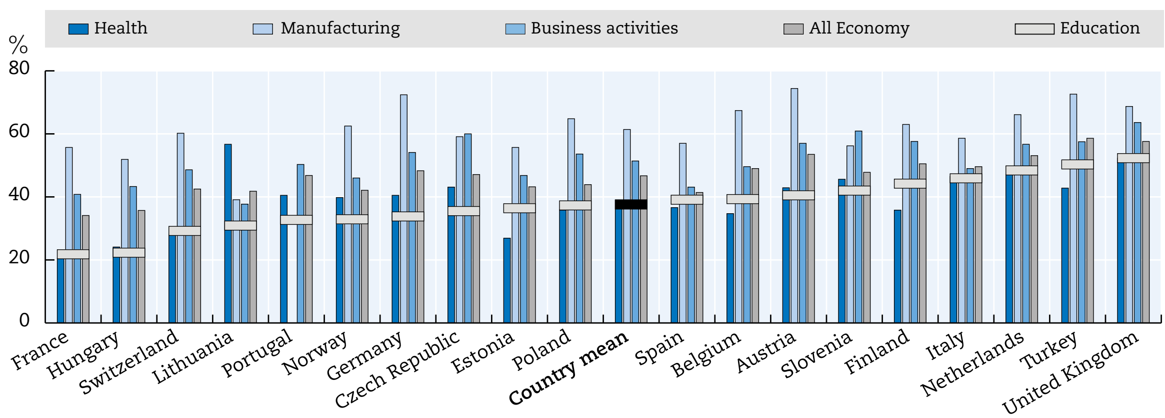


StatLink http://dx.doi.org/10.1787/888933082005

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.10 **Professionals in highly innovative workplaces regarding product or service innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



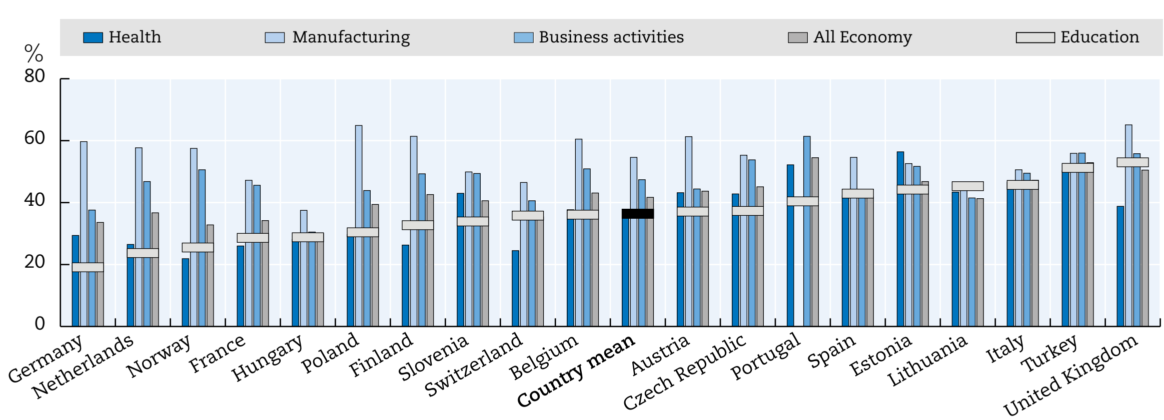
StatLink http://dx.doi.org/10.1787/888933082024

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.11 **Professionals in highly innovative workplaces regarding technology, tools or instruments innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082043

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation within the education sector by level of education

Innovation occurrence and types

Within the education sector, highly innovative workplaces are more common in higher education than at either primary or secondary level (Figure 1.12 and Figure 1.13). Against 69% for the education sector in general (including Portugal), 80% of graduates working in the higher education sector in Europe were employed in highly innovative organisations in relation to at least one type of innovation. This compares with 63% for secondary and 65% for primary education. The likelihood of higher education workplaces being highly innovative in at least one type of innovation was twice that of secondary or primary education. Moreover, the higher education sector outperformed most other sectors of the economy – including the manufacturing sector – in terms of highly innovative workplaces. While primary education stands at the average level when compared to other sectors, secondary education ranked below the average.

Higher education has the largest share of highly innovative workplaces in terms of the three different types of innovation, whereas secondary education ranks last in this respect (Figure 1.12 and Figure 1.13). Against the 20% for the whole education sector, 28% of graduates in higher education worked in innovative organisations regarding three innovation types. These figures were only 14% for secondary and 17% for primary education. Graduates employed in higher education were more than twice as likely to work for an organisation concentrating on all three types of innovation than those working in secondary education. In comparison with the rest of the economy, higher education had above average level of highly innovative workplaces in terms of the range of innovation types, whereas both secondary and primary education ranked below average in this respect.

Innovation types

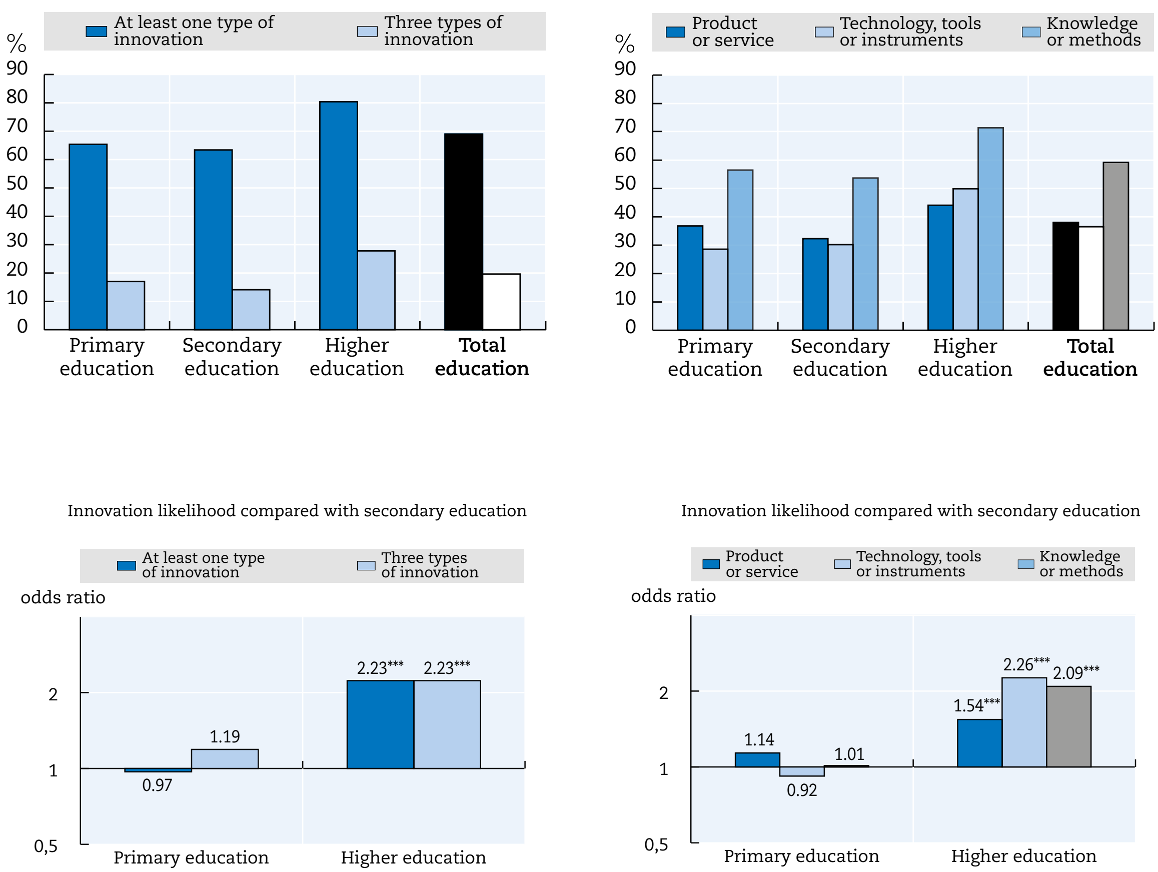
Highly innovative workplaces across the different levels of education are mostly focused on knowledge or methods innovation. This was the most common type of innovation across all levels of education in terms of graduates working in highly innovative organisations in 2005 (Figure 1.12). While product or service innovation was more common than technology, tools or instruments innovation in primary and secondary education, the opposite was true for higher education.

Higher education also outperforms other levels of education regarding all different innovation types (Figure 1.12 and Figure 1.14). Of all levels of education, higher education employed the largest proportion of graduates to highly innovative workplaces with regard to knowledge or methods (71%), product or service (44%) and technology, tools or instruments (50%) innovation. Higher education also outperformed all other sectors of the economy regarding knowledge or methods innovation and ranked above average for technology, tools or instruments innovation. Compared to secondary and primary education, the odds of working in an innovative organisation in higher education were more than twice greater for technology, tools or instruments innovation and twice greater for knowledge or methods innovation. Relative to secondary education, the odds were one and a half times greater for product or service innovation.

Secondary and primary levels of education have less highly innovative workplaces with respect to different innovation types (Figure 1.12 and Figure 1.14). Of all education levels, innovative workplaces in secondary education were the least common with regard to knowledge or methods innovation (54%) as well as to product or service innovation (32%). As to technology, tools or instruments innovation, primary education (29%) had fewer highly innovative workplaces. Although primary and secondary education outperformed the economy average in knowledge or methods innovation, both ranked below the average in product or service and technology, tools or instruments innovation.

Figure 1.12 **Education professionals in highly innovative workplaces, by innovation type and education level**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



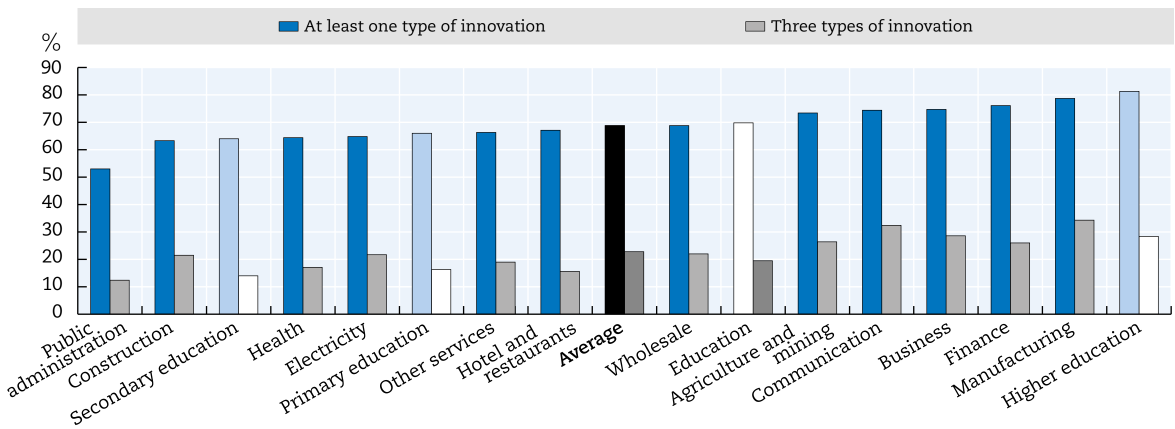
StatLink http://dx.doi.org/10.1787/888933082062

Notes: *** = odds ratio significant at the 0.01 level; ** = odds ratio significant at the 0.05 level; * = odds ratio significant at 0.1 level. Spain is excluded. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.13 **Professionals in highly innovative workplaces across three types of innovation, by sector and education level**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008

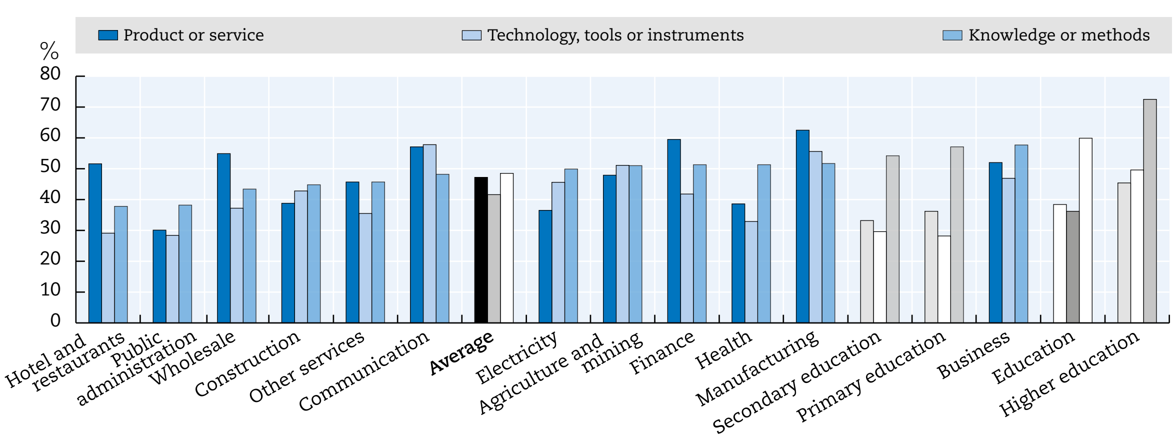


StatLink http://dx.doi.org/10.1787/888933082081

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal and Spain are excluded.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 1.14 **Professionals in highly innovative workplaces, by innovation type, sector and education level**

Percentage of graduates working in highly innovative workplaces, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082100

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal and Spain are excluded.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

CHAPTER 2

Employee participation in innovation in education and other sectors

Employees may or may not have a role to play in introducing innovations into their workplace. For those who do, such participation may be focused on a specific type of innovation, or across various types.

The extent to which employees participate in innovation within the education sector can be compared with other sectors of the economy such as manufacturing or other public services. Differences across primary, secondary and higher education can also be explored to understand whether participation is more common at some levels than others.

Innovation occurrence and types within the education sector

General findings

Employee participation in innovation within the education sector is common in Europe (Figure 2.1). On average, 76% of higher education graduates working in the education sector in 2005 reported that they participated in introducing at least one type of innovation in their organisation. With the exception of Hungary and Spain, this was the case for at least 70% of graduates.

However, employees in the education sector do not necessarily take part in introducing each of the different forms of innovation (Figure 2.2). Of graduates working in education, on average 23% reported that they participated in introducing three types of innovation in their organisation. Only in Turkey, Estonia and the Czech Republic did this figure exceed 30% of the higher education graduates, while it remained at 15% or below in four countries.

Employee participation in innovation is particularly high regarding knowledge or methods innovation, but lower for product or service innovation and – especially – technology, tools or instruments innovation (Figure 2.3). In 2005, 70% of higher education graduates in the education sector played a role in introducing knowledge or methods innovations in their organisations. For product or service innovation this was the case for 44% of graduates and regarding technology, tools or instruments, of 36% of graduates. Knowledge or methods innovation was the most common type of innovation in all countries. Technology, tools or instruments innovation was less common than product or service innovation in most countries – the opposite was true only in Spain.

Country specificities

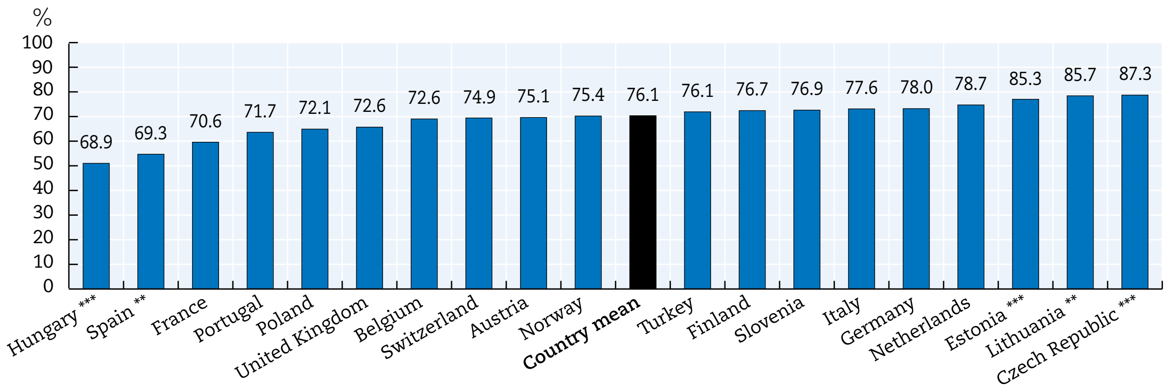
The Czech Republic, Estonia and Lithuania stand out as countries with above average level range of employee participation in innovation in the education sector. In 2005, the share of graduates participating in at least one type of innovation and all three types of innovation was above average in Czech Republic (87% and 32%), Lithuania (86% and 30% in 2008) and Estonia (85% and 36%). Both the Czech Republic and Estonia also ranked above the average regarding the three different innovation types individually, whereas this was the case for Lithuania concerning knowledge or methods and product or service innovation.

In contrast, employees in Hungary, Poland, Germany, Switzerland and Austria participate less in innovation in education. Hungary had the smallest share of graduates taking part in any type of innovation (69%) in their workplace and below average share regarding also all three types of innovations (18%) as well as individually. Regarding employee participation in a range of types of innovation in education, Poland (11%), Germany (12%), Switzerland (13%) and Austria (15%) stood below the European average. More specifically, these four countries had below average level participation in product or service and technology, tools or instruments innovation.

In Spain, the Netherlands, Italy and Slovenia employee participation is high for some innovation types, but low for others. In 2005, Spain ranked below the average in the education sector employee participation in any type of innovation as well as specifically in knowledge or methods and product or service innovation. Although the Dutch education sector ranked below the average both in terms of the range and technology, tools or instruments innovation, the case was reverse concerning product or service innovation. In Italy, education employee participation was high for product or service and technology, tools or instruments innovation, but low for knowledge or methods innovation, the reverse of Slovenia.

Figure 2.1 **Participation of education professionals in the introduction of at least one type of innovation, by country**

Percentage of graduates working in the education sector who play a role in introducing at least one type of innovation, 2005 or 2008



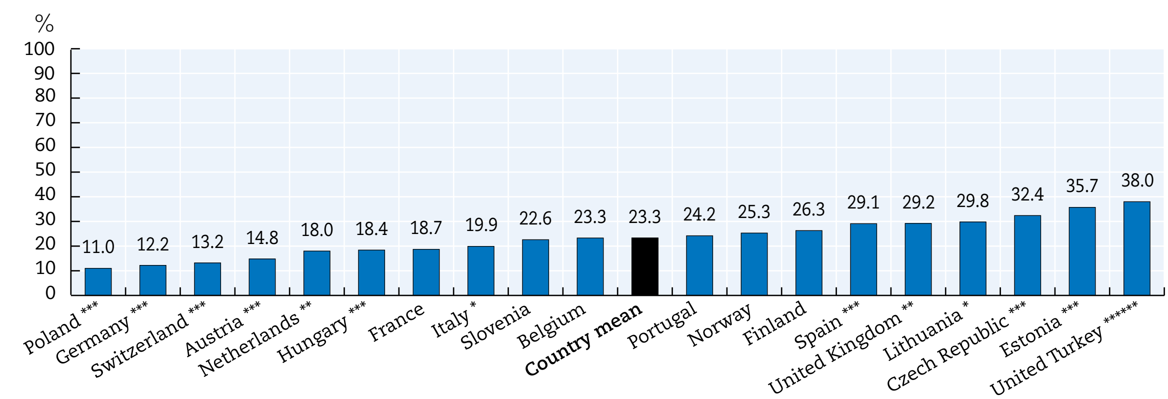
StatLink http://dx.doi.org/10.1787/888933082119

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.2 **Participation of education professionals in the introduction of three types of innovation, by country**

Percentage of graduates working in the education sector who play a role in introducing three types of innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082138

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

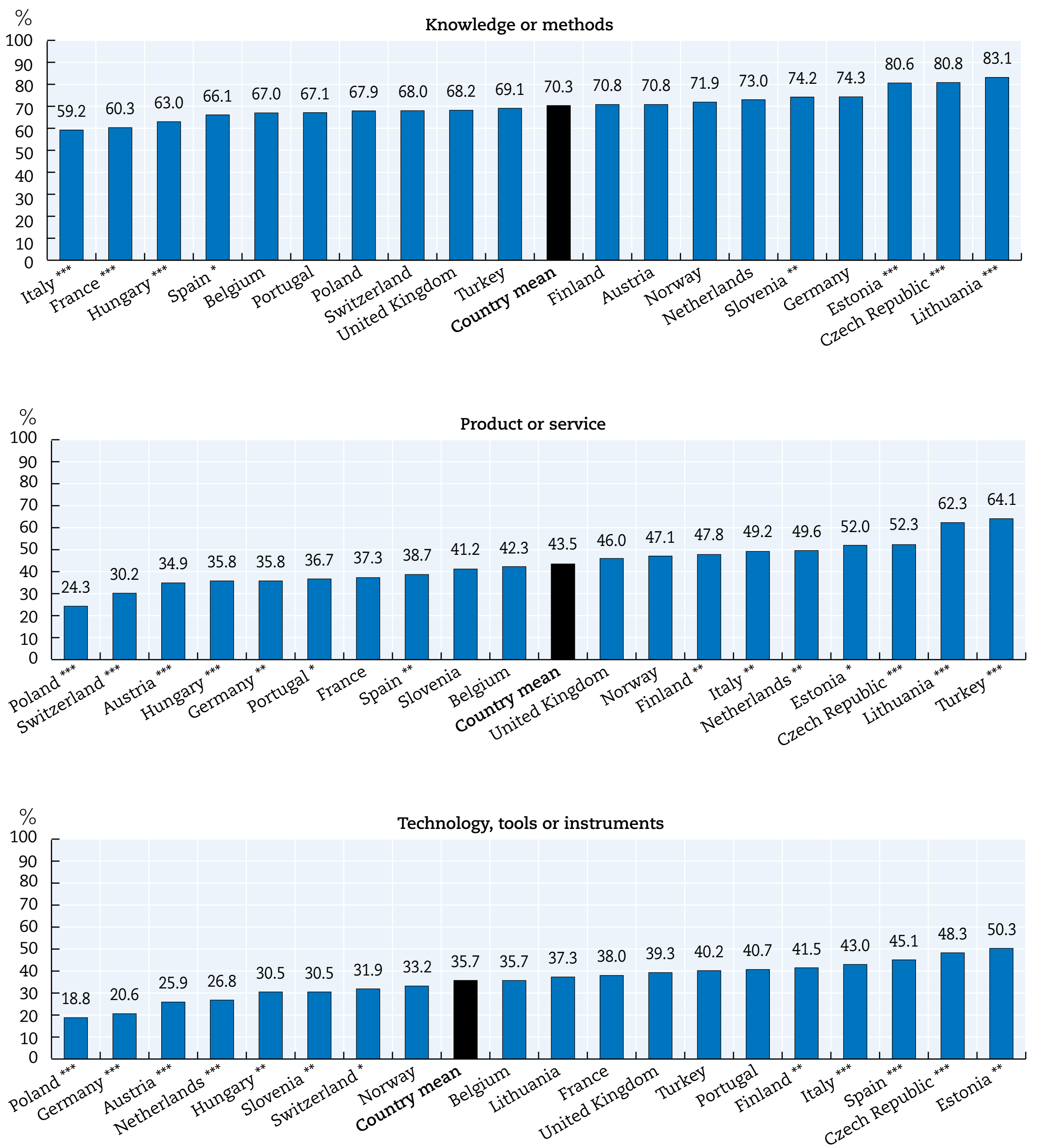
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Box 2.1 **Data source details for Chapter 2**

REFLEX (2005) and HEGESCO (2008) surveys asked higher education graduates five years after their graduation "Do you play a role in introducing these innovations in your organisation?" regarding "product or service", "technology, tools or instruments" and "knowledge or methods" innovation. The answer options were ''Yes", "No" and "Not applicable, no innovations". The education sector includes primary, secondary and higher education as well as other non-specified education activities.

Figure 2.3 **Participation of education professionals in innovation, by innovation type and country**

Percentage of graduates working in the education sector who play a role in introducing different types of innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082157

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source : Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation occurrence within the education sector compared with other sectors

General findings

Compared with other sectors of the economy, employee participation in innovation in the education sector is common (Figure 2.4 and Figure 2.5). Above the 71% average for the economy in 2005, 76% of graduates working in education reported having played a role in introducing at least one type of innovation in their organisation. In eight individual countries, participation in innovation in education was significantly above that of the whole economy. Together with manufacturing (78%), employee participation in innovation in education was among the highest of all sectors. Such participation in innovation in education stood at a similar level to that of manufacturing in most countries, the opposite being the case only for Switzerland and Turkey.

In terms of introducing different innovation types, the education sector stands at the average level (Figure 2.6 and Figure 2.7). Across all sectors, 24% of graduates participated in introducing all three types of innovation, compared with 23% of those working in education. While at the level of – or even above – the economy as a whole in most individual countries, the education sector ranked significantly below the whole economy only in Austria. Employee participation in three types of innovation was the highest in agriculture and mining (30%), manufacturing (27%) and business activities (26%), and significantly above education. The education sector ranked lower than manufacturing in eight countries and lower than business services in nine, and below the European country mean. Only in three countries did the education sector outperform manufacturing and, in two others, business services.

Employees take part in introducing innovation more in education than in other public services (Figure 2.4 to Figure 2.7). In 2005, fewer higher education graduates participated in introducing at least one type of innovation in public administration (61%) and health (68%) than in education (76%). In this respect, the health sector was significantly behind the education sector in nine European countries, as well as on average. When looking at several types of innovation, education (23%) ranked above public administration (14%), but stood at similar level to health (22%). Education outperformed health in three countries, whereas the opposite was true only for Estonia.

Country specificities

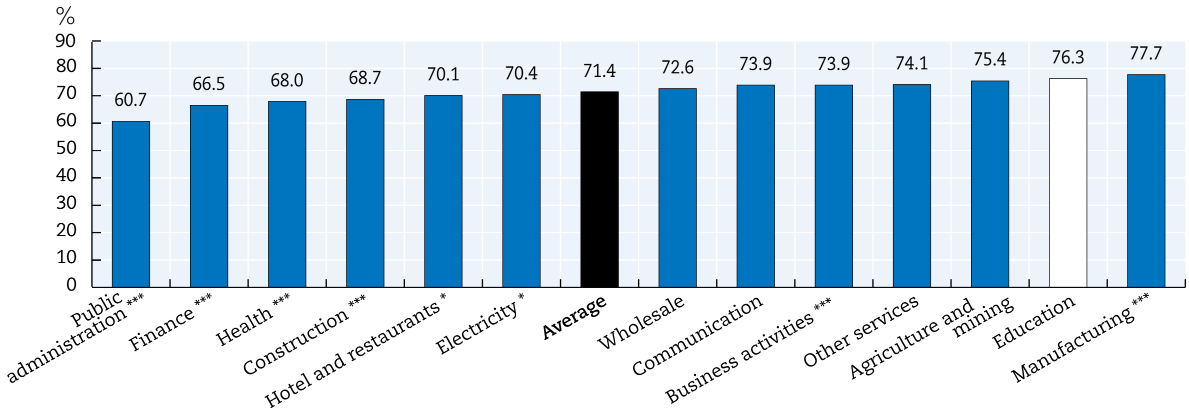
The Czech Republic stands out as a country where employee participation in innovation in the education sector is particularly common when compared to other sectors of the economy. In 2005, the Czech education sector outperformed the economy as a whole in terms of both the level and types of employee participation in innovation. The Czech education sector outperformed business services by 4% points and manufacturing by 8% points in participation in at least one type of innovation, and outperformed manufacturing by 9% points across the three types of innovation.

In contrast, employee participation in innovation in the Turkish education sector is less common relative to other sectors and countries. In Turkey in 2008, fewer graduates employed in education played a role in introducing at least one type of innovation than those employed in manufacturing (16% points difference) or business activities (14% points difference). Education ranked below business activities by 24% points and manufacturing by 14% points regarding participation in various types of innovation.

The case of the Netherlands illustrates that employee participation in innovation in education can be relatively high for some types of innovation. The Dutch education sector outperformed the economy as a whole by 8% points, health by 14% points and business activities by 9% points in terms of participation in at least one type of innovation. Yet, in terms of participation in various types of innovation, education ranked below both manufacturing (15% points less) and business activities (6% points less).

Figure 2.4 **Professionals participating in innovation, by sector**

Percentage of graduates who play a role in introducing at least one type of innovation, 2005 or 2008



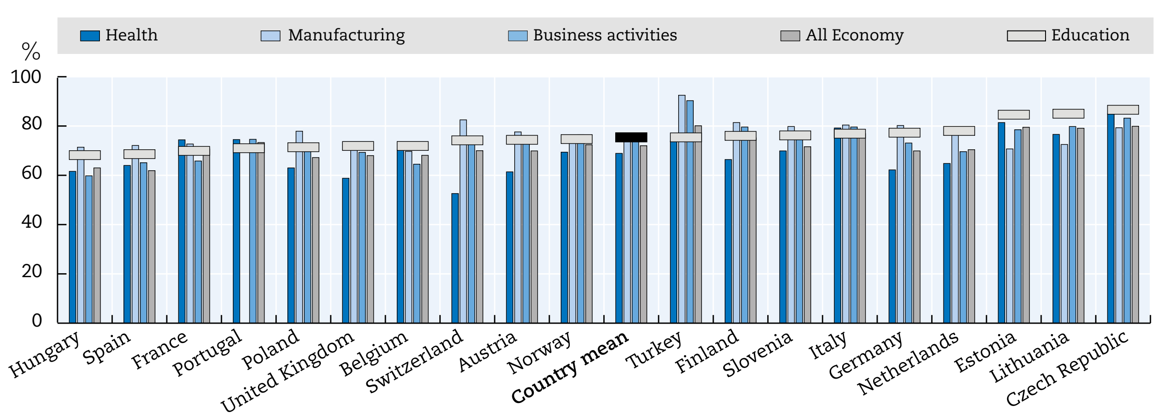
StatLink http://dx.doi.org/10.1787/888933082176

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.5 **Professionals participating in innovation, by sector and country**

Percentage of graduates who play a role in introducing at least one type of innovation, 2005 or 2008



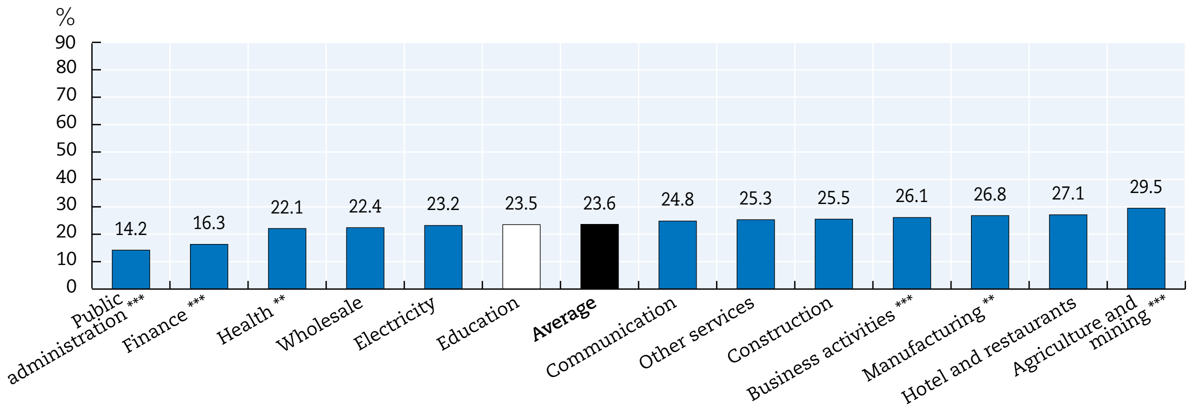
StatLink http://dx.doi.org/10.1787/888933082195

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.6 **Professionals participating across three types of innovation, by sector**

Percentage of graduates who play a role in introducing three types of innovation, 2005 or 2008



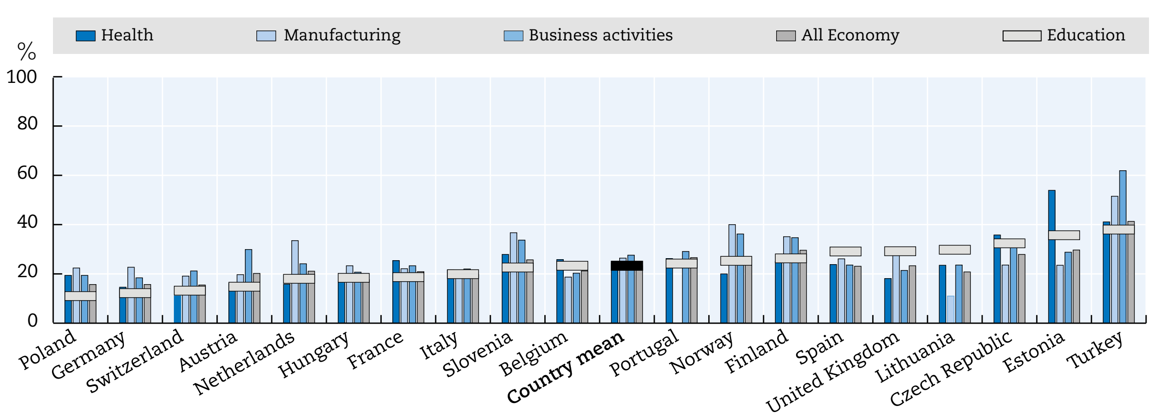
StatLink http://dx.doi.org/10.1787/888933082214

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.7 **Professionals participating across three types of innovation, by sector and country**

Percentage of graduates who play a role in introducing three types of innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082233

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: REFLEX 2005 and HEGESCO 2008

Innovation types within the education sector compared with other sectors

General findings

Education outperforms most other sectors of the economy regarding employee participation in knowledge or methods innovation in Europe (Figure 2.8 and Figure 2.9). Against the average of 61% and more than in most other sectors, 71% of graduates working in education played a role in introducing knowledge or methods innovation in their organisation in 2005. The education sector outperformed most other sectors of the economy in five countries. Employee participation in knowledge or methods innovation was more common than participation in other types of innovation in nearly all sectors of the economy including education.

A smaller proportion of graduates participate in product or service innovation in the education sector than the rest of the economy on average (Figure 2.8 and Figure 2.10). In 2005, 44% of graduates working in education had played a role in introducing product or service innovation, below the average of sectors (47%) and outperforming only public administration (35%). Education ranked significantly below most other sectors of the economy in six countries and on average – outperforming manufacturing only in Lithuania. Participation in product or service innovation was the second most common for education and most other sectors of the economy, while holding similar standing with knowledge or methods innovation for the hotel and restaurants sector.

Employee participation in technology, tools or instruments innovation in education is at the average level when compared to other sectors of the economy (Figure 2.8 and Figure 2.11). Graduates working in the education sector reported a participation rate of 35% for technology, tools or instruments innovation in 2005, close to the 36% economy average. Education ranked below the sectors of agriculture and mining (46%) and manufacturing (43%), but significantly above public administration (24%) and health (30%). Manufacturing and business activities outperformed education in eight countries. In contrast, education ranked above manufacturing in Czech Republic and Estonia and above health in five countries. Amongst the different innovation types, participation in technology, tools or instruments innovation was the least common for most sectors of the economy.

Country specificities

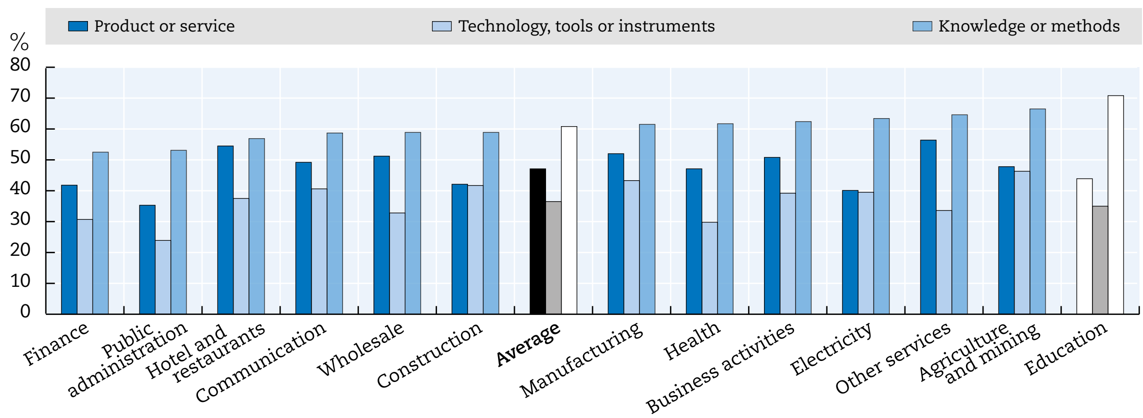
With regard to employee participation in innovation, education ranks highly in terms of different types of innovation in Spain. Spain was among countries where education outperformed most other sectors of the economy regarding participation in knowledge or methods innovation in 2005. The Spanish education sector also ranked significantly above the economy as a whole as well as health (by 11% points) and business activities (by 9% points) in terms of technology, tools or instruments innovation.

In contrast, in Poland education employee participation in innovation is relatively low. Together with health, the Polish education sector ranked below most other sectors regarding participation in product or service and technology, tools or instruments innovation in 2008.

The cases of Germany and Austria illustrate examples of countries where education employees participate in some, but not all types of innovation. The German and Austrian education sectors outperformed most other sectors of the economy with regard to participation in knowledge or methods innovation in 2005. Yet, education ranked below manufacturing and business activities concerning both product and service innovation and technology, tools or instruments innovation.

Figure 2.8 **Professionals participating in innovation, by sector and innovation type**

Percentage of graduates who play a role in introducing innovation, 2005 or 2008

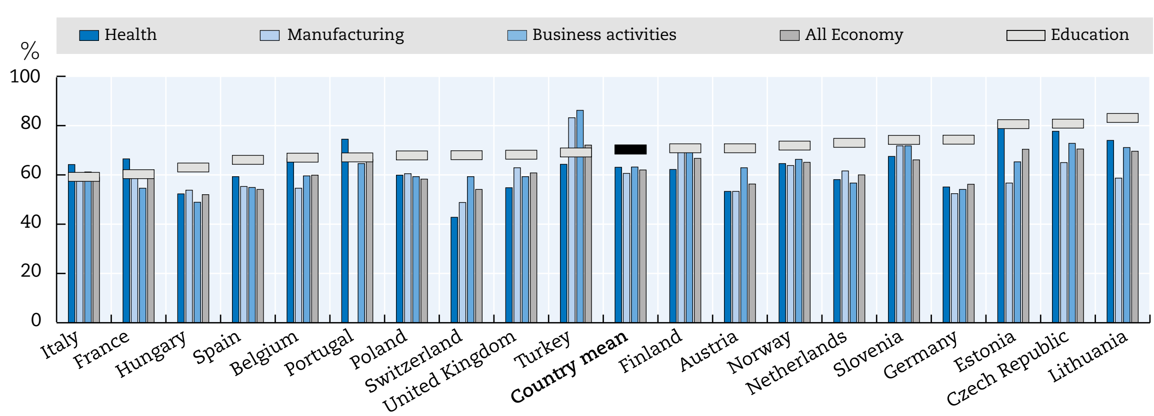


StatLink http://dx.doi.org/10.1787/888933082252

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.9 **Professionals participating in knowledge or methods innovation, by sector and country**

Percentage of graduates who play a role in introducing knowledge or methods innovation, 2005 or 2008

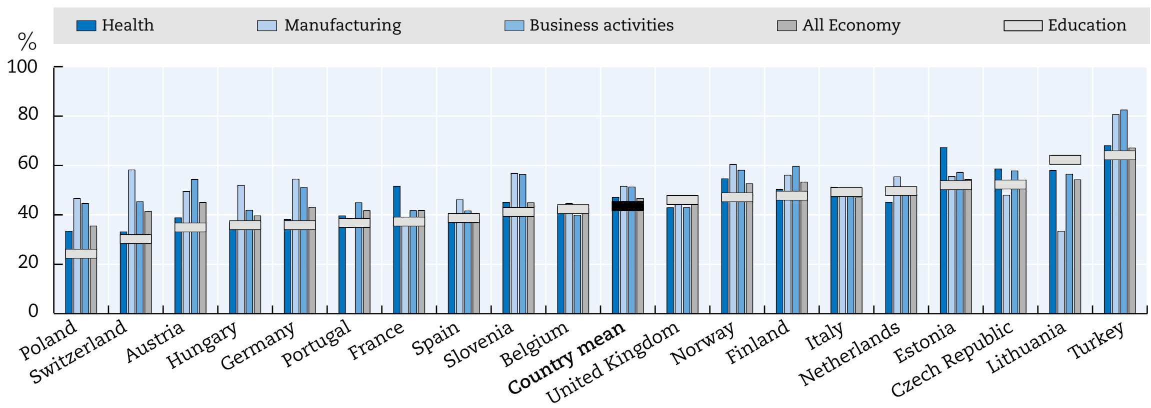


StatLink http://dx.doi.org/10.1787/888933082271

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.10 **Professionals participating in product or service innovation, by sector and country**

Percentage of graduates who play a role in introducing product or service innovation, 2005 or 2008



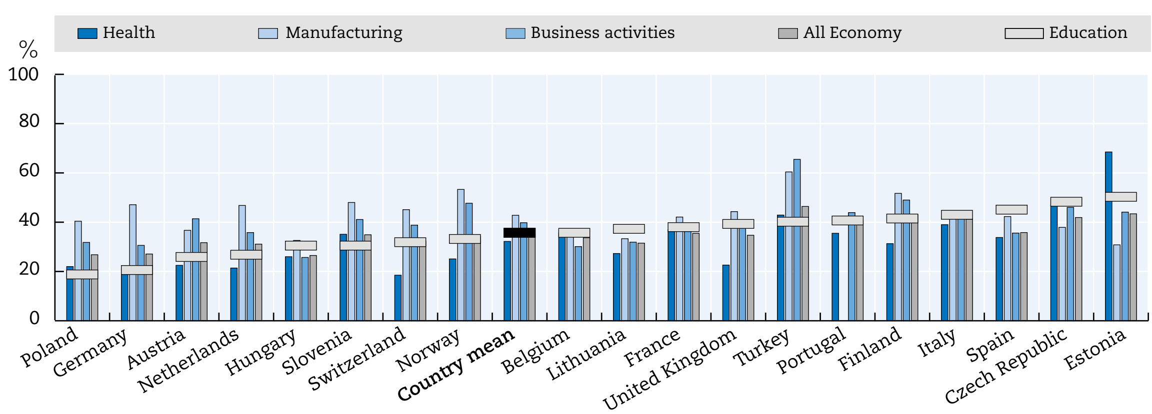
StatLink http://dx.doi.org/10.1787/888933082290

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.11 **Professionals participating in technology, tools or instruments innovation, by sector and country**

Percentage of graduates who play a role in introducing technology, tools or instruments innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082309

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation within the education sector by level of education

Innovation occurrence and types

Employee participation in innovation is more frequent in the higher education sector than in secondary or primary education (Figure 2.12 and Figure 2.13). Against 76% for the education sector in general, 81% of graduates working in the higher education sector had played a role in introducing at least one type of innovation in 2005. This compares with 74% of those in employment within secondary education and 73% within primary education. Graduates working in higher education were nearly 50% more likely to participate in at least one type of innovation than those working in secondary or primary education. Moreover, the higher education sector outperformed all other sectors of the economy – including manufacturing – regarding employee participation in at least one type of innovation. Higher education stands out as the education sector with most employee participation in various types of innovation (Figure 2.12 and Figure 2.13). Against 24% for the whole education sector, 26 % of graduates in higher education played a role in introducing the three different types of innovations. This figure was only 20% for secondary and 24% for primary education. Graduates employed in higher education were 30% more likely to take part in different types of innovation than those working in secondary education. Higher education was also among the sectors of the economy with above average (24%) levels of employees participating in different types of innovation, whereas secondary education ranked below the average in this respect.

Innovation types

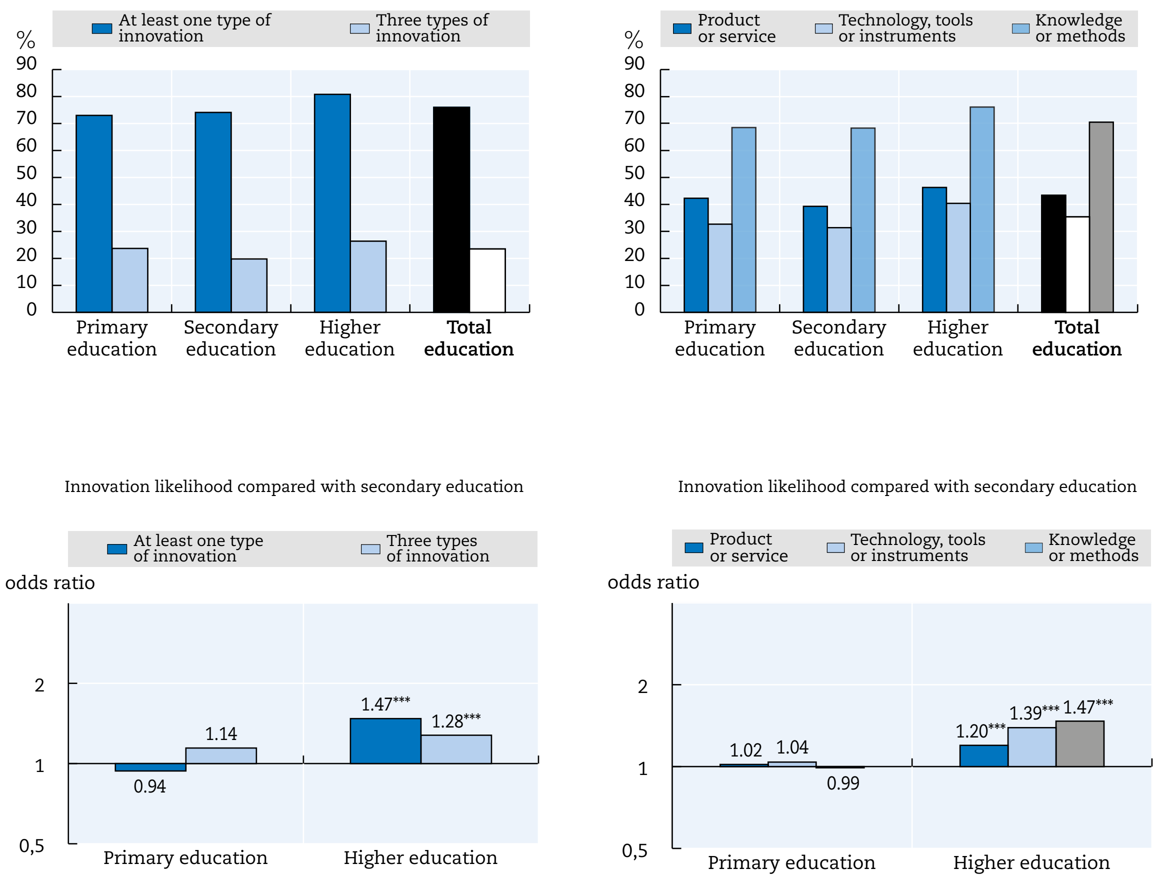
Knowledge or methods innovation was the most common type of innovation across all levels of education in terms of graduate participation in innovation in 2005 (Figure 2.12). Employee participation in product or service innovation was more common than in technology, tools and instruments innovation.

Higher education outperforms other levels of education in terms of the introduction of all three innovation types (Figure 2.12 and Figure 2.14). It showed the greatest share of graduates participating in innovation – in terms of knowledge or methods (76%), product or service (46%) and technology, tools or instruments (40%) innovation. Higher education also outperformed all other sectors of the economy regarding employee participation in knowledge or methods innovation and was among the most innovative sectors in technology, tools or instruments innovation. Compared to secondary and primary education, the likelihood of participating in introducing knowledge or methods innovation was almost 50% greater for graduates working in higher education and 40% higher with regard to technology, tools or instruments innovation.

In secondary education, employee participation in innovation was least common with regard to technology, tools or instruments innovation (31%), product or service innovation (39%) and knowledge or methods innovation (68%). Although primary and secondary education outperformed the economy average in participation in knowledge or methods innovation, both ranked significantly below the average for product or service and technology, tools or instruments innovation.

Figure 2.12 **Professionals participating in innovation, by innovation type and education level**

Percentage of graduates working in the education sector who play a role in introducing innovation, 2005 or 2008



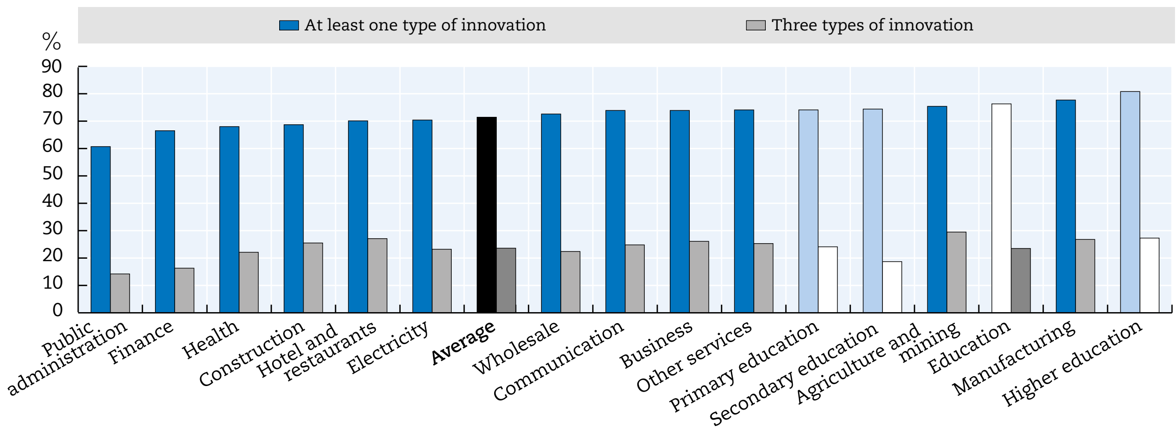
StatLink http://dx.doi.org/10.1787/888933082328

Notes: *** = odds ratio significant at the 0.01 level; ** = odds ratio significant at the 0.05 level; * = odds ratio significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Spain is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.13 **Professionals participating in innovation across three types of innovation, by sector and education level and sectors of the economy**

Percentage of graduates who play a role in introducing innovation, 2005 or 2008



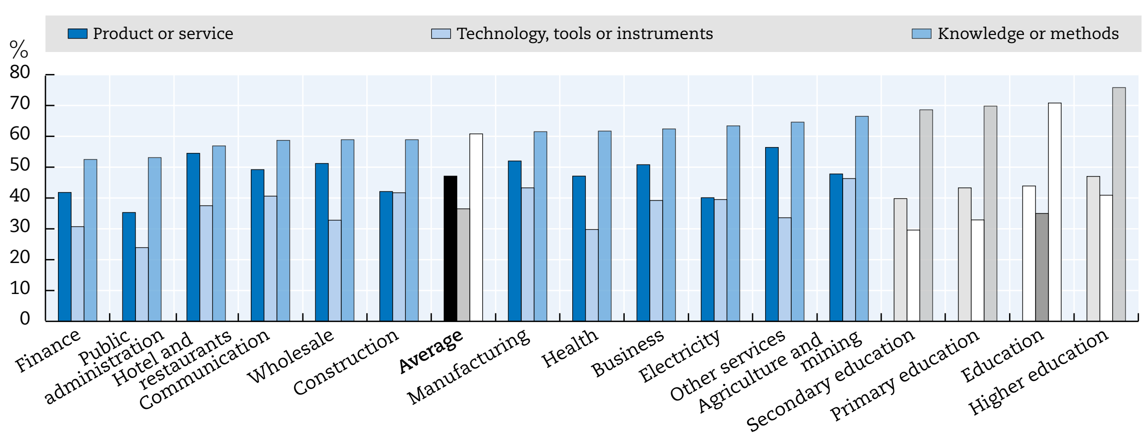
StatLink http://dx.doi.org/10.1787/888933082347

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal and Spain are excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 2.14 **Professionals participating in innovation, by innovation type, sector and education level**

Percentage of graduates who play a role in introducing innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082366

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal and Spain are excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

CHAPTER 3

Speed of adoption of innovation in education and other sectors

A workplace may sometimes be at the forefront of adopting innovations or new knowledge or methods (described as lead innovation adoption), whether or not it is highly innovative. Analysis of lead innovation adoption can identify the extent to which such activities are observed in the education sector within more innovative organisations. The education sector can also be compared with other sectors of the economy such as manufacturing or other public services and across primary, secondary and higher education.

Level of Innovation within the education sector

General findings

Lead innovation adoption occurs when organisations are at the forefront in terms of adopting innovations or new knowledge or methods. Instances of lead innovation adoption in education are widespread in Europe and Japan (Figure 3.1 and Figure 3.2). On average, 73% of graduates working in the education sector in 2005 indicated that their organisation was a lead adopter; higher than the percentage describing their organisation as highly innovative (described in Chapter 1). This was the case for more than half of graduates in all 20 countries for which data was available. Combining lead adoption with reports on highly innovative workplaces, on average across the education sector, 56% of graduates were working in a highly innovative workplace that was at least sometimes at the forefront of innovation adoption (Figure 3.2). This was the case for at least half of the graduates in most of the 19 European countries with available data.

Graduates within the education sector were less likely to report that their workplace was mostly (as opposed to sometimes) at the forefront of innovation adoption (Figure 3.3 and Figure 3.4). In 2005 only 37% of graduates in education sectors in Europe and Japan saw their organisations as being mostly at the forefront. The percentage of graduates that felt this was the case was below 50% in all countries except Switzerland and Finland. Figure 3.4 shows that around a third of graduates in the education sector in Europe (32%) considered their organisation to be highly innovative and mostly at the forefront when adopting innovations. This figure exceeded a half only in Switzerland.

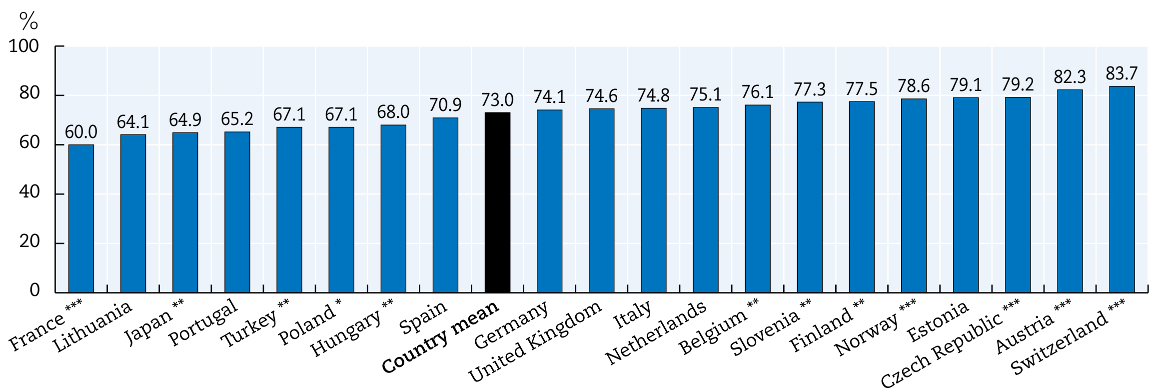
Country specificities

Switzerland, Finland and Austria stand out as countries with above average levels of lead innovation adoption in education. In 2005, the share of graduates employed in education that considered their workplace to be at least sometimes at the forefront of innovation adoption was over 80% in Switzerland (84%) and Austria (82%). In the case of graduates who also reported that they worked in highly innovative workplaces, the proportion exceeded 65% for both countries. When looking at lead adoption in all workplaces, at least half of the graduates considered their organisation to be mostly at the forefront of innovation adoption in Switzerland (57%) and Finland (51%). For these countries and Austria, these figures exceeded 40% of graduates employed in highly innovative workplaces in the education sector.

On the contrary, Poland, France, Japan and Hungary are countries with relatively little lead innovation adoption in education. Below average levels of graduates working in the education sector considered their organisation to be at least sometimes at the forefront of innovation adoption in France (60%), Japan (65%), Poland (67%) and Hungary (68%). When looking at highly innovative workplaces in particular, the figures for the three European countries reached a maximum of 50%. The percentage of employees considering their workplaces in education to be mostly at the forefront of adopting innovations, new knowledge or new methods was low in Poland (17%), France (18%), Portugal (22%), Hungary (27%) and Japan (28%). France (14%), Poland (16%) and Portugal (17%) ranked also particularly low in terms of highly innovative organisations being mostly at the forefront.

Figure 3.1 **Education professionals in workplaces at least sometimes quick to adopt innovation, by country**

Percentage of graduates working in the education sector in workplaces at least sometimes at the forefront of adopting innovation, 2005 or 2008



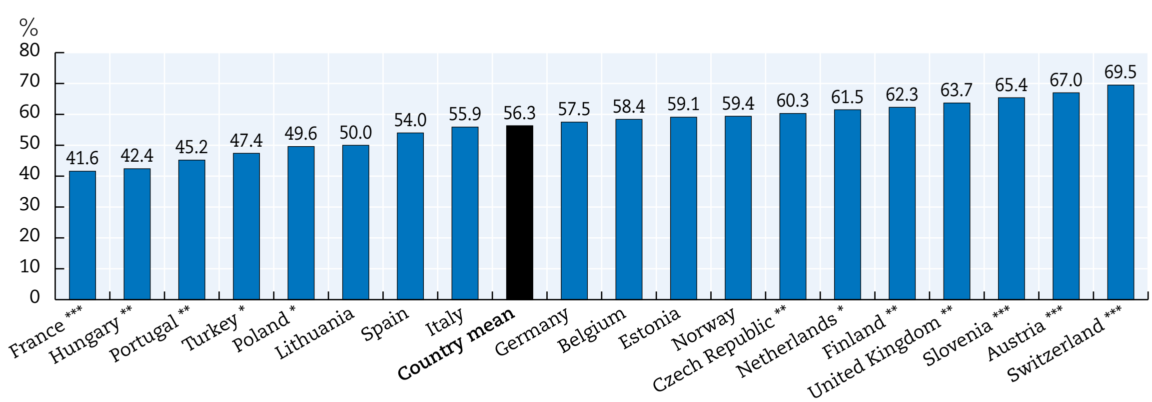
StatLink http://dx.doi.org/10.1787/888933082385

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.2 **Education professionals in highly innovative workplaces at least sometimes quick to adopt innovation, by country**

Percentage of graduates working in the education sector in highly innovative workplaces at least sometimes at the forefront of adoting innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082404

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

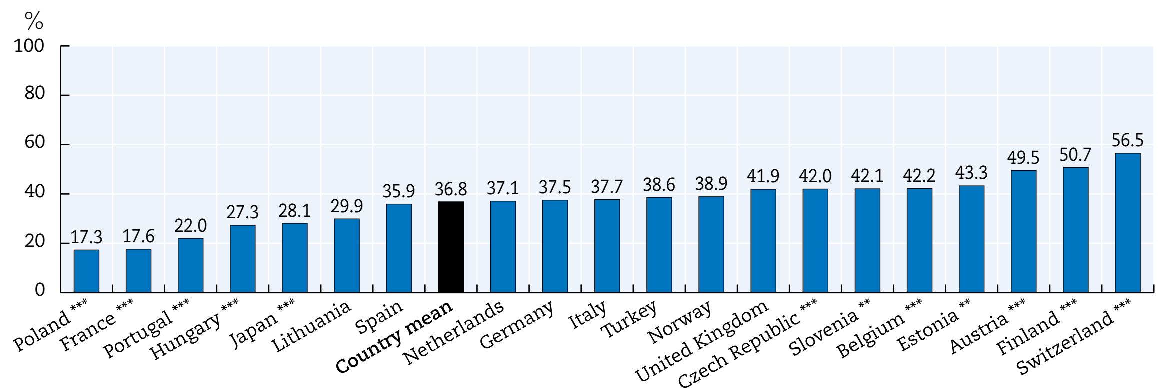
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Box 3.1 **Data source details for Chapter 3**

REFLEX (2005) and HEGESCO (2008) surveys asked higher education graduates five years after their graduation "Is your organization normally at the forefront when it comes to adopting innovations, new knowledge or new methods, or is it more a follower?". In the scale from 1 (mainly at the forefront) to 5 (mainly a follower), mostly at the forefront corresponds to values 1 and 2 and sometimes at the forefront to values 1, 2 and 3. The graduates were also asked "How would you characterize the extent of innovation in your organization or your work?" regarding three types of innovation separately. High innovative organisations correspond to values 4 and 5 in the scale from 1 (very low) to 5 (very high) regarding at least one type of innovation. The education sector includes primary, secondary and higher education as well as other non-specified education activities.

Figure 3.3 **Education professionals in workplaces mostly quick to adopt innovation, by country**

Percentage of graduates working in the education sector in workplaces mostly at the forefront of adopting innovation, 2005 or 2008



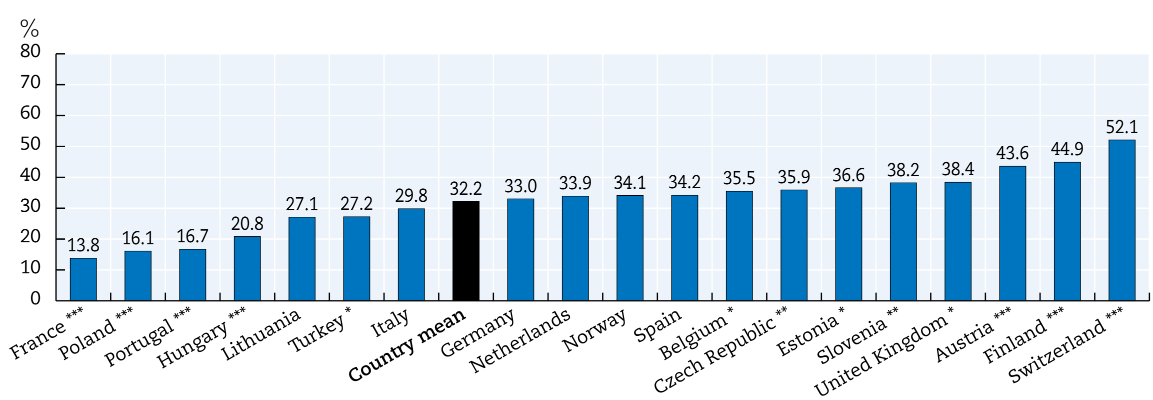
StatLink http://dx.doi.org/10.1787/888933082423

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source : Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.4 **Education professionals in highly innovative workplaces mostly quick to adopt innovation, by country**

Percentage of graduates working in the education sector in highly innovative workplaces mostly at the forefront of adopting innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082442

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source : Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Lead innovation within the education sector compared with other sectors

General findings

The education sector stands at the average regarding the spread of lead innovation adoption when compared to other sectors of the economy in Europe and Japan (Figure 3.5 and Figure 3.6). Similar to the 74% average across economies in 2005, 73% of graduates working in education reported that their workplace was at least sometimes at the forefront in adopting innovations, new knowledge or methods. In line with the average of the economy (57%), a little more than half of graduates worked in organisations that were both highly innovative and exhibited lead innovation adoption (57%). Education ranked significantly below five other sectors including business activities (80%) or manufacturing in terms of lead innovation adoption (79%), but above public administration (58%). Amongst graduates who reported that they were in highly innovative workplaces that were also at the forefront of adoption, education ranked below five other sectors, but above both public administration (39%) and health (53%). Both manufacturing and business activities outperformed education in terms of lead innovation adoption in eight individual countries in general, but education ranked above health in six countries. In the case of highly innovative workplaces with lead innovation adoption, manufacturing outperformed education in most countries and business activities in nine, whereas health ranked significantly below education in five countries. Only in Slovenia did education rank above manufacturing for all workplaces and those also described as highly innovative workplaces. Health outperformed education in France and Estonia in all workplaces, while it outperformed the Czech Republic in highly innovative workplaces.

Conversely, the education sector falls below the average in terms of being mostly at the forefront of innovation (Figure 3.7 and Figure 3.8). In 2005, 37% of graduates working in education considered their organisation as being mostly at the forefront of innovation adoption in Europe and Japan compared with 41% for the average sector of the economy. This was the case for 33% of graduates in education who also considered their workplace to be highly innovative, below the 36% economy average in Europe. Ranking below six other sectors, education outperformed only public administration (27%) in general and both public administration (21%) and health (30%) regarding highly innovative workplaces at the forefront of innovation adoption. Both in general and in the case of highly innovative organisations, manufacturing and business activities outperformed education in most countries. Education outperformed health in five countries in general, the opposite being true for three countries.

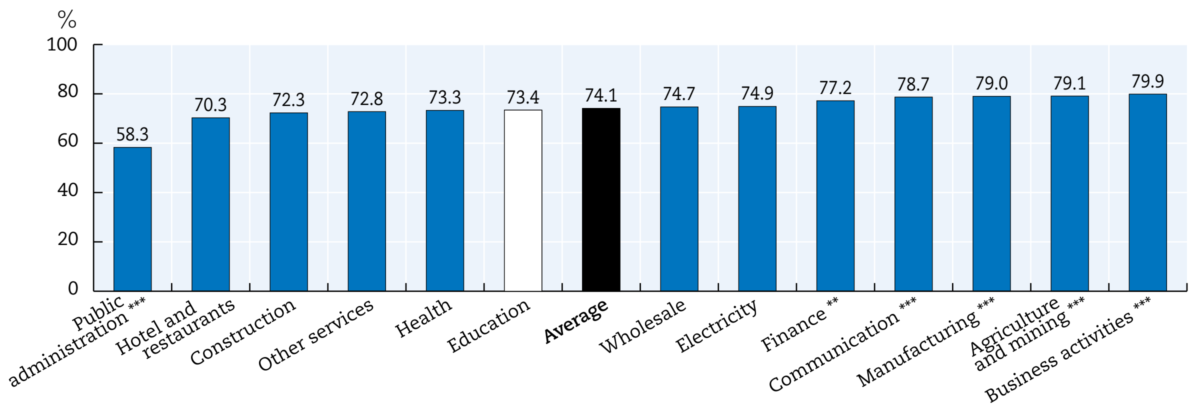
Country specificities

In comparison to other sectors of the economy, education in Slovenia and Switzerland does relatively well in lead innovation adoption (Figure 3.9 to Figure 3.12). In 2008 and 2005, the Slovenian and Swiss education sectors significantly outperformed the health sectors with workplaces sometimes or mostly at the forefront of innovation adoption in general and highly innovative workplaces being at the forefront. In both countries, education stood at least at the similar level with other sectors of the economy in being at least sometimes, but also mostly, in forefront of adopting innovations, new knowledge or methods.

The Czech Republic and, to a lesser extent, France and Hungary compare less well to other sectors in terms of lead innovation. In 2005, the Czech education sector ranked below all other sectors of the economy in the share of graduates being employed by all or only highly innovative organisations that were mostly at the forefront of innovation. This was also the case for workplaces that were mostly at the forefront of innovation adoption in the Czech Republic. The economy as a whole, manufacturing and business activities significantly outperformed education in both France and Hungary regarding graduates being employed in highly innovative workplaces that were mostly at the forefront of adopting innovations.

Figure 3.5 **Professionals in workplaces at least sometimes quick to adopt innovation, by sector**

Percentage of graduates in workplaces at least sometimes at the forefront of adopting innovation, 2005 or 2008



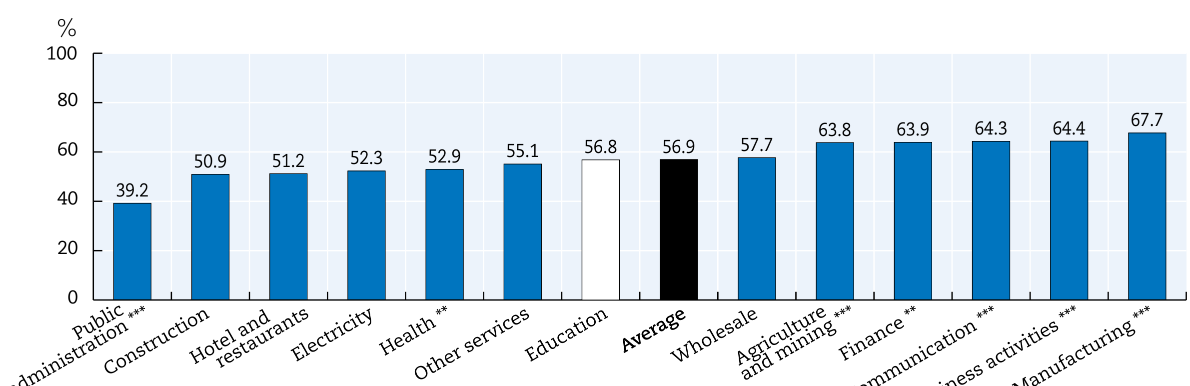
StatLink http://dx.doi.org/10.1787/888933082461

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.6 **Professionals in highly innovative workplaces at least sometimes quick to adopt innovation, by sector**

Percentage of graduates in highly innovative workplaces at least sometimes at the forefront of adopting innovation, 2005 or 2008



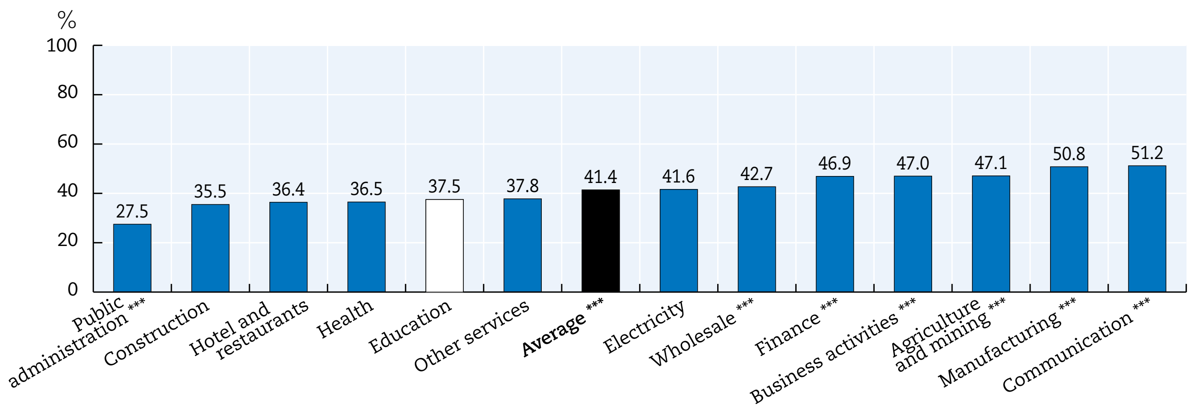
StatLink http://dx.doi.org/10.1787/888933082480

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.7 **Professionals in workplaces mostly quick to adopt innovation, by sector**

Percentage of graduates in workplaces mostly at the forefront of adopting innovation, 2005 or 2008



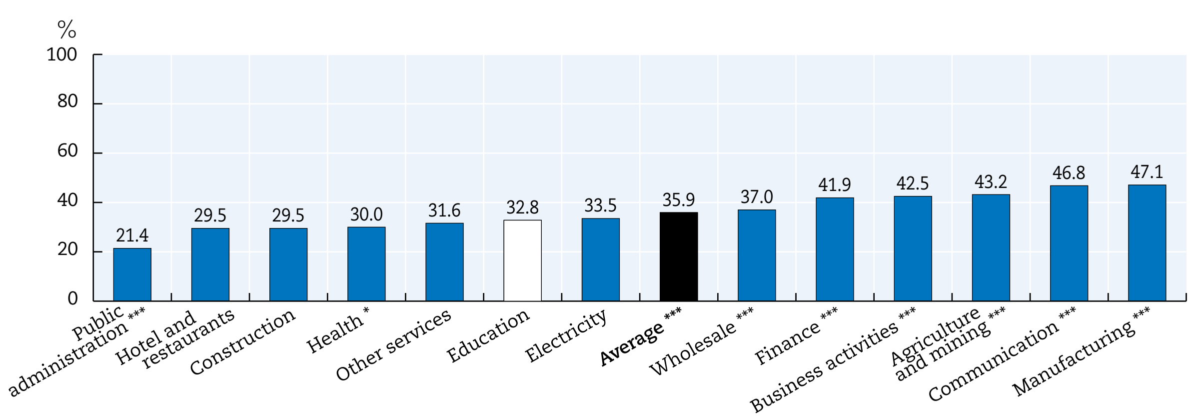
StatLink http://dx.doi.org/10.1787/888933082499

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.8 **Professionals in highly innovative workplaces mostly quick to adopt innovation, by sector**

Percentage of graduates in highly innovative workplaces mostly at the forefront of adopting innovation, 2005 or 2008



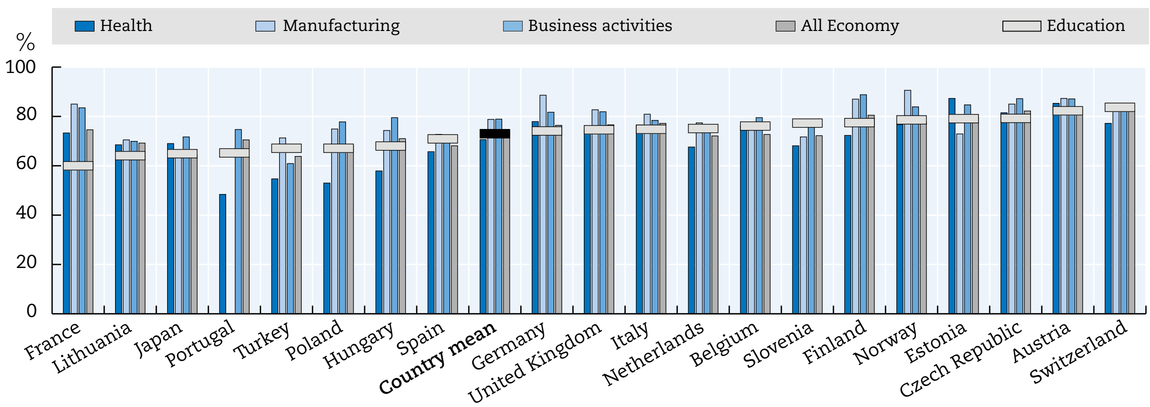
StatLink http://dx.doi.org/10.1787/888933082518

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.9 **Professionals in workplaces at least sometimes quick to adopt innovation, by sector and country**

Percentage of graduates in workplaces at least sometimes at the forefront of adopting innovation, 2005 or 2008



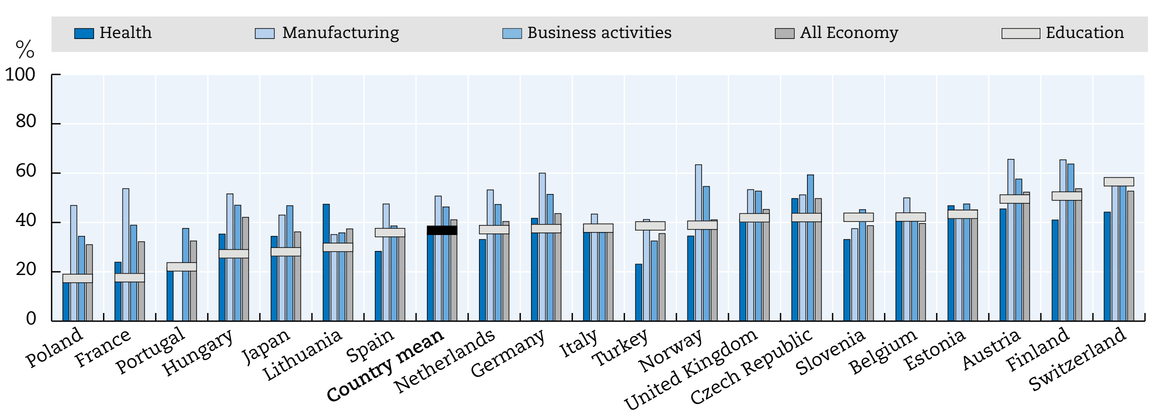
StatLink http://dx.doi.org/10.1787/888933082537

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.10 **Professionals in workplaces mostly quick to adopt innovation, by sector and country**

Percentage of graduates in workplaces mostly at the forefront of adopting innovation, 2005 or 2008



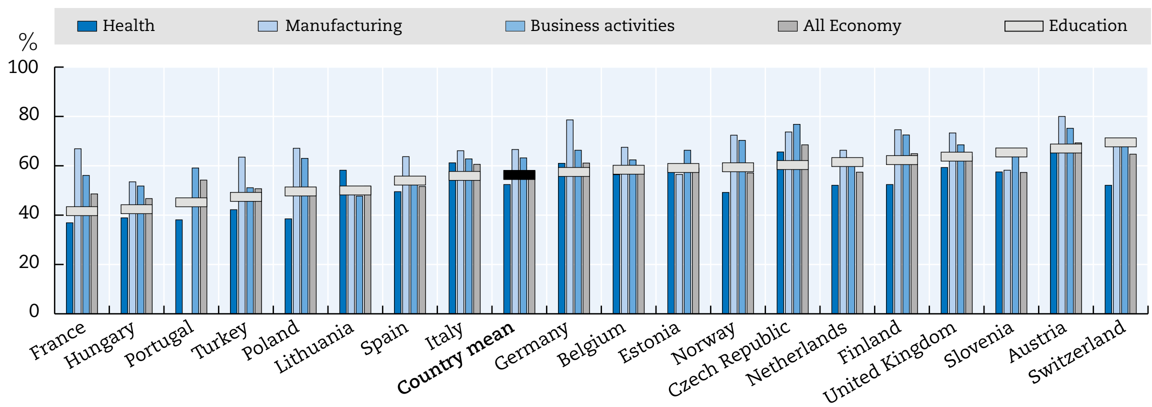
StatLink http://dx.doi.org/10.1787/888933082556

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.11 Professionals in highly innovative workplaces at least sometimes quick to adopt innovation, by sector and country

Percentage of graduates in highly innovative workplaces at least sometimes at the forefront of adopting innovation, 2005 or 2008



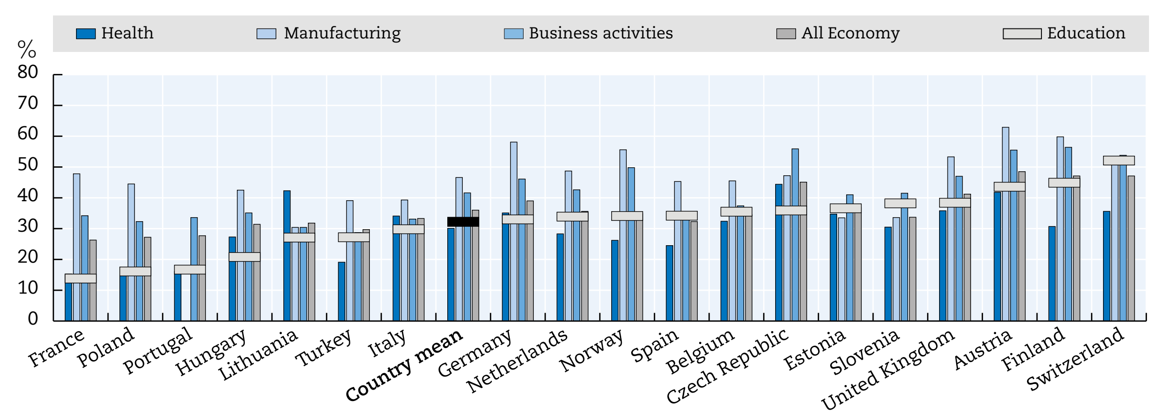
StatLink http://dx.doi.org/10.1787/888933082575

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.12 Professionals in highly innovative workplaces mostly quick to adopt innovation, by sector and country

Percentage of graduates in highly innovative workplaces mostly at the forefront of adopting innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082594

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

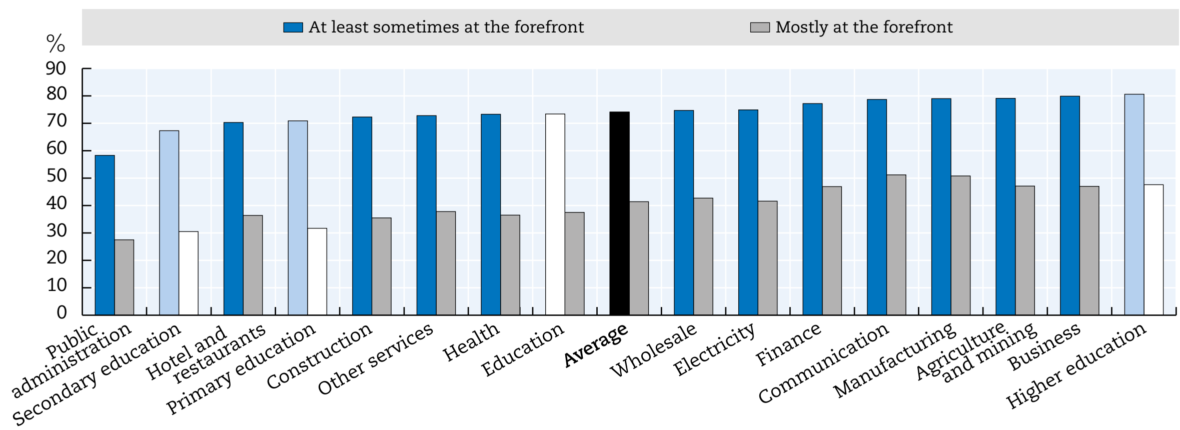
Innovation within the education sector by level of education

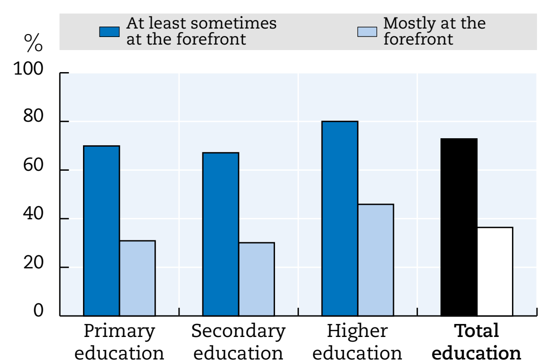
Lead innovation adoption is more widespread in higher education than in secondary or primary education (Figure 3.13 and Figure 3.12). Against 73% for the education sector in general, 80% of graduates working in the higher education sector were employed in organisations at least sometimes at the forefront in adopting innovations in 2005. The relevant figure for the secondary education sector was 67% and 70% for primary education. As to workplaces considered to be highly innovative and at the forefront of innovation adoption, higher education (69%) outperformed all other sectors of education and the economy except the manufacturing sector (68%). In contrast, both primary (53%) and secondary education (49%) ranked slightly below the economy average (57%). The likelihood of graduates working in an organisation at the forefront of adopting innovation was almost twice as high for those working in higher education as in secondary or primary education – and more than twice as high in the case of highly innovative organisations.

Higher education stands out with regard to workplaces in the education sector that are mostly at the forefront of adopting innovation (Figure 3.13 and Figure 3.14). Above the 36% for the whole education sector, 46% of graduates working in higher education reported that their workplace was mostly at the forefront in adopting innovations, new knowledge or methods in 2005. In comparison, just 30% of those in employment within secondary education and 31% in primary education reported that their organisations were mostly at the forefront. In comparison with other sectors of the economy, higher education also outperformed the average (41%) – whilst the opposite was true for both secondary and primary education. The picture was similar when looking at the proportion of graduates reporting that their workplace was both highly innovative and mostly at the forefront of adopting innovation. Higher education (43%) significantly outperformed both the education sector in general (32%) and the economy average (36%); it also compared favourably with the 25% for both secondary and primary education. Graduates employed in the higher education sector were nearly twice as likely to work in an organisation that was mostly at the forefront of adopting innovation compared with those employed in secondary or primary education. In the case of highly innovative workplaces, these odds were more than double.

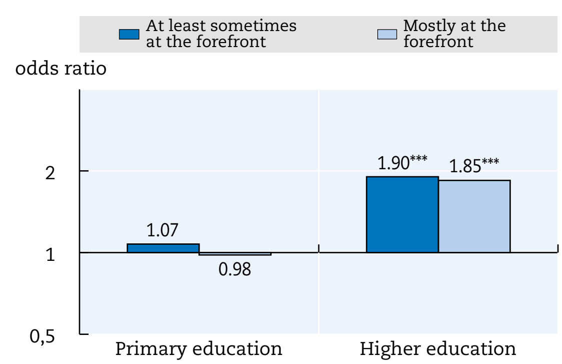
Figure 3.13 **Professionals in workplaces quick to adopt innovation, by sector and education level**

Percentage of graduates in workplaces at the forefront of adopting innovation, 2005 or 2008





Innovation likelihood compared with secondary education



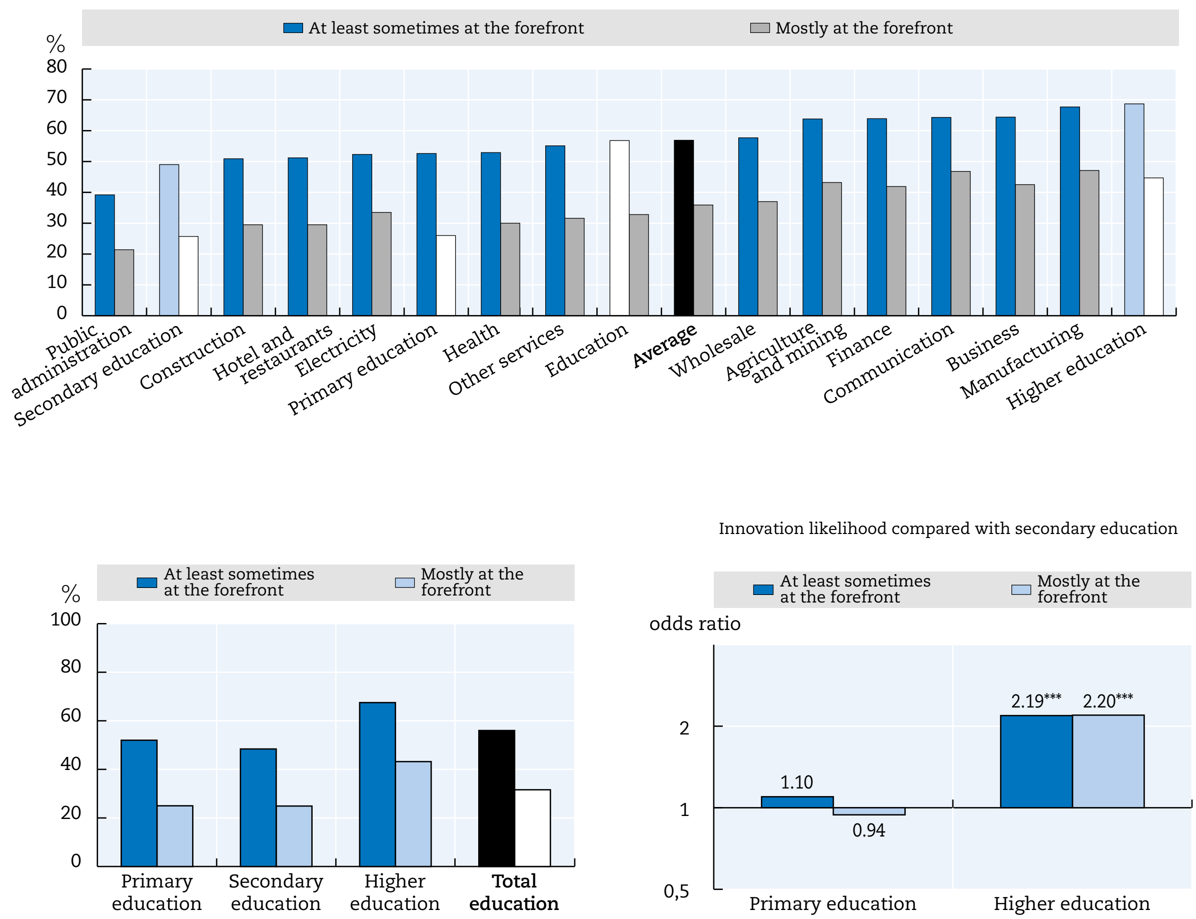
StatLink http://dx.doi.org/10.1787/888933082613

Notes: *** = odds ratio significant at the 0.01 level; ** = odds ratio significant at the 0.05 level; * = odds ratio significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Spain is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 3.14 **Professionals in highly innovative workplaces quick to adopt innovation, by sector and education level**

Percentage of graduates in highly innovative workplaces at the forefront of adopting innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082632

Notes: *** = odds ratio significant at the 0.01 level; ** = odds ratio significant at the 0.05 level; * = odds ratio significant at 0.1 level. Spain is excluded. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

CHAPTER 4

Highly innovative jobs

It is possible to measure the percentage of recent graduates who have highly innovative jobs - that is jobs in highly innovative workplaces where they themselves participate in introducing the innovation - by deriving a new variable from their responses to the two questions reported in Chapters 1 and 2. Such highly innovative jobs may combine various kinds of innovation or focus on a specific type of innovation.

The education sector can be compared with other sectors of the economy such as manufacturing or other public services to see which have the largest proportion of highly innovative jobs. Exploring differences between innovative jobs across levels of education is also important, highly innovative jobs may not be equally distributed amongst primary, secondary and higher education.

Innovation occurrence and types within the education sector

General findings

Highly innovative jobs are not uncommon in Europe (Figure 4.1). On average, 58% of graduates working in the education sector in 2005 considered that they had a highly innovative job – they reported that they worked in highly innovative organisations regarding at least one type of innovation and that they themselves also played a role in introducing those kinds of innovations. This was the case for at least half of the graduates in a large majority of the 19 European countries for which data was available, with the exception of France, Portugal and Hungary.

However, innovative jobs in education do not necessarily incorporate each of the three forms of innovation (Figure 4.2). Of graduates working in education in an average European country just 9% reported that their organisation was highly innovative concerning three types of innovation and that they also participated in introducing those innovations. In no country did this figure exceed 20% of graduates.

Highly innovative jobs in education are most likely to cover knowledge or methods innovation, while other types of innovation are less common (Figure 4.3). In 2005, 47% of graduates played a role in introducing knowledge or methods innovations in their highly innovative organisations across the countries studied. For technology, tools or instruments innovation this was the case for only 21% of graduates and regarding product or service innovation, 25% of graduates. Knowledge or method innovation was the most common type of innovation in all countries. In eight countries, product or service innovation was more common than technology, tools or instruments innovation.

Country specificities

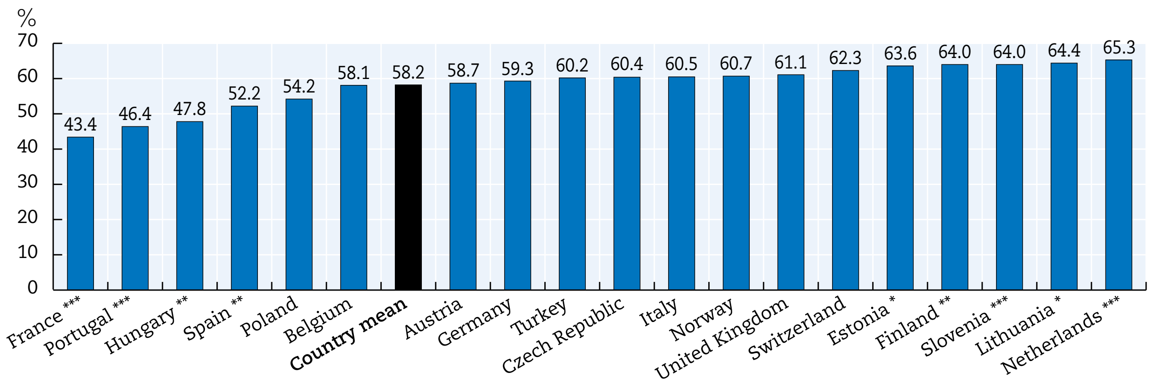
The United Kingdom and Finland stand out as countries with more highly innovative jobs than average across different types of innovation in the education sector. In 2005, the United Kingdom had the largest share of graduates (17%) considering their jobs to be highly innovative in all three types of innovation. Innovative jobs in education concerning product or service as well as technology, tools or instruments innovation were significantly more common in the United Kingdom than on average. Finland was among the countries with above average levels of innovative jobs concerning at least one type of innovation (64%) – as well as knowledge or methods and product or service innovation specifically.

In contrast, Hungary, France and Poland have few highly innovative jobs in the education sector. The share of graduates participating in the introduction of three types of innovation in highly innovative organisations was significantly below the European average in Hungary (3%), France (5%) and Poland (6%). Regarding at least one type of innovation, France (43%) and Hungary (48%) were among countries with the lowest share of graduates in innovative jobs. Hungary ranked below the European average for all three types of innovation, whilst France was below average for knowledge or methods and product or service innovation and Poland was below average for product or service and technology, tools or instruments.

The Dutch and Spanish cases illustrate that jobs in the education sector may not be highly innovative across all types of innovation. In 2005, the Netherlands had the largest share of highly innovative jobs covering at least one type of innovation (65%) – with above average levels for both knowledge or methods and product or service innovation. Yet the level of highly innovative jobs in technology, tools or instruments innovation in the Dutch education sector was below the European average. In Spain, highly innovative jobs in education were below average when considering at least one type of innovation (52%) and knowledge or methods innovation. However, the Spanish education sector was among the most innovative when looking at technology, tools or instruments innovation.

Figure 4.1 **Education professionals in highly innovative jobs regarding at least one type of innovation, by country**

Percentage of graduates working in the education sector in highly innovative workplaces regarding at least one type of innovation and playing a role in introducing innovation, 2005 or 2008



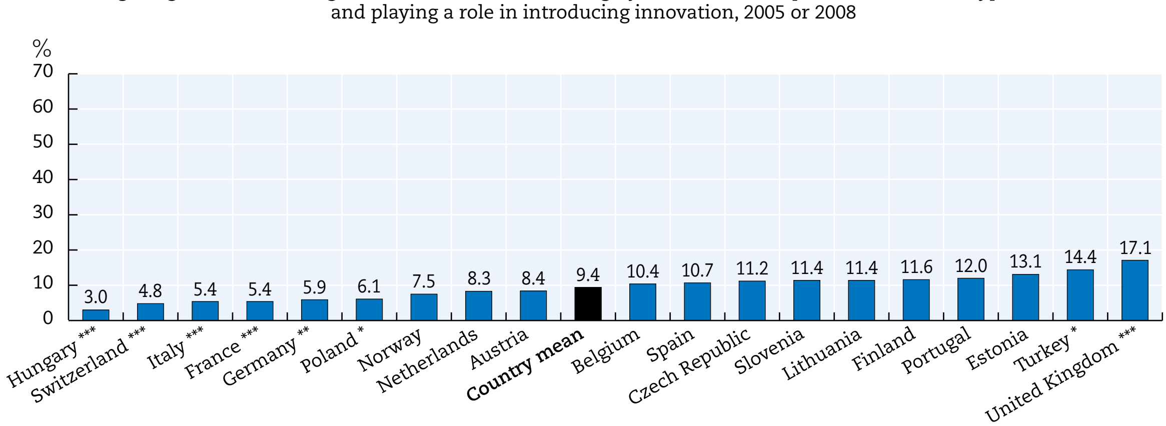
StatLink http://dx.doi.org/10.1787/888933082651

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.2 **Education professionals in highly innovative jobs in education across three types of innovation, by country**

Percentage of graduates working in the education sector in highly innovative workplaces across three types of innovation and playing a role in introducing innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082670

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

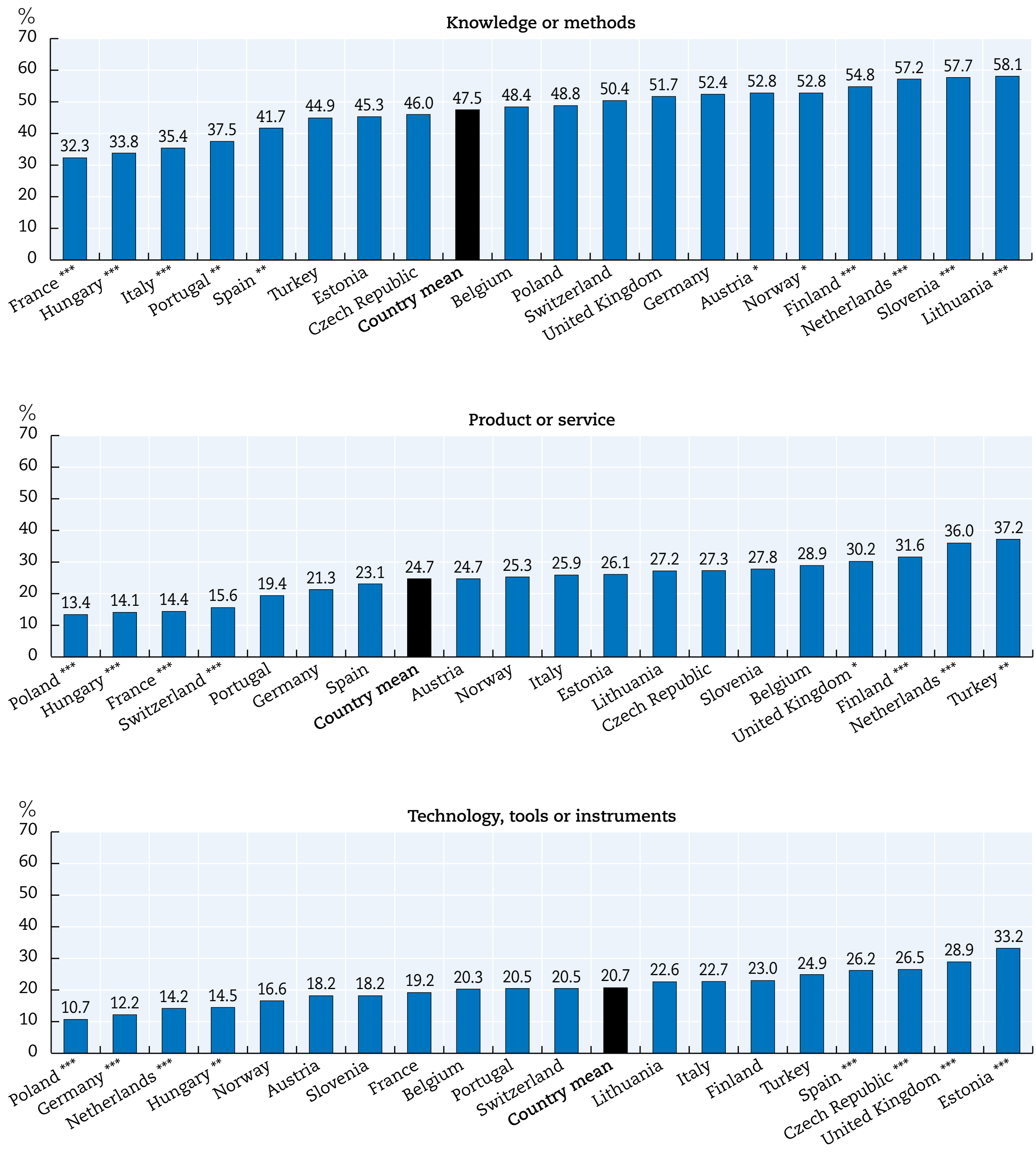
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Box 4.1 **Data source details for Chapter 4**

REFLEX (2005) and HEGESCO (2008) surveys asked higher education graduates five years after their graduation "How would you characterize the extent of innovation in your organization or your work?" regarding "product or service", "technology, tools or instruments" and "knowledge or methods" innovation. High innovation intensity corresponds to values 5 and 4 in the scale from 1 (very low) to 5 (very high). The graduates were also asked "Do you play a role in introducing these innovations in your organisation?" regarding the three innovation types. The education sector includes primary, secondary and higher education as well as other non-specified education activities.

Figure 4.3 **Education professionals in highly innovative jobs in education, by innovation type and country**

Percentage of graduates working in the education sector in highly innovative workplaces across three types of innovation and playing a role in introducing innovation, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082689

Notes: *** = difference with the country mean significant at the 0.01 level; ** = difference with the country mean significant at the 0.05 level; * = difference with the country mean significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source : Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation occurrence within the education sector compared with other sectors

General findings

The education sector is amongst the economic sectors where highly innovative jobs are relatively common (Figure 4.4 and Figure 4.5). Compared with a 55% average for the whole economy in 2005 (excluding Portugal), 59% of graduates working in the education sector had highly innovative jobs. In six individual countries, the level of highly innovative jobs in education was significantly above that of the economy as a whole. Only the manufacturing sector (64%) had significantly more highly innovative jobs than the education sector across the countries analysed.

The education sector stands at the average level in comparison with other sectors in Europe for jobs that are highly innovative regarding three types of innovation (Figure 4.6 and Figure 4.7). Both across the economy and in the education sector, 9% of graduates had highly innovative jobs concerning three different types of innovation at the same time. Such highly innovative jobs were the most common in manufacturing, communication and business activities (13% each). The education sector ranked significantly lower than manufacturing in eight countries and lower than business services in nine countries.

Highly innovative jobs are more common in the education sector than in other public services (Figure 4.4 to Figure 4.7). In 2005, fewer graduates were employed in highly innovative jobs regarding at least one type of innovation in public administration (40%) and health (50%) than in education (59%). In this respect, the health sector was significantly behind the education sector on average and in seven European countries– the opposite was true only in the Czech Republic. When looking at the occurrence of three types of innovation, the education sector (10%) clearly ranked above public administration (5%) and health (7%) sectors. This was confirmed for the health sector in Finland and Belgium, whereas the opposite was the case for the Czech Republic.

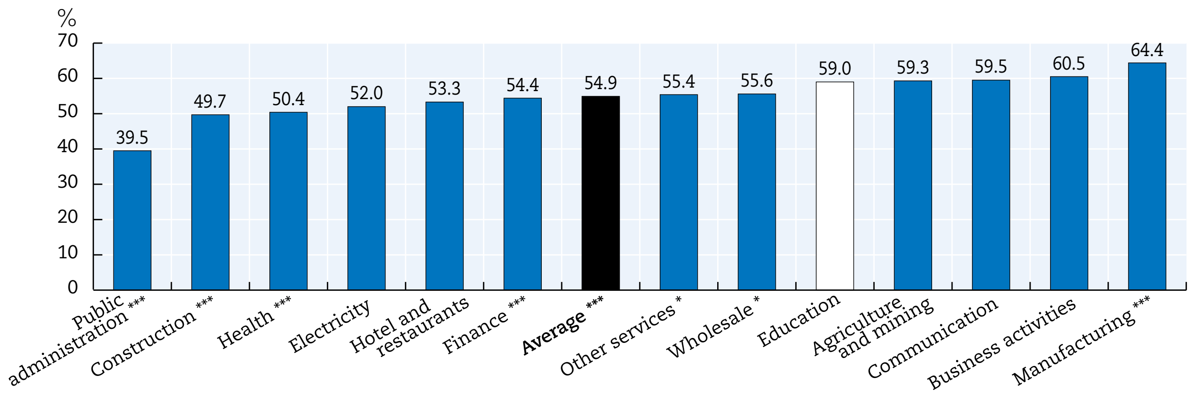
Country specificities

Lithuania and, to a lesser extent, the Netherlands and Estonia stand out as countries where highly innovative jobs in education are common when compared to other sectors of the economy. The education sector outperformed most sectors of the economy in Lithuania in 2008 and in the Netherlands in 2005 when considering graduates working in highly innovative jobs regarding at least one type of innovation. Unlike in most European countries, highly innovative jobs were significantly more common in education than in manufacturing in Lithuania (by 17% points) and Estonia (by 9% points) – however the level of highly innovative jobs in manufacturing was below the European average in both countries.

On the contrary, relative to other sectors and countries, in the Czech and Italian education sectors few graduates are in highly innovative jobs. As to employee participation in at least one type of innovation in highly innovative workplaces, most sectors of the economy outperformed education in the Czech Republic in 2008. Unlike the other countries analysed, the Czech education sector ranked below the health sector regarding both occurrence of innovation (by 5% points) and across three types of innovation (by 3% points). Italy stood out as the only country where the education sector ranked significantly below the economy as a whole across three types of innovation (3% points) as well as below most other sectors in 2005.

Figure 4.4 **Professionals in highly innovative jobs, by sector**

Percentage of graduates working in highly innovative workplaces regarding at least one type of innovation and playing a role in introducing those innovations, 2005 or 2008



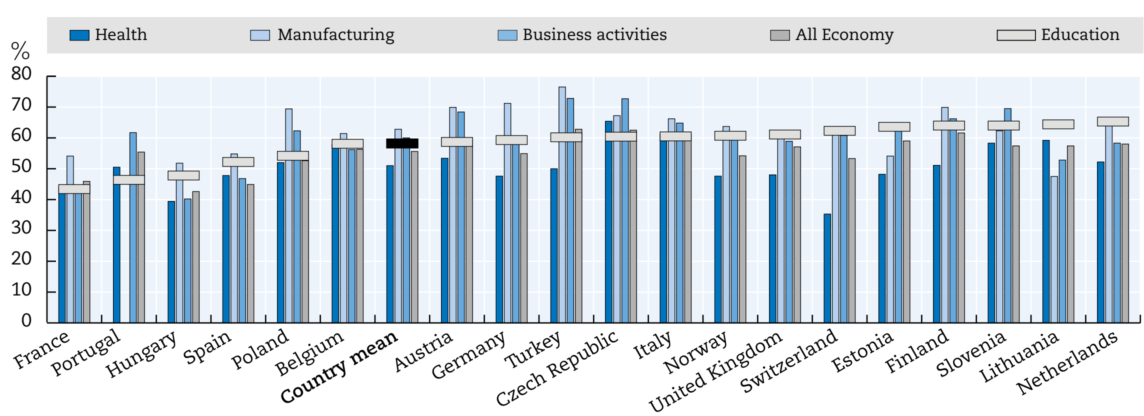
StatLink http://dx.doi.org/10.1787/888933082708

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.5 **Professionals in highly innovative jobs, by sector and country**

Percentage of graduates working in highly innovative workplaces regarding at least one type of innovation and playing a role in introducing those innovations, 2005 or 2008



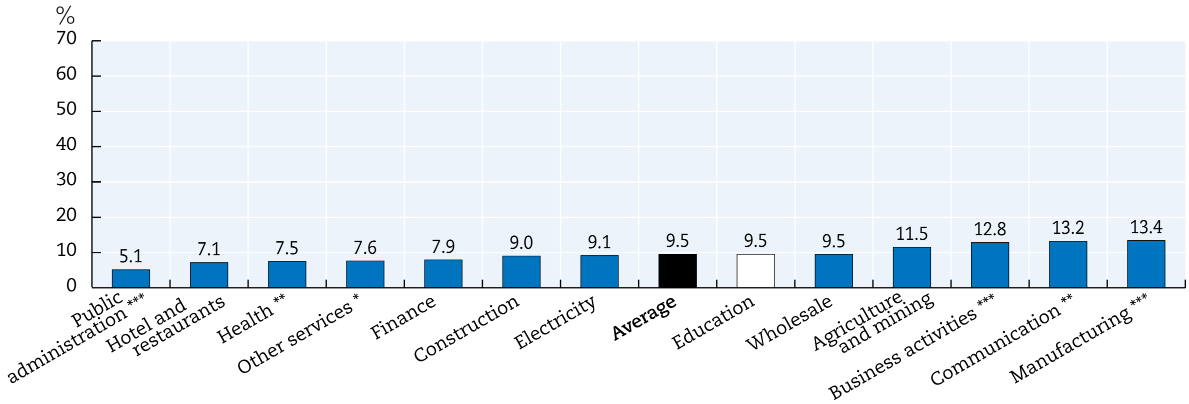
StatLink http://dx.doi.org/10.1787/888933082727

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.6 **Professionals in highly innovative jobs across three types of innovation, by sector**

Percentage of graduates working in highly innovative workplaces regarding three types of innovation and playing a role in introducing those innovations, 2005 or 2008



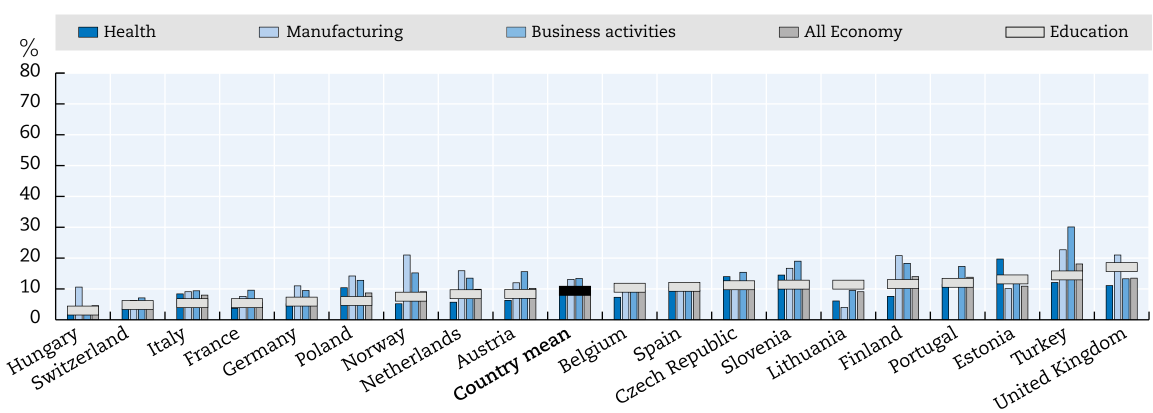
StatLink http://dx.doi.org/10.1787/888933082746

Notes: *** = difference with the education sector significant at the 0.01 level; ** = difference with the education sector significant at the 0.05 level; * = difference with the education sector significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.7 **Professionals in highly innovative jobs across three types of innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces regarding three types of innovation and playing a role in introducing those innovations, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082765

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation types within the education sector compared with other sectors

General findings

Education outperforms other sectors of the economy in terms of highly innovative jobs in knowledge or methods innovation – the most common innovation type in most sectors of the economy in Europe (Figure 4.8 and Figure 4.9). Against the average of 37% and more than in any other sector, 48% of graduates in the education sector held highly innovative jobs in knowledge or methods innovation in 2005. The education sector surpassed all other sectors in knowledge or methods innovation in five countries. In no country had education the smallest share of highly innovative jobs. As in education, knowledge or methods innovation was the most common innovation type for highly innovative jobs in on average across the economy and in seven other specific sectors.

As to product or service innovation, the education sector employs a smaller proportion of graduates in highly innovative jobs than the rest of the economy in Europe (Figure 4.8 and Figure 4.10). While 25% of graduates in education worked in highly innovative jobs in terms of product or service in 2005, this was below the average (29%) and the manufacturing sector (37%). Education outperformed manufacturing only in Lithuania. Alongside health, education was among the sectors with the smallest share of graduates in highly innovative jobs in six countries. Whereas product or service innovation was the second most common innovation type for education, it held a similar standing with knowledge or methods innovation in manufacturing, communication, wholesale and hotels and restaurants.

Highly innovative jobs in technology, tools or instruments innovation in education are at the average level when compared with other sectors of the economy – despite the fact that this is the least common type of innovation for education (Figure 4.8 and Figure 4.11). Both in the education sector and on average, 21% of graduates worked in highly innovative jobs regarding technology, tools or instruments innovation in 2005. Education ranked below the leading sector of manufacturing (29%), for example, but significantly above both public administration (13%) and health (16%). Manufacturing outperformed education in eight countries – the situation was reversed only in Estonia. In contrast, the health sector ranked lower than the education sector in five countries. Only in Slovenia, Poland and the Netherlands was education – together with health – among the sectors with the smallest share of highly innovative jobs in technology, tools or instruments innovation. Similarly to education, technology, tools or instruments innovation was the least common type of innovation overall and in nine other sectors.

Country specificities

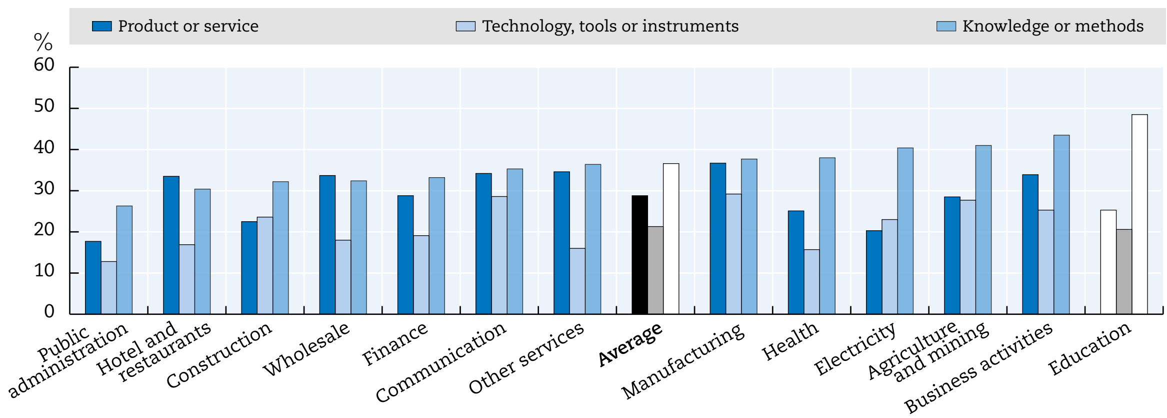
With regard to highly innovative jobs, education ranks comparatively well across three types of innovation in Lithuania. This country was among those where education outperformed all other sectors of the economy in 2008 regarding knowledge or methods innovation. It was also the only country where education outperformed manufacturing in product or service innovation (27% against 12%).

In contrast, Poland has relatively few highly innovative jobs in education. In 2008, the Polish education sector ranked poorly against other sectors both regarding product or service and technology, tools or instruments innovation.

The cases of Germany, Switzerland and the Netherlands illustrate education sectors with a focus on certain types of innovation. The German, Swiss and Dutch education sectors had the largest share of highly innovative jobs in terms of knowledge or methods in 2005. Yet education performed relatively poorly concerning product or service innovation in Germany and Switzerland and regarding technology, tools or instruments innovation in the Netherlands.

Figure 4.8 **Professionals in highly innovative jobs, by sector and innovation type**

Percentage of graduates working in highly innovative workplaces and playing a role in introducing those innovations, 2005 or 2008

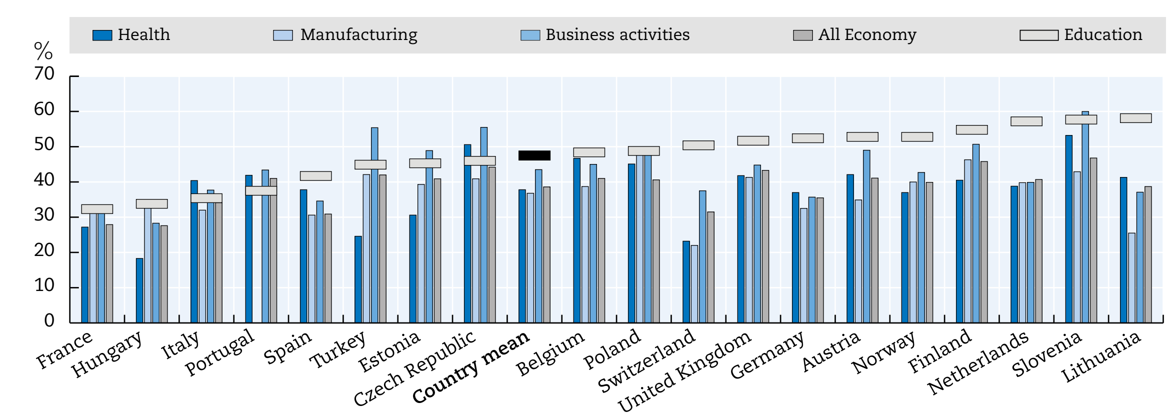


StatLink http://dx.doi.org/10.1787/888933082784

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal is excluded.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.9 **Professionals in highly innovative jobs regarding knowledge or methods innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces and playing a role in introducing those innovations, 2005 or 2008

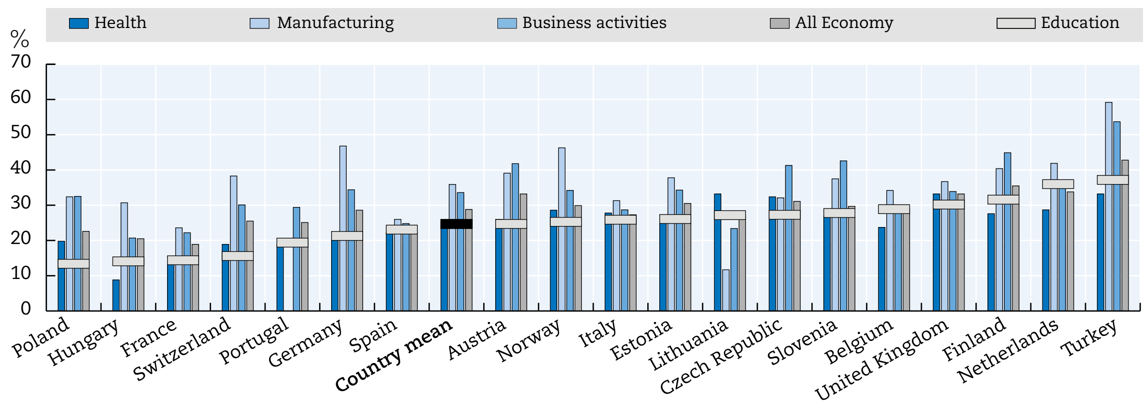


StatLink http://dx.doi.org/10.1787/888933082803

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.10 **Professionals in highly innovative jobs regarding product or service innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces and playing a role in introducing those innovations, 2005 or 2008

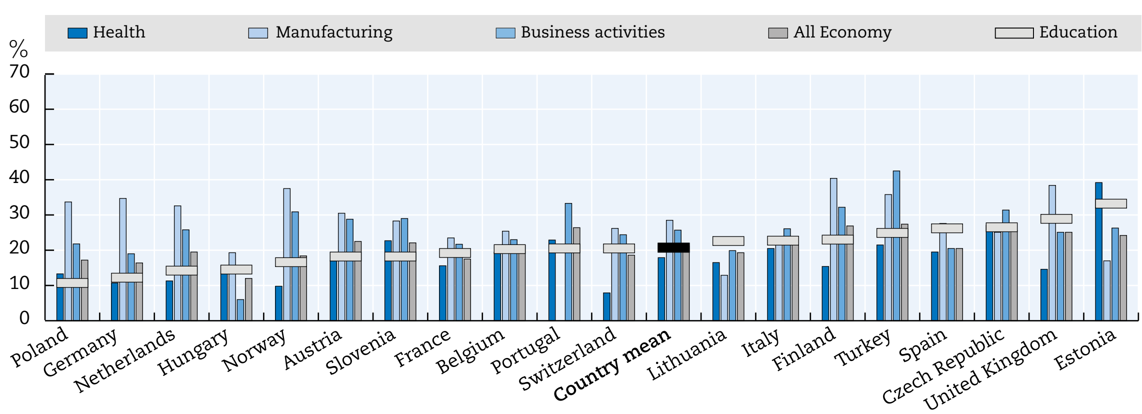


StatLink http://dx.doi.org/10.1787/888933082822

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.11 **Professionals in highly innovative jobs regarding technology, tools or instruments innovation, by sector and country**

Percentage of graduates working in highly innovative workplaces and playing a role in introducing those innovations, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082841

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Innovation within the education sector by level of education

Innovation occurrence and type

A larger proportion of graduates have highly innovative jobs in the higher education sector than in secondary or primary education (Figure 4.12 and Figure 4.13). Against 58% for the education sector in general (including Portugal), 68% of graduates working in the higher education sector in Europe had highly innovative jobs in 2005. This figure was 53% for secondary and 55% for primary education, while the likelihood of graduates having highly innovative jobs was nearly twice as high for those working in higher education as in secondary or primary education. Moreover, the higher education sector outperformed all other sectors of the economy – including the manufacturing sector – in the proportion of highly innovative jobs. Both primary and secondary education stood at the average level when compared to other sectors of the economy.

Higher education stands out as the education sector with the largest share of highly innovative jobs with regard to three types of innovation, whereas secondary education is at the end of the rank in this respect (Figure 4.12 and Figure 4.13). Against the 10% for the whole education sector, 14% of graduates in higher education worked in innovative organisations regarding three innovation types and played a role in introducing those innovations. This figure was only 6% for secondary and 9% for primary education. Graduates employed in higher education were more than twice as likely to hold highly innovative jobs regarding three innovation types than those working in secondary education. Higher education was also among the sectors of the economy that had the greatest share of highly innovative jobs in terms of innovation across the different types, whereas secondary education ranked below average in this respect.

Innovation types

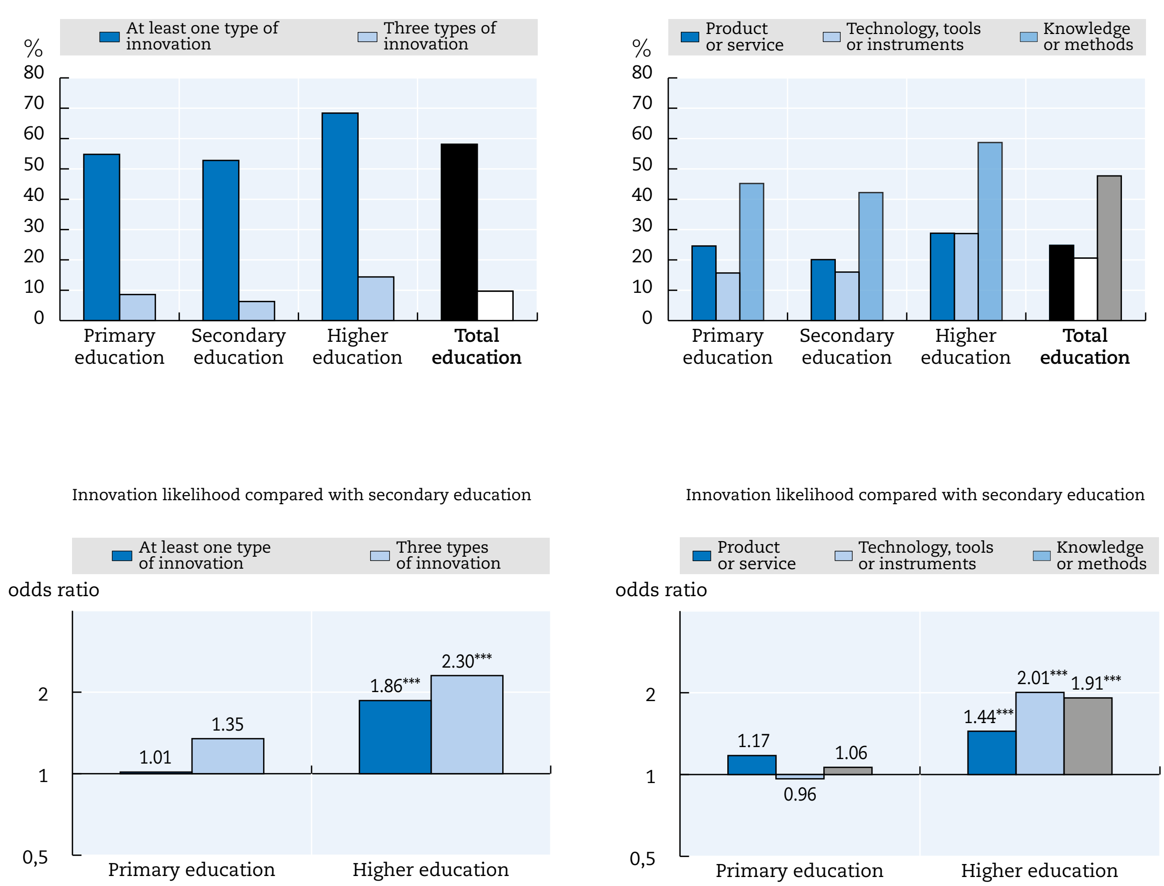
As within the education sector as a whole, most highly innovative jobs found at different levels of the education system concern knowledge or methods innovation (Figure 4.12). This was the most common type of innovation for all levels of education in 2005. While product or service innovation was more common than technology, tools and instruments innovation in primary and secondary education, the two types held an equal standing in the higher education sector.

Higher education outperforms other levels of education regarding the three different innovation types (Figure 4.12 and Figure 4.14). Across all levels of education, higher education employed the greatest share of graduates to highly innovative jobs – in terms of knowledge or methods (59%), product or service (29%) and technology, tools or instruments (29%) innovation. Higher education also outperformed all other sectors of the economy regarding knowledge or methods innovation and was among the most innovative sectors in technology, tools or instruments innovation. Compared to secondary and primary education, the odds of having an innovative job in higher education were twice as high for technology, tools or instruments innovation and nearly twice as high for knowledge or methods innovation. Relative to secondary education, the odds were almost one and a half times as high for product or service innovation.

It can be seen that within secondary and primary education the proportion of graduates in innovative jobs across the various types of innovation falls short of that in higher education (Figure 4.12 and Figure 4.14). Secondary education had the lowest proportion of graduates in highly innovative jobs with regard to knowledge or methods innovation (42%) and product or service innovation (20%). In terms of technology, tools or instruments innovation, both primary and secondary education (16%) employed a low proportion of graduates in highly innovative jobs. Although primary and secondary education outperformed the economy average in knowledge or methods innovation, both ranked below the average in product or service and technology, tools or instruments innovation.

Figure 4.12 **Education professionals in highly innovative jobs, by innovation type and education level**

Percentage of graduates employed in education working in highly innovative organisations
and playing a role in introducing innovations, 2005 or 2008



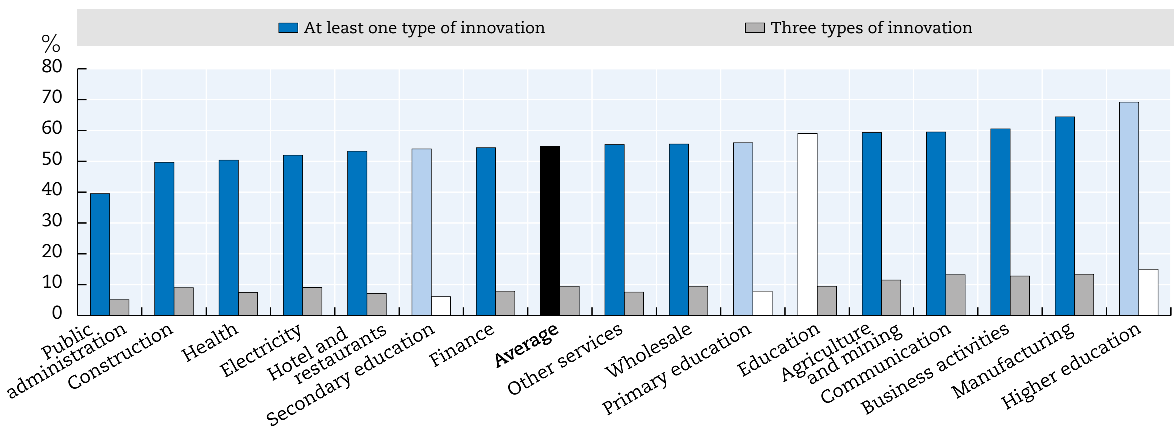
StatLink http://dx.doi.org/10.1787/888933082860

Notes: *** = odds ratio significant at the 0.01 level; ** = odds ratio significant at the 0.05 level; * = odds ratio significant at 0.1 level. Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Spain is excluded.

Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.13 **Professionals in highly innovative jobs across three types of innovation, by sector and education level**

Percentage of graduates working in highly innovative organisations and playing a role in introducing innovations, 2005 or 2008

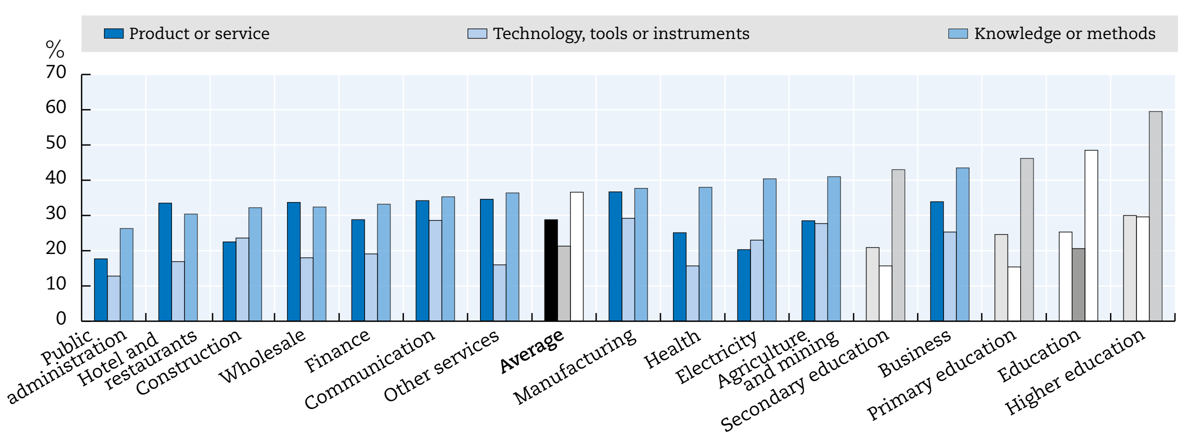


StatLink http://dx.doi.org/10.1787/888933082879

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal and Spain are excluded.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

Figure 4.14 **Professionals in highly innovative jobs, by innovation type, sector and education level**

Percentage of graduates working in highly innovative organisations and playing a role in introducing innovations, 2005 or 2008



StatLink http://dx.doi.org/10.1787/888933082898

Notes: Year 2008 for Hungary, Lithuania, Poland, Slovenia and Turkey, year 2005 for other countries. Portugal and Spain are excluded.
Source: Authors' calculations based on REFLEX (2005) and HEGESCO (2008)

PART II

Innovation as change in classrooms and schools

CHAPTER 5

Innovation in teaching style

Innovation in the classroom in terms of teaching style could incorporate more or less use of front-of-class teaching such as lecturing in class, reading aloud or demonstrating science experiments. The aim of innovation with regard to increasing the use of front-of-class teaching could be, for example, to ensure that basic principles are explained to the whole class, whilst a reduction may occur as a result of the introduction of a more individualised approach to classroom teaching.

Innovation could also take the form of more or less time devoted to independent work. An increase in independent work may reflect a move towards engendering greater autonomy whilst a decrease could indicate a change towards more direct teacher guidance.

Use of front-of-class teaching

General findings

Innovation in the classroom in secondary school is not widely observed in terms of a change in the time spent on lecture-style presentations. The absolute change in the percentage of 8th grade mathematics class-time spent on this style of teaching across the OECD between 2003 and 2007 was 2% points; in science the equivalent absolute change amounted to 3% points (Figure 5.1 and Figure 5.2). According to student reports, the absolute change in the time spent on lecture style presentations in maths across OECD countries was 5% points compared with 3% points in science (Figure 5.2 and Figure 5.4). Secondary school students' reporting also indicated an absolute change in demonstrations of experiments across OECD countries of 5% points (Figure 5.5). Student reports show that the incidence of lecture style presentation in maths fell markedly in Japan (34% points) and increased in the Russian Federation (26% points). These changes had medium to large effect sizes. Students also reported a reduction in the extent to which teachers demonstrated experiments in the Basque country (11% points) and an increase in Korea (15% points). These two education system changes had small effect sizes. In total, with at least small effect sizes, students reported a reduction in lecture style presentations in maths lessons in three countries and an increase in one.

Innovation in 4th grade classes has meant increases and decreases in the amount of time spent on lecture-style presentations and reading to the whole class. The average absolute change across the OECD area between 2003 and 2007 in lecturing during 4th grade maths was 2% points, while the equivalent absolute change in reading aloud to 4th grade students between 2001 and 2011 was 4% points (Figure 5.5 and Figure 5.6). The OECD absolute change in teachers demonstrating experiments to the class, according to student reports, was 9% points. Only Quebec (9% points) exhibited an increase in the use of lecture-style presentations for 4th grade mathematics. Slovenia (10% points) increased the use of front-of-class science demonstrations between 2003 and 2007 according to students, whilst several countries, including Japan (19% points), the Netherlands (17% points) and Australia (14% points) reduced the use of this teaching approach. Teacher reports from Hong Kong (18% points), Quebec (9% points) and the Netherlands (7% points) indicate the greatest increases in reading aloud between 2001 and 2011, whilst reading aloud reduced in the Slovak Republic (11% points), the Russian Federation (6% points) and Slovenia (4% points). These education system level changes recorded small to medium effect sizes. Overall, and with at least small effect sizes, there was an increase in 4th grade students reporting that teachers demonstrated experiments in one country and a decrease in five, compared with an increase in 4th grade teachers reading aloud to their class in three education systems and a decrease in four others.

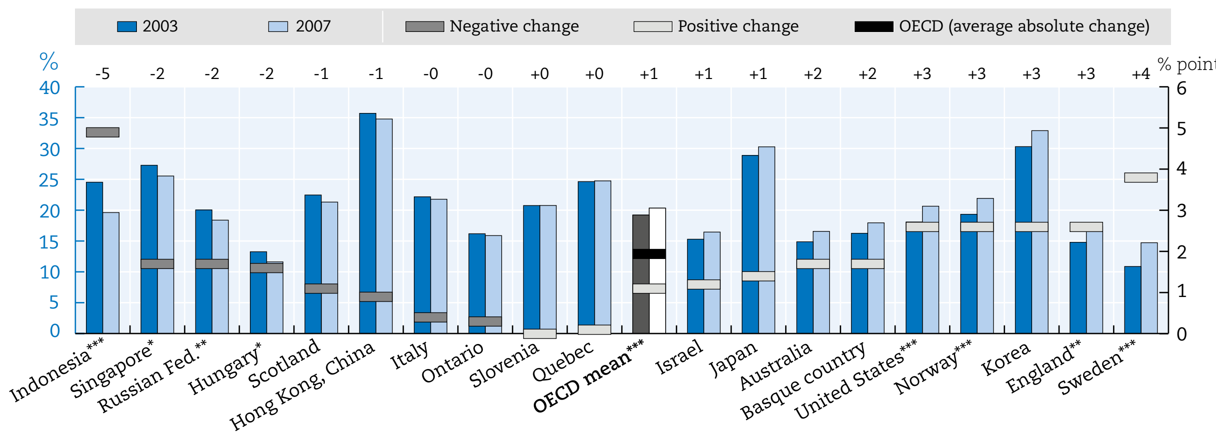
Country specificities

The Netherlands is an example of a country that reduced the use of front-of-class science demonstrations between 2003 and 2007 according to 4th grade students, but increased the extent to which teachers read aloud to 4th grade students between 2001 and 2011.

In contrast in the Russian Federation, there was a marked increase in science demonstrations at secondary school level between 2003 and 2007, whilst the incidence of reading aloud in primary school decreased between 2001 and 2011.

Figure 5.1 **Time spent on lecture-style presentations in 8th grade maths, according to teachers**

Percentage of class time and change over time



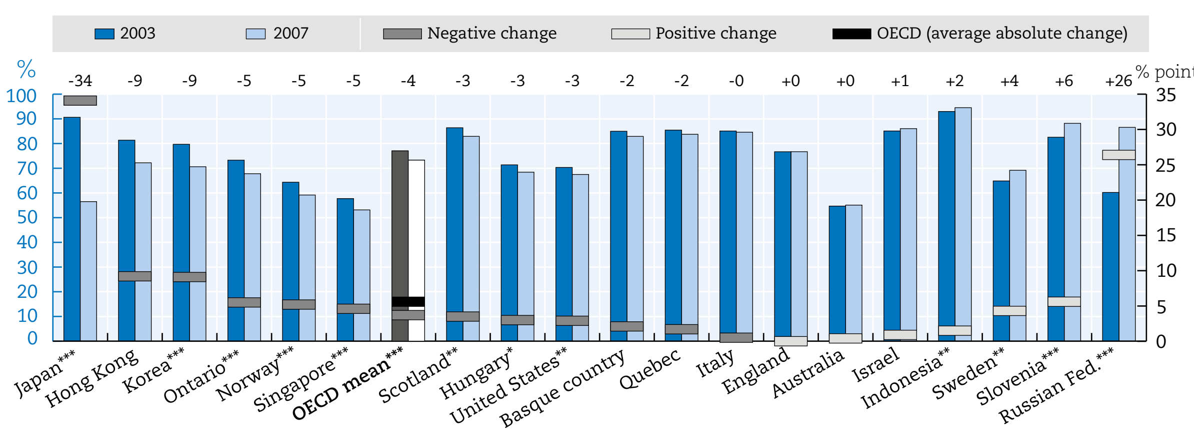
StatLink http://dx.doi.org/10.1787/888933082917

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.2 **Time spent on lecture-style presentations in 8th grade maths, according to students**

Percentage of class time and change over time



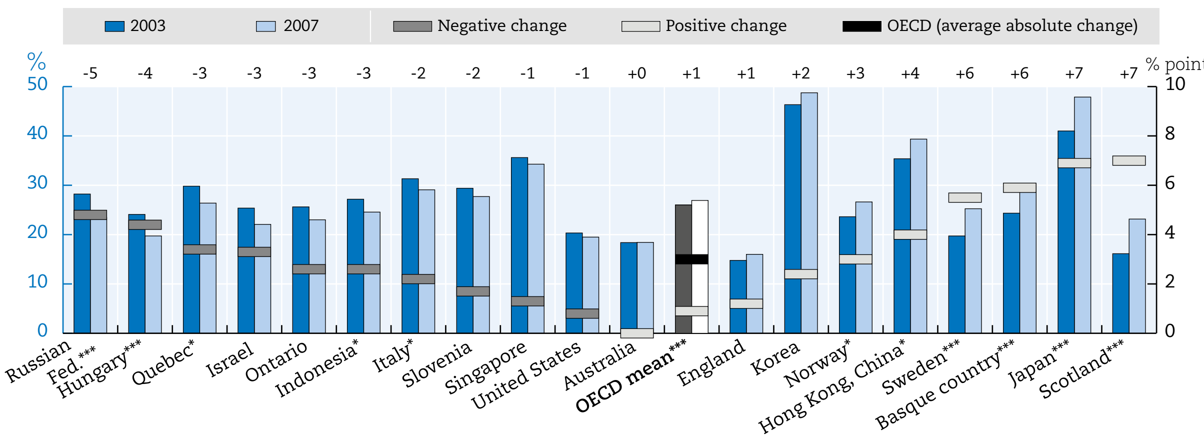
StatLink http://dx.doi.org/10.1787/888933082936

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.3 **Time spent on lecture-style presentations in 8th grade science, according to teachers**

Percentage of class time and change over time



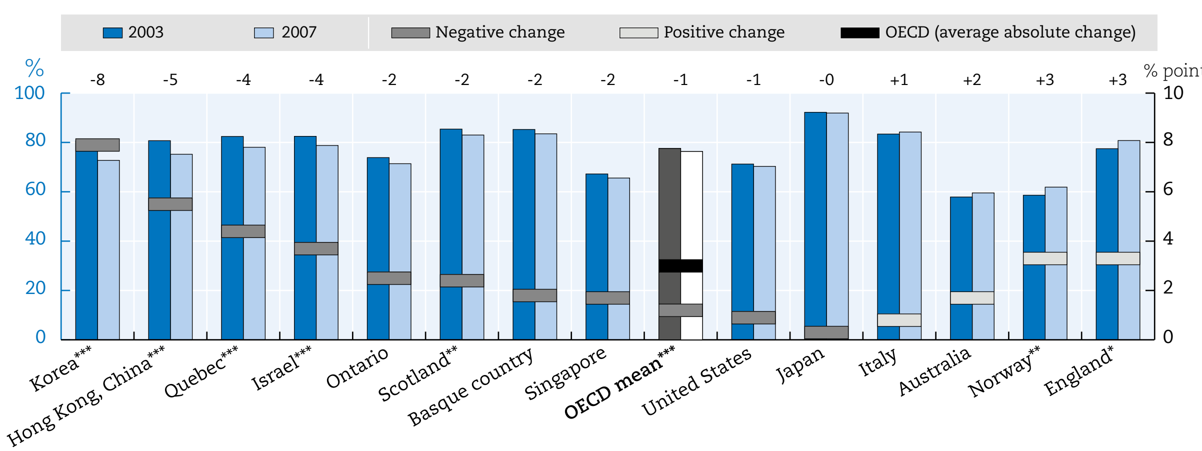
StatLink http://dx.doi.org/10.1787/888933082955

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.4 **Time spent on lecture-style presentations in 8th grade science, according to students**

Percentage of class time and change over time



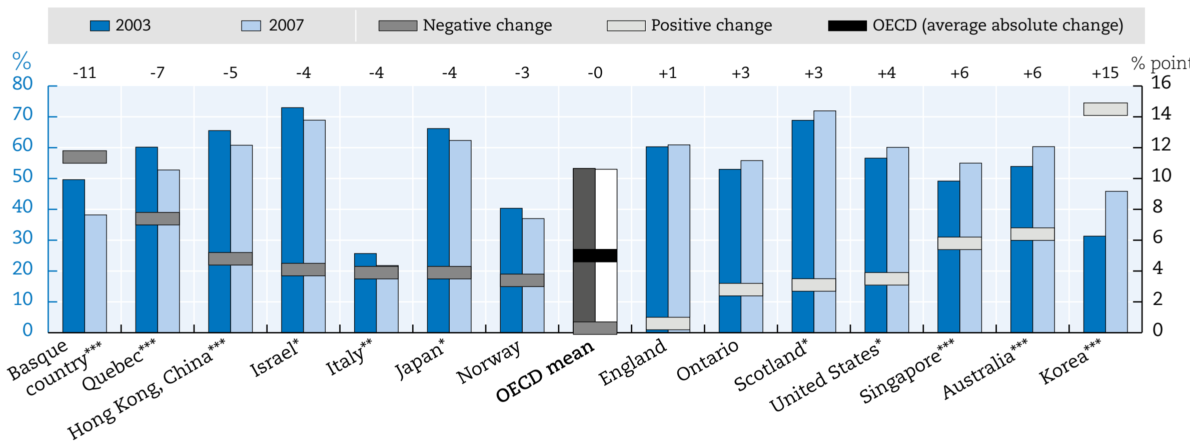
StatLink http://dx.doi.org/10.1787/888933082974

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.5 **Watching the teacher demonstrate an experiment or investigation in 8th grade science, according to students**

Percentage of students watching the teacher demonstrate an experiment or investigation in at least half the lessons and change over time



StatLink http://dx.doi.org/10.1787/888933082993

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

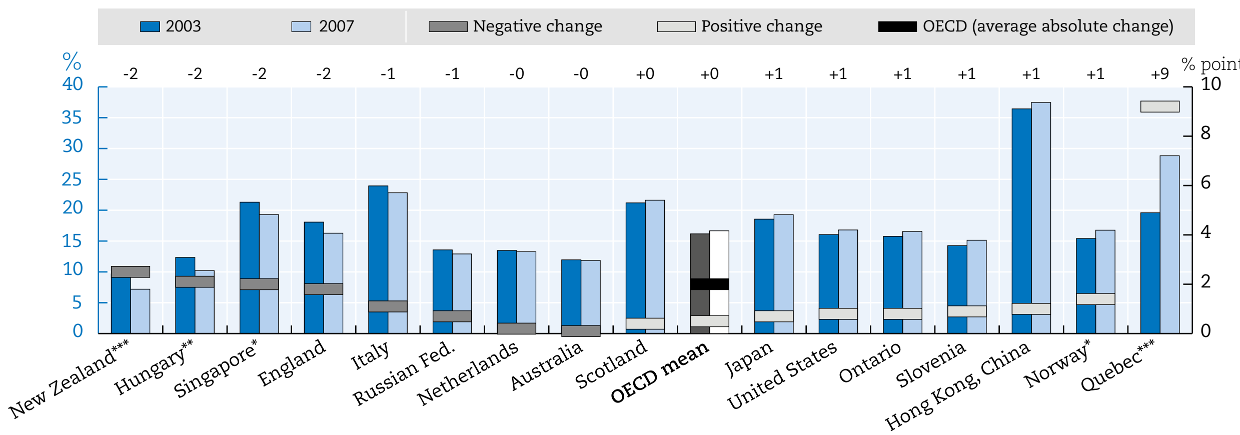
Source: Authors' calculations based on TIMSS (2003 and 2007)

Box 5.1 **Data source details for Chapter 5.1 to 5.5**

TIMSS (2003 and 2007) surveys asked 8th grade teachers "In a typical week of mathematics/science lessons for the TIMSS class, what percentage of time do students spend on each of the following activities? [...] b) Listening to lecture-style presentations". TIMSS (2003 and 2007) asked 8th grade students "How often do you do these things in your mathematics/science lessons? [...] k/l) We listen to the teacher give a lecture-style presentation" and b) "We watch the teacher demonstrate an experiment or investigation" with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 5.6 Time spent on lecture-style presentations in 4th grade maths, according to teachers

Percentage of class time and change over time



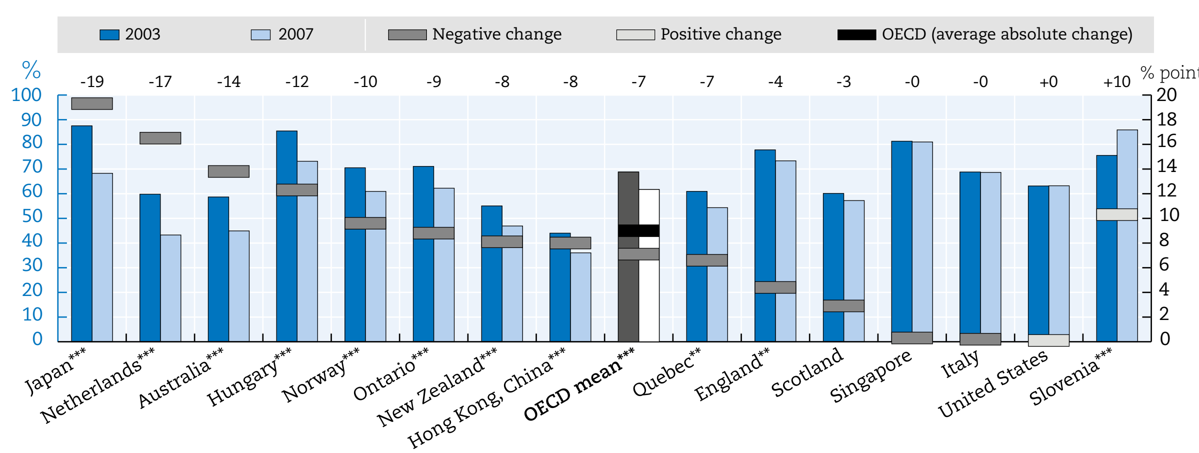
StatLink http://dx.doi.org/10.1787/888933083012

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.7 Watching the teacher demonstrate an experiment or investigation in 4th grade science, according to students

Percentage of students watching the teacher demonstrate an experiment or investigation once or twice a month or more and change over time



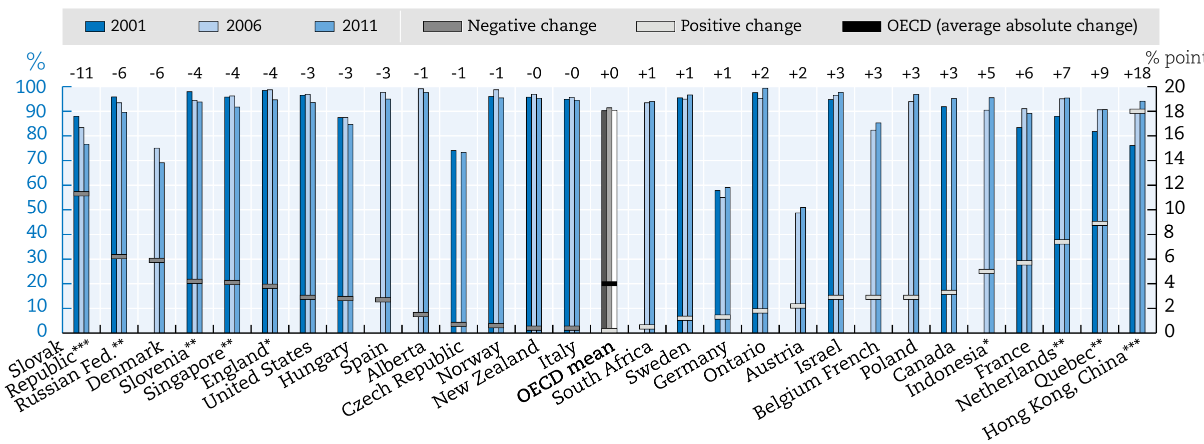
StatLink http://dx.doi.org/10.1787/888933083031

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.8 **Reading aloud to 4th grade students, according to teachers**

Percentage of students whose teacher reads aloud to the whole class weekly or more and change over time



StatLink http://dx.doi.org/10.1787/888933083050

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Box 5.2 Data source details for Chapter 5.6 to 5.8

TIMSS (2003 and 2007) surveys asked 4th grade teachers "In a typical week of mathematics lessons for the <fourth-grade> students in the TIMSS class, what percentage of time do students spend on each of the following activities? [...] b) Listening to lecture-style presentations". TIMSS (2003 and 2007) asked 4th grade students "In school, how often do you do these things? [...] b) "I watch the teacher do a science experiment" with answer options "At least once a week", "once or twice a month", "a few times a year", "Never". PIRLS (2001, 2006 and 2011) surveys asked "When you have reading instruction and/or do reading activities with the students, how often do you do the following? [...] a) Read aloud to the class" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Independent work

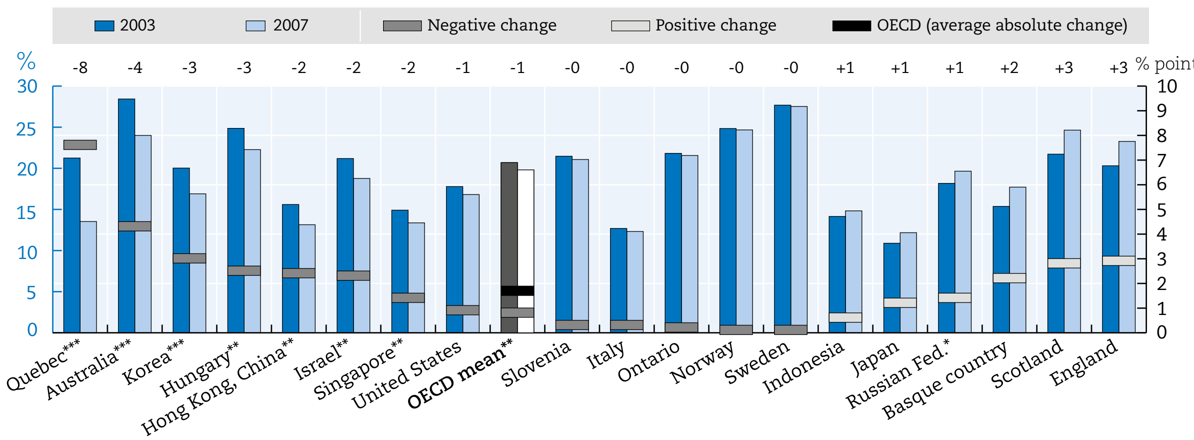
General findings

Innovation in terms of independent work has not been widely observed in 8th grade maths or science classes between 2003 and 2007 (Figure 5.9 and Figure 5.10). Only in Quebec (8% points) did innovation result in a reduction in independent work in mathematics. This change was characterised by a small effect size.

No significant innovation was observed in 4th grade maths between 2003 and 2007, but innovation in reading took the form of a greater emphasis on reading alone between 2001 and 2011 (Figure 5.11 and Figure 5.12). The average absolute change in reading alone across the OECD was 4% points. Norway (12% points) and Hong Kong (20% points) exhibited noticeable increases in this aspect of classroom practice. These country level changes were characterised by medium effect sizes whilst the OECD average and average absolute change exhibited small effect sizes. Overall, with at least small effect sizes, there was an increase in teachers asking students to read alone in 13 countries.

Figure 5.9 **Time spent on independent work in 8th grade maths, according to teachers**

Percentage of class time and change over time



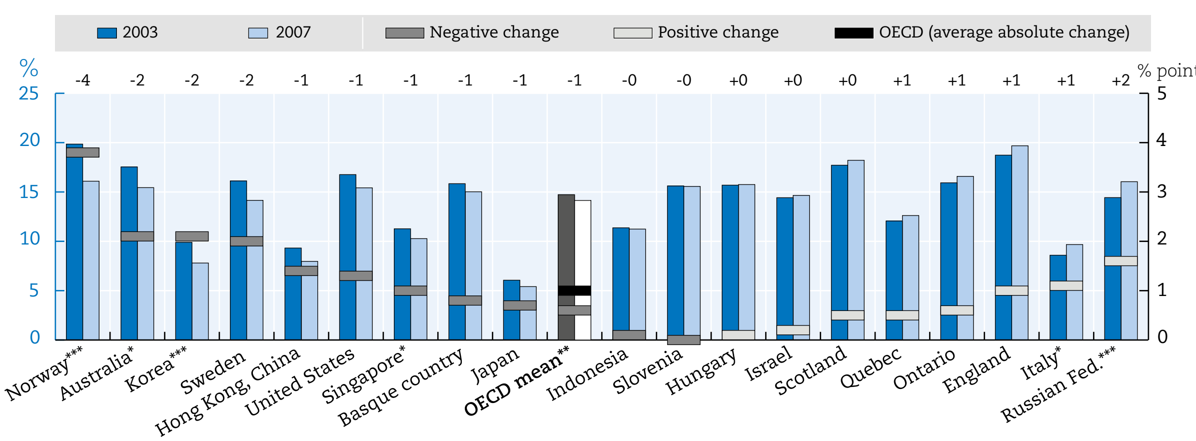
StatLink http://dx.doi.org/10.1787/888933083069

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.10 **Time spent on independent work in 8th grade science, according to teachers**

Percentage of class time and change over time



StatLink http://dx.doi.org/10.1787/888933083088

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

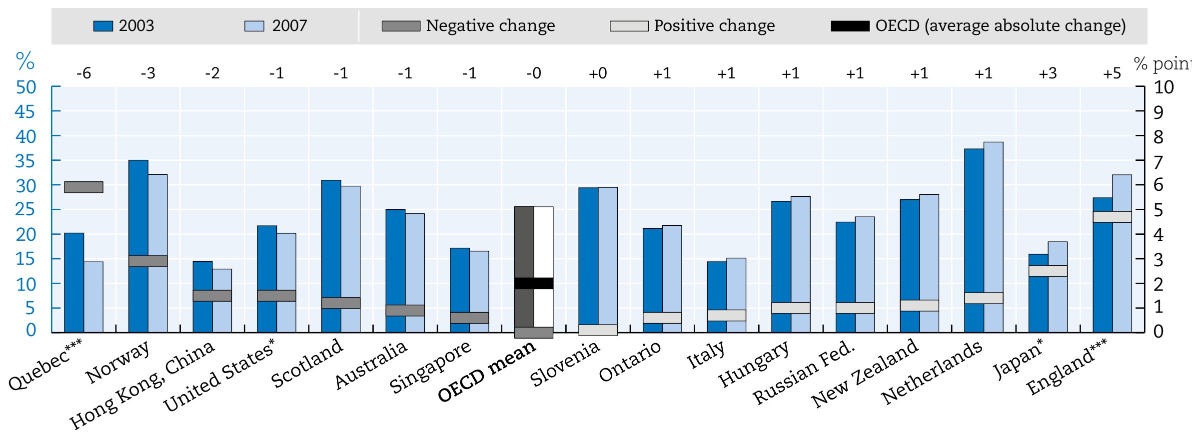
Box 5.3 **Data source details for Chapter 5.9 to 5.10**

TIMMS (2003 and 2007) asked 8th grade teachers "In a typical week of mathematics/science lessons for the TIMSS class, what percentage of time do students spend on each of the following activities? […] d) Working problems on their own without your guidance".

The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 5.11 **Time spent on independent work in 4th grade maths, according to teachers**

Percentage of class time and change over time



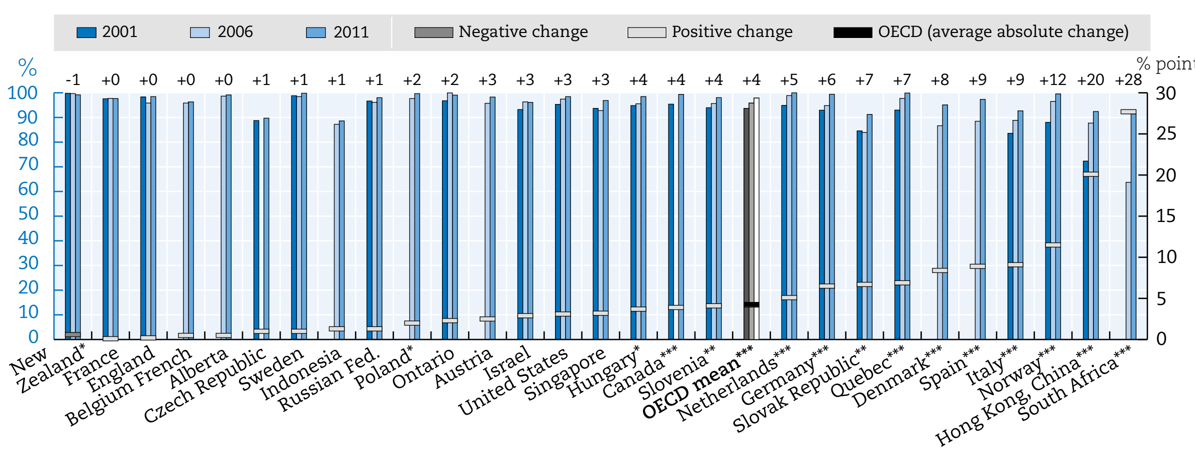
StatLink http://dx.doi.org/10.1787/888933083107

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 5.12 **Students reading silently alone in 4th grade, according to teachers**

Percentage of teachers asking students to read silently on their own once a week or more and change over time



StatLink http://dx.doi.org/10.1787/888933083126

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

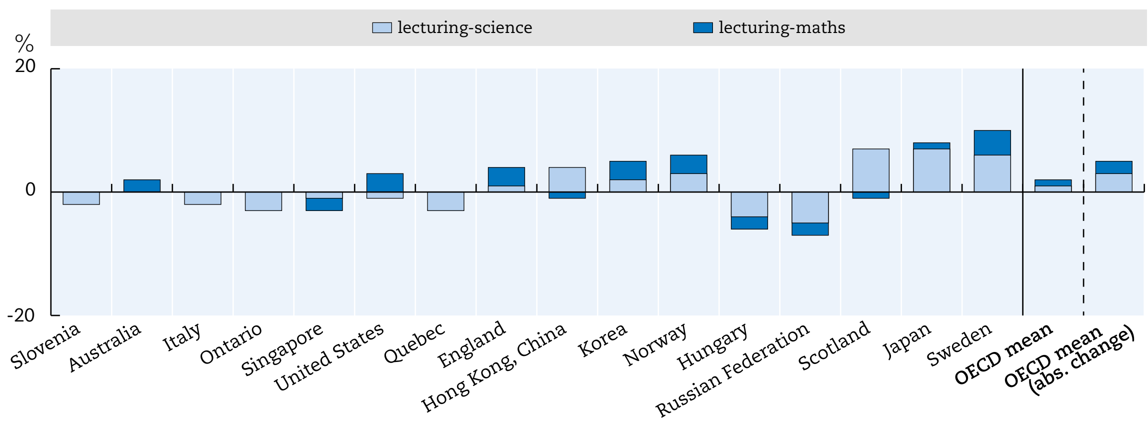
Box 5.4 **Data source details for Chapter 5.11 to 5.12**

TIMMS (2003 and 2007) asked 4th grade teachers "In a typical week of mathematics lessons for the <fourth-grade> students in the TIMSS class, what percentage of time do students spend on each of the following activities? [...] d) Working problems on their own without your guidance". PIRLS (2001, 2006 and 2011) asked teachers "When you have reading instruction and/or do reading activities with the students, how often do you do the following? [...] c) Ask students to read silently on their own" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

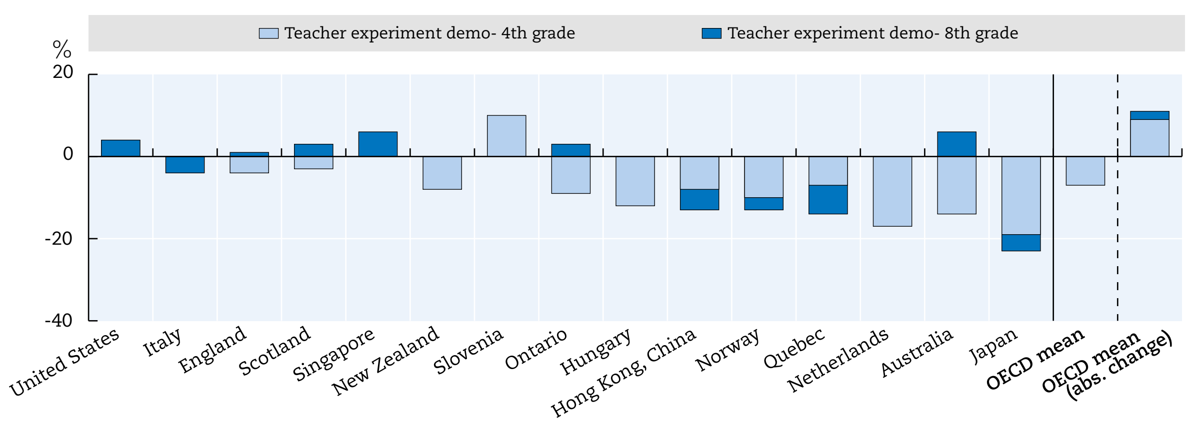
Innovation in terms of teaching styles has been more notable in terms of changes in the use of front-of-class teaching than in the extent to which students carry out independent work, although there have been changes in reading alone in primary schools. Front-of-class teaching at 8th grade has both increased and decreased over time, but has typically been in the same direction for maths and science within a country and has been more marked in maths. There has also been consistency in the direction of change in the extent to which teachers demonstrate science experiments to primary and secondary students within a country (albeit over different time periods), which in most cases has meant reducing this practice.

Figure 5.13 **Change in time spent on lecture-style presentations in 8th grade, according to teachers.**



StatLink http://dx.doi.org/10.1787/888933083145

Figure 5.14 **Change in watching the teacher demonstrate an experiment or investigation in at least half the lessons, according to students.**



StatLink http://dx.doi.org/10.1787/888933083164

Note : For details please see Figures 5.1, 5.3, 5.5 and 5.7.

Note on Israel

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.

Table 5.1. Effect sizes for changes in front-of-class practices and use of independent work

	Change in front of class practices								Change in independent work			
	8th grade					4th grade			8th grade		4th grade	
	lecture-style presentation in maths	Lecture-Style presentation in maths (student resp.)	Lecture-Style presentation in science	Lecture-style presentation in science (student resp.)	Science experiments demonstration	Lecture-style presentation in maths	Science experiments demonstration	Reading aloud to the class	Mathematics	Science	Mathematics	Reading on their own
	03-07	03-07	03-07	03-07	03-07	03-07	03-07	01-11	03-07	03-07	03-07	01-11
Australia	0.03	0.00	0.00	0.02	0.13	0.00	-0.28	m	-0.06	-0.04	-0.01	m
Canada	m	m	m	m	m	m	m	0.14	m	m	m	0.27
Ontario	-0.01	-0.07	-0.04	-0.03	0.06	0.01	-0.19	0.15	0.00	0.01	0.01	0.17
Quebec	0.00	-0.03	-0.04	-0.07	-0.15	0.15	-0.13	0.26	-0.16	0.01	-0.12	0.48
Czech Republic	m	m	m	m	m	m	m	-0.02	m	m	m	0.03
France	m	m	m	m	m	m	m	0.17	m	m	m	0.01
Germany	m	m	m	m	m	m	m	0.03	m	m	m	0.38
Hungary	-0.04	-0.04	-0.06	m	m	-0.05	-0.31	-0.08	-0.05	0.00	0.02	0.21
Israel	0.02	0.02	-0.04	-0.06	-0.09	m	m	0.15	-0.05	0.00	m	0.13
Italy	-0.01	-0.01	-0.04	0.01	-0.09	-0.03	0.00	-0.02	-0.01	0.04	0.03	0.29
Japan	0.02	-0.41	0.06	-0.01	-0.08	0.01	-0.47	m	0.02	-0.01	0.04	m
Korea	0.04	-0.17	0.02	-0.14	0.30	m	m	m	-0.08	-0.08	m	m
Netherlands	m	m	m	m	m	0.00	-0.33	0.27	m	m	0.02	0.46
New Zealand	m	m	m	m	m	-0.08	-0.16	-0.02	m	m	0.02	-0.09
Norway	0.06	-0.07	0.05	0.05	-0.07	0.04	-0.20	-0.03	0.00	-0.06	-0.03	0.57
Slovak Republic	m	m	m	m	m	m	m	-0.30	m	m	m	0.21
Slovenia	0.00	0.11	-0.02	m	m	0.03	0.26	-0.22	-0.01	0.00	0.00	0.22
Basque country	0.04	-0.03	0.09	-0.03	-0.23	m	m	m	0.05	-0.02	m	m
Sweden	0.09	0.05	0.08	m	m	m	m	0.06	0.00	-0.03	m	0.14
England	0.06	0.00	0.02	0.05	0.01	-0.03	-0.10	-0.22	0.04	0.02	0.08	0.01
Scotland	-0.03	-0.06	0.19	-0.05	0.07	0.01	-0.06	m	0.04	0.01	-0.02	m
United States	0.05	-0.04	-0.01	-0.01	0.07	0.01	0.00	-0.14	-0.02	-0.02	-0.02	0.19
OECD (average)	0.02	-0.05	0.02	-0.02	-0.01	0.00	-0.15	0.01	-0.02	-0.01	0.00	0.22
OECD (avevage absolute)	0.03	0.07	0.05	0.04	0.11	0.04	0.14	0.19	0.04	0.02	0.03	0.24
Hong Kong, China	-0.01	-0.13	0.04	-0.09	-0.10	0.01	-0.16	0.53	-0.05	-0.03	-0.03	0.55
Indonesia	-0.08	0.04	-0.03	m	m	m	m	m	0.01	0.00	m	m
Russian Federation	-0.04	0.31	-0.06	m	m	-0.01	m	-0.24	0.04	0.04	0.02	0.08
Singapore	-0.04	-0.08	-0.02	-0.03	0.12	-0.03	-0.01	-0.17	-0.05	-0.03	-0.01	0.15

StatLink http://dx.doi.org/10.1787/888933083183

Notes: OECD average includes all OECD education systems for which data is available for all years concerned
= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003 and 2007) and PIRLS (2001, 2006 and 2011).

CHAPTER 6

Innovation in instructional practices

Innovation in instructional practices could incorporate changes in the extent to which students apply their knowledge and skills to their real lives or to activities such as interpretation of data or reasoning. The aim of such innovation may be to encourage engagement and motivation by making lessons more salient or to encourage students' critical thinking skills. A reduction in these practices may occur if teachers explore innovative alternatives or seek to spend the time on different activities.

Relating lessons to real-life

General Findings

Innovation in the classroom encompasses an increase in the practice of asking students to relate what they learned to their daily lives. Across the OECD area the absolute change in 8th grade teachers asking students to relate what they learned in maths to real-life between 2003 and 2011 was 13% points; the equivalent change in secondary school science lessons was 15% points (Figure 6.1 and Figure 6.3). The average absolute change in students in OECD countries reporting that they related what they learned to their daily lives between 2003 and 2007 was 8% points for maths and 2% point for science (Figure 6.2 and Figure 6.4). In maths, teachers in Indonesia exhibited the largest increase (36% points), whilst increases in Italy (31% points) and the Russian Federation (28% points) were also marked. Indonesia (28% points) also stood out in 8th grade science, as did Ontario (27% points), Korea (25% points), Italy (22% points), Singapore (22% points) and Israel (20% points). These education system changes presented large to medium effect sizes. Based on teacher reports, the OECD average and average absolute change for 8th grade maths and science showed small effect sizes. Overall, and with at least small effect sizes, there was an increase in teachers asking students to relate maths lessons to daily life in 14 countries, and a decrease in one. Students own reporting in maths indicated an increase in five countries with small effect sizes. In 8th grade science, increases were observed in 20 education systems with at least small effect sizes.

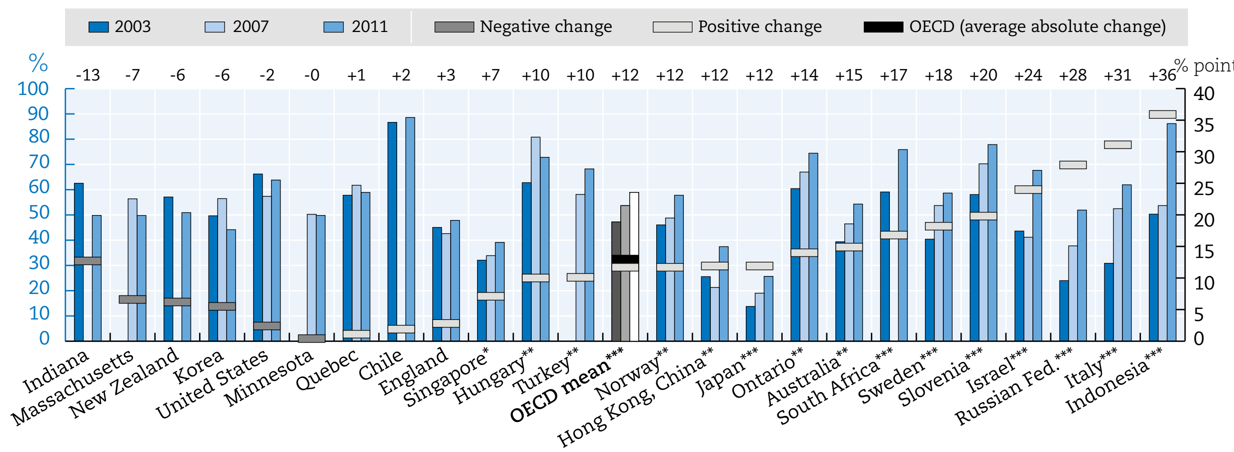
Fourth grade teachers innovated by increasing the extent to which they asked their students to relate their maths, science and reading lessons to their daily lives (Figure 6.5 to Figure 6.7). Between 2007 and 2011 the average absolute change across OECD countries in students being asked to relate what they learned in maths to real-life was 11% points, whilst in science the change between 2003 and 2011 amounted to 18% points. In reading, the average absolute change in students relating their reading to their own experiences between 2001 and 2011 in OECD countries amounted to 11% points. Norway (22% points) and Denmark (22% points) exhibited the largest increases in relating lessons to real-life maths, with small effect sizes. Italy (45% points), Belgium (Flemish; 36% points), Hong Kong (32% points) and Quebec (32% points) showed large increase in teachers asking students to relate science lessons to real-life between 2003 and 2011 with a large effect size. Norway (38% points), Indonesia (25% points), Netherlands (24% points), Hong Kong (24% points) and Ontario (18% points) were characterised by a large increase with regards to reading. OECD average and average absolute change effect sizes for 4th grade mathsmscience and reading were small. Overall, with small effect sizes, there was an increase in the extent to which 4th grade maths students related what they learned to daily life between 2007 and 2011 in 10 education systems; similarly, and with at least small effect sizes, an increase can be observed for 4th grade science students in 13 countries. Significant increases, with at least small effect sizes, occurred in the extent to which reading was related with real-life experiences for 4th grade students in 13 countries.

Country specificities

Indonesia and Italy stand out as countries where teachers' reports indicate that there has been widespread innovation across subjects and grades with regards to relating lessons to students' daily lives. In Italy, for example, a greater proportion of students were asked to relate their mathematics and science lessons to their real life experiences in 2007 than 2003 in 8th grade as well as in 4th grade science with at least medium effect sizes.

Figure 6.1 **Relating 8th grade maths learning to students' daily life, according to teachers**

Percentage of students whose teachers ask them to relate what they learn in class to their daily life in at least half their lessons and change over time



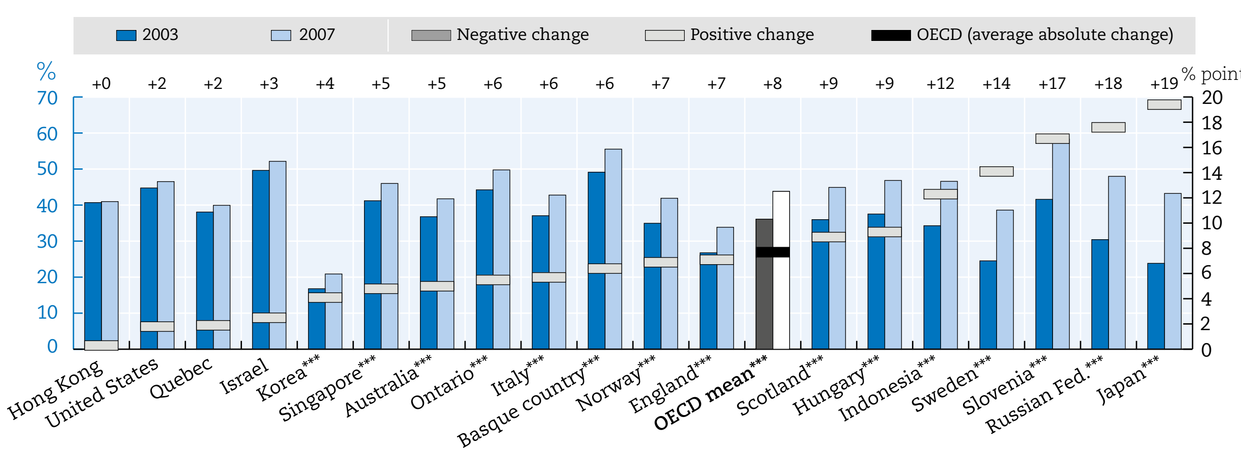
StatLink http://dx.doi.org/10.1787/888933083202

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 6.2 **Relating 8th grade maths learning to students' daily life, according to students**

Percentage of students whose teachers ask them to relate what they learn in class to their daily life in at least half their lessons and change over time



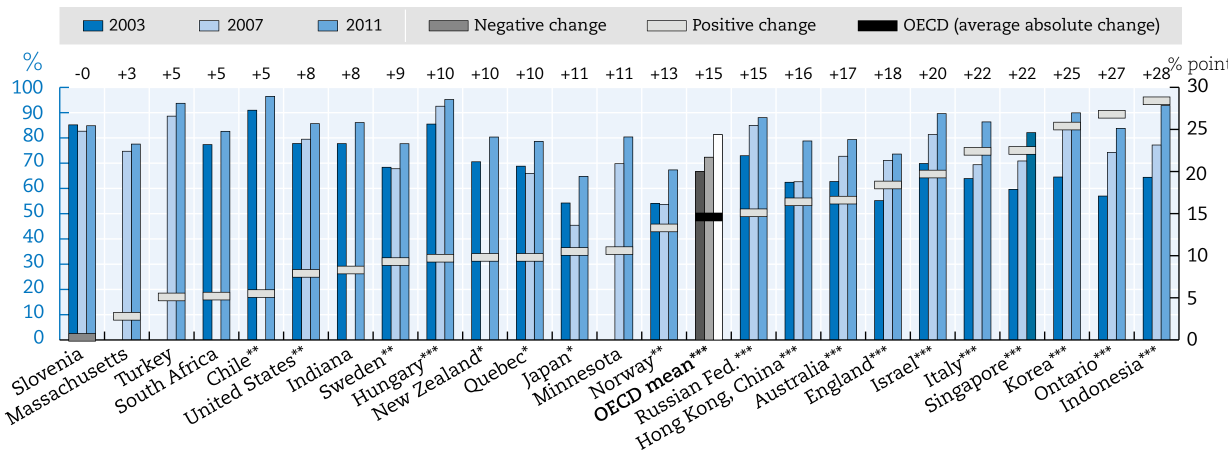
StatLink http://dx.doi.org/10.1787/888933083221

*** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 6.3 **Relating 8th grade science learning to students' daily life, according to teachers**

Percentage of students whose teachers ask them to relate what they learn in class to their daily life in at least half their lessons and change over time



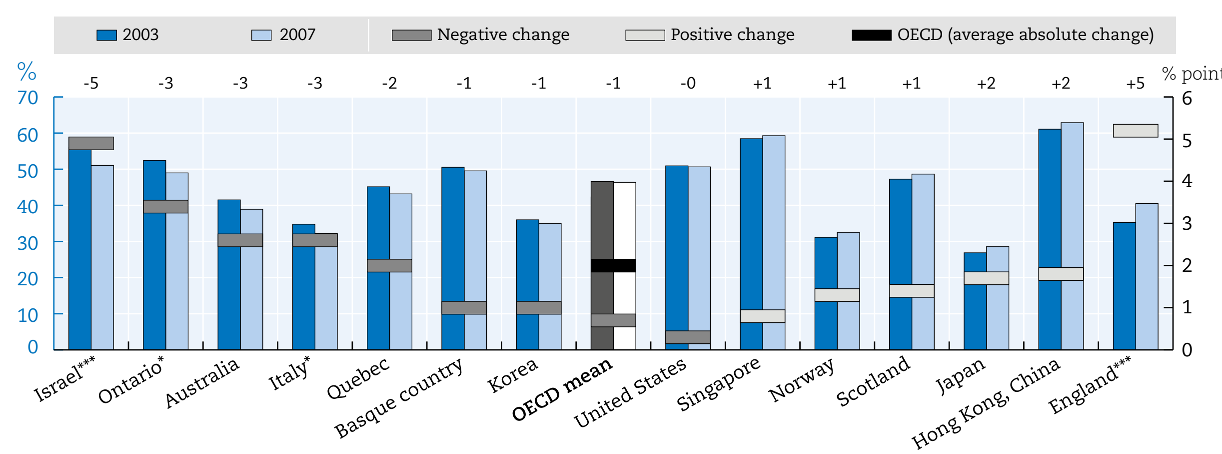
StatLink http://dx.doi.org/10.1787/888933083240

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 6.4 **Relating 8th grade science learning to students' daily life, according to students**

Percentage of students whose teachers ask them to relate what they learn in class to their daily life in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083259

*** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

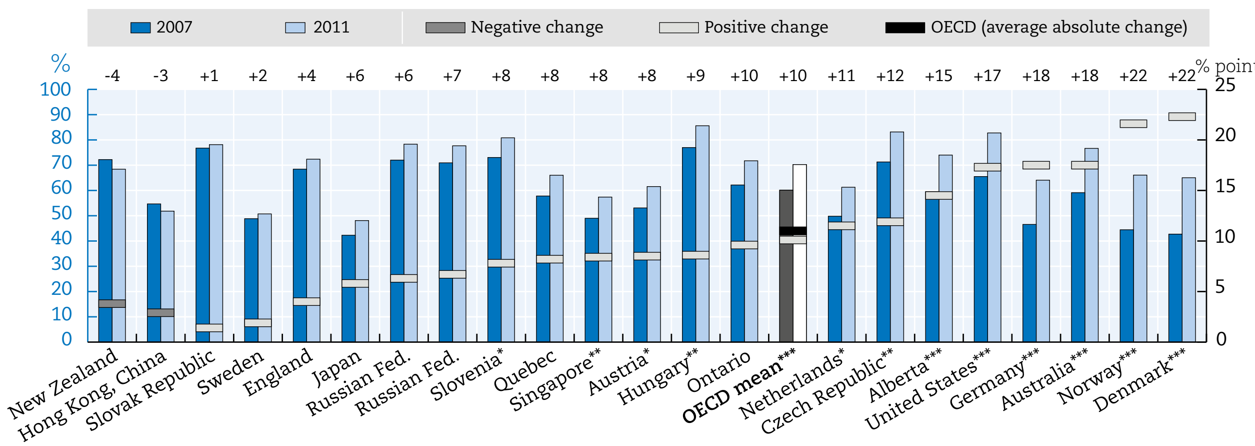
Source: Authors' calculations based on TIMSS (2003 and 2007)

Box 6.1 **Data source details for Figures 6.1 to 6.4**

TIMSS (2003, 2007 and 2011) surveys asked 8th grade teachers "In teaching mathematics/science to this class, how often do you usually ask students to do the following? […] h/i) Relate what they are learning in mathematics/science to their daily lives"; with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". TIMSS (2003 and 2007) asked 8th grade students "How often do you do these things in your mathematics/science lessons? […] h/j) We relate what we are learning in mathematics/science to our daily lives" with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 6.5 **Relating 4th grade maths learning to students' daily life, according to teachers**

Percentage of students whose teachers ask them to relate what they learn in class to their daily life in at least half their lessons and change over time



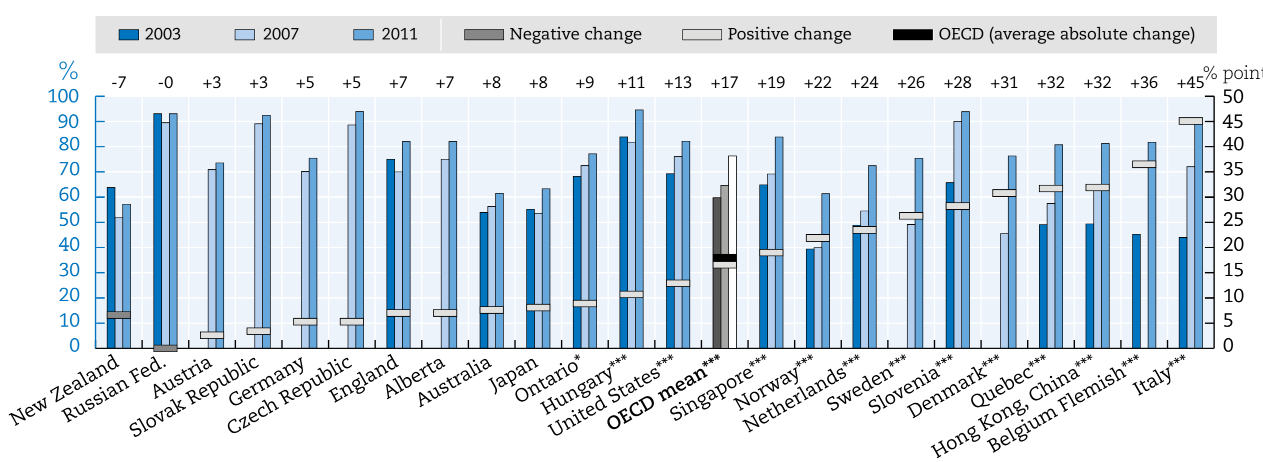
StatLink http://dx.doi.org/10.1787/888933083278

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2007 and 2011)

Figure 6.6 **Relating 4th grade science learning to students' daily life, according to students**

Percentage of students whose teachers ask them to relate what they learn in class to their daily life in at least half their lessons and change over time



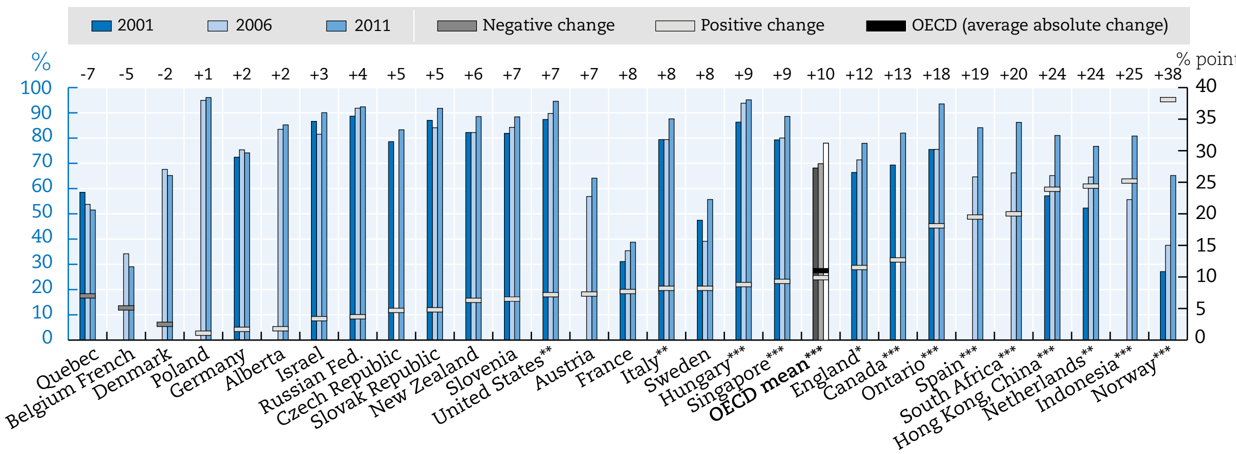
StatLink http://dx.doi.org/10.1787/888933083297

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 6.7 **Relating 4th grade reading to students' own experience, according to teachers**

Percentage of students whose teachers ask them to relate what they read with their own experience in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083316

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Box 6.2 **Data source details for Figures 6.5 to 6.7**

TIMSS (2003, 2007 and 2011) surveys asked 4th grade teachers "In teaching mathematics/science to this class, how often do you usually ask students to do the following? [...] g/h) Relate what they are learning in mathematics/science to their daily lives" with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". PIRLS (2001, 2006 and 2011) asked 4th grade teachers: "How often do you ask the students to do the following things to help develop reading comprehension skills or strategies? [...] d) Compare what they have read with experiences they have had" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Data and text interpretation

General Findings

Innovation in classroom practice has included both increases and decreases in the extent to which students interpret data and text.

Across the OECD area the average absolute change in 8th grade students reporting that they had interpreted data in maths between 2003 and 2007 was 7% points (Figure 6.8). A larger proportion of students in Japan (18% points), Hong Kong, (14% points), Korea (14% points) and the Russian Federation (10% points) interpreted data in 2007 than 2003. In contrast, students in Hungary (21% points) indicated a large reduction in data interpretation over this time period. These education system changes presented small effect sizes.

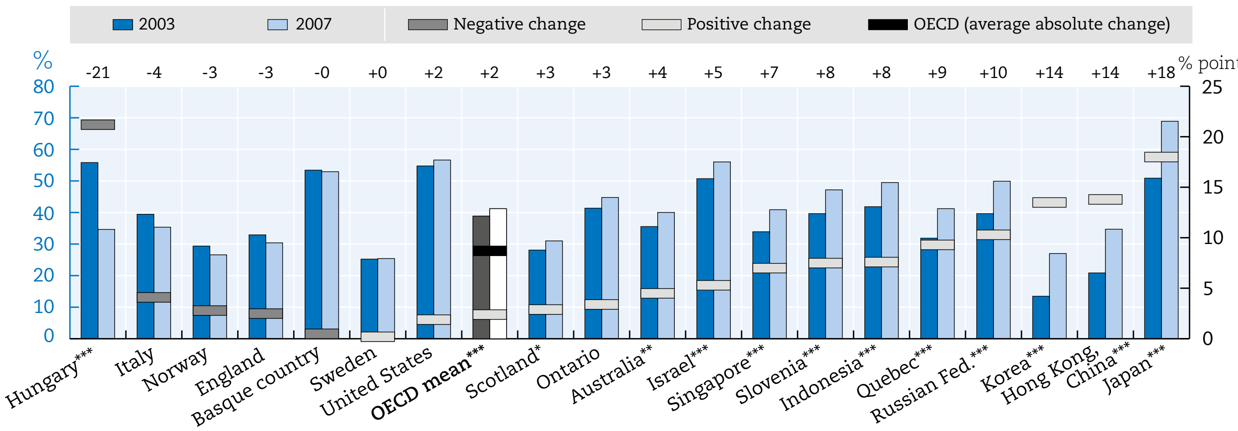
The average absolute change between 2001 and 2011 for teachers reporting that 4th grade students made generalisations and drew inferences when reading came to 16% points (Figure 6.9). Such text interpretation increased notably in Hong Kong (38% points), the Slovak Republic (37% points) and France (32% points). These education system level increases showed medium to large effect sizes whilst the OECD average and average absolute change for 4th grade reading showed small effect sizes. Overall, and with at least medium effect sizes, there was an increase in the extent to which students were asked to make generalisations and draw inferences in five countries.

Country specificities

Hong Kong stands out as an education system where students were asked to interpret data and text more across disciplines and levels. In Hong Kong a larger proportion of students were asked to interpret data in 2007 than 2003 in 8th grade mathematics and to draw inferences from text in 2011 than 2001 in 4th grade reading, with at least small effect sizes.

Figure 6.8 **Interpreting data in tables, figures or graphs in 8th grade maths, according to students**

Percentage of students reporting that they interpret data in tables, figures or graphs
in half of the classes or more and change over time



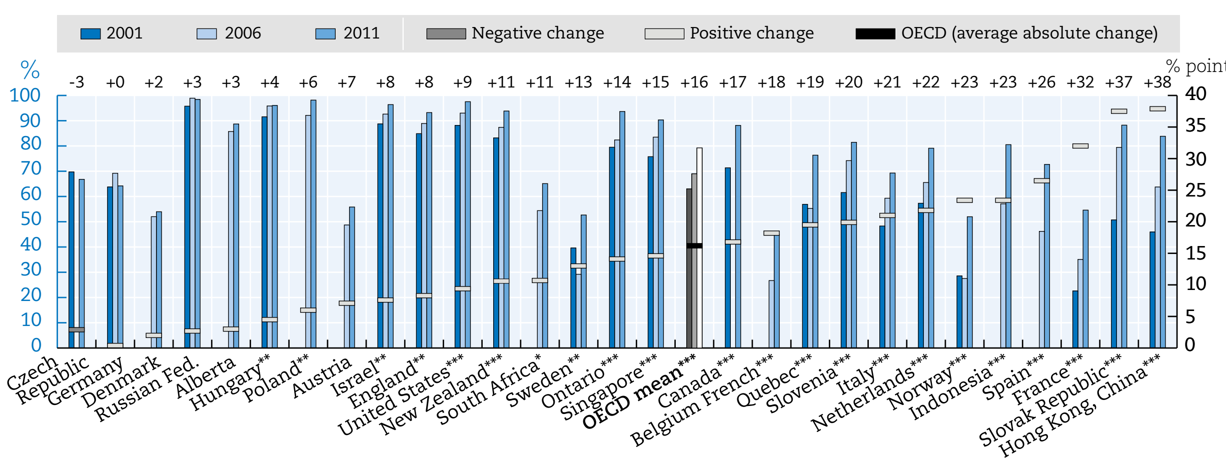
StatLink http://dx.doi.org/10.1787/888933083335

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 6.9 **Students making generalisations and drawing inferences from a text in 4th grade reading, according to teachers**

Percentage of students whose teachers ask them to make generalisations and draw inferences
from a text once a week or more and change over time



StatLink http://dx.doi.org/10.1787/888933083354

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Box 6.3 **Data source details for Figures 6.8 to 6.9**

TIMSS (2003 and 2007) asked 8th grade students "How often do you do these things in your mathematics lessons? […] d) We interpret data in tables, Figures, or graphs" "Every or almost every lesson; About half the lessons; Some lessons; Never". PIRLS (2001, 2006, and 2011) asks 4th grade teachers "How often do you ask the students to do the following things to help develop reading comprehension skills or strategies? […] g) Make generalizations and draw inferences based on what they have read" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Reasoning

General findings

Innovation in instructional practices can also be indicated through students explaining and elaborating their answers more widely during mathematics and science lessons in secondary education (Figure 6.10 to Figure 6.13). Between 2007 and 2011 OECD average absolute change for students being asked to observe and describe natural phenomena was 20% points, while it amounted to 12% points for students being asked to explain what they are studying during science classes. As for mathematics classes, the average absolute change within the OECD area between 2003 and 2011 was 10% points for students being asked to explain their answers, similar to the one reported by students (6% points) between 2003 and 2007. During science classes, a larger proportion of students in England (34% points), Australia (32% points) and the United States (31% points) in particular have been asked to describe natural phenomena, whereas in Quebec (31% points) and Hong Kong (24% points) a larger proportion of students was asked to explain what they were studying. Significantly more teachers in Indonesia (30% points), Singapore (22% points), Australia (21% points) and Japan (20% points) asked their students to explain their answer during mathematics lessons, while more students reported having to explain their answer in Japan (44% points). These changes were characterised by large and medium effect sizes, while the OECD average and average absolute changes showed small effect sizes. Overall, with at least small effect size, the extent to which students described natural phenomena increased in 20 education systems and the extent to which they explained what they were studying during their science lessons increased in 16. There was an increase in teachers asking students to explain their answers during mathematics classes in 13 countries and a decrease in one, whereas students reported having explained their answers more in two countries and less in one, although within a shorter time period.

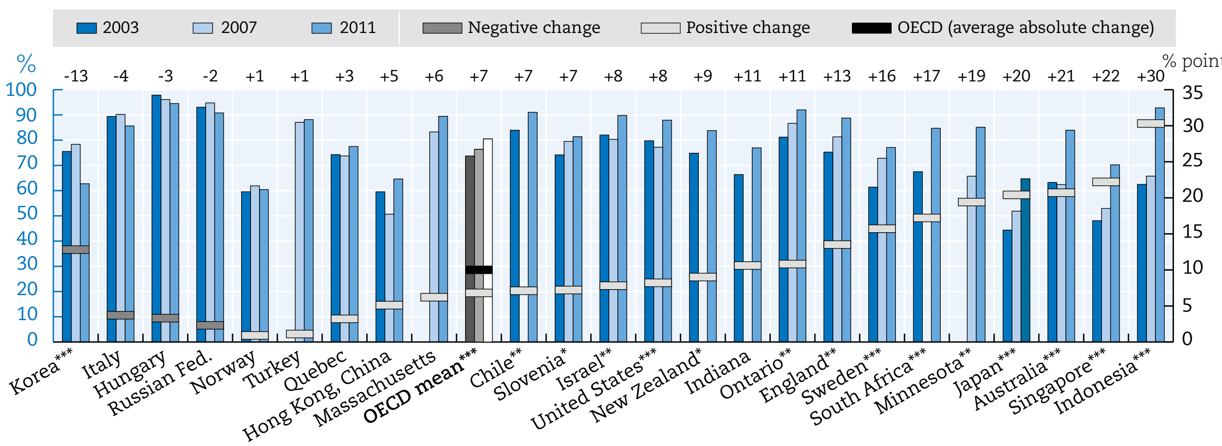
As to primary education, classroom innovation was also illustrated through an increase in students being asked to explain their answers and what they were studying (Figure 6.14 and Figure 6.15). OECD average absolute change regarding students being asked to explain what they were studying in science lessons was 13% points between 2007 and 2011, whilst it amounted to 12% points for students being asked to explain their answers in mathematics between 2003 and 2011. The Netherlands (37% points), Sweden (30% points) and the Slovak Republic (21% points) are countries where there was an increase in students being asked to explain what they were studying in their science classes. For mathematics, the education systems showcasing the largest increases in students explaining their answers were Norway (40% points), Hong Kong (28% points), Alberta (23% points), Australia (23% points) and the United States (17% points) These system level changes exhibited from medium to large effect size, while the OECD average and average absolute change effect sizes were small for both mathematics and science. Altogether, with at least small effect sizes, primary school students were asked more for explanations in 17 education systems during both mathematics and science classes.

Country specificities

Innovation in the form of an increase in the practice of asking students to elaborate on their answers and the topics they studied occurred across disciplines and levels in Australia. With at least small effect sizes, there was an increase in Australian students being asked to explain their answers and the topics of their studies both in 8th and 4th grade and to describe observed natural phenomena in 8th grade.

Figure 6.10 **Students explaining answers during 8th grade maths lessons, according to teachers**

Percentage of students whose teachers ask them to explain their answers in at least half their lessons and change over time



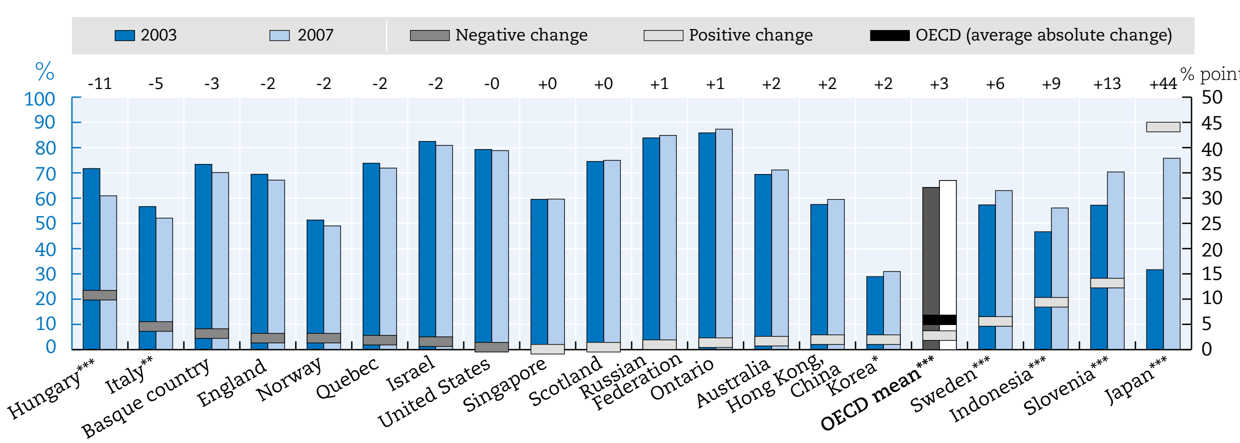
StatLink http://dx.doi.org/10.1787/888933083373

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 6.11 **Students explaining answers during 8th grade maths lessons, according to students**

Percentage of students whose teachers ask them to explain their answers in at least half their lessons and change over time



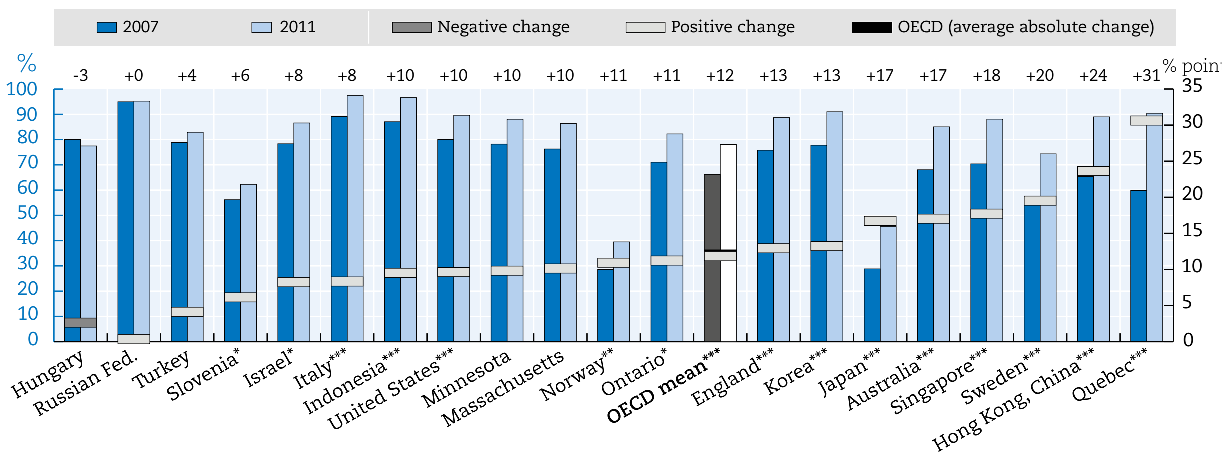
StatLink http://dx.doi.org/10.1787/888933083392

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 6.12 **Students explaining what they are studying during 8th grade science lessons, according to teachers**

Percentage of students whose teachers ask them to explain what they are studying in at least half their lessons and change over time



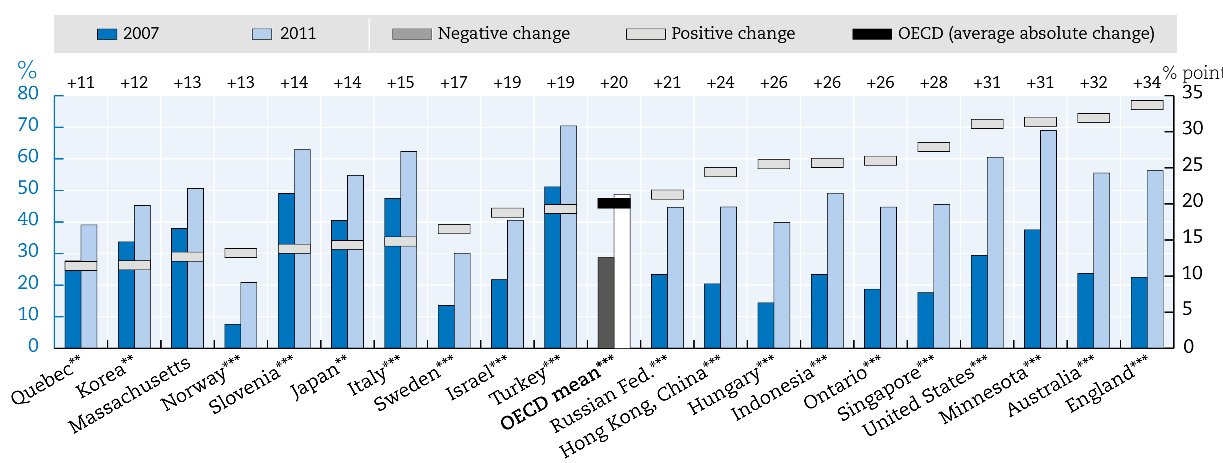
StatLink http://dx.doi.org/10.1787/888933083411

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2007 and 2011)

Figure 6.13 **Students observing and describing natural phenomena during 8th grade science lessons, according to teachers**

Percentage of students whose teachers ask them to observe and describe natural phenomena in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083430

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

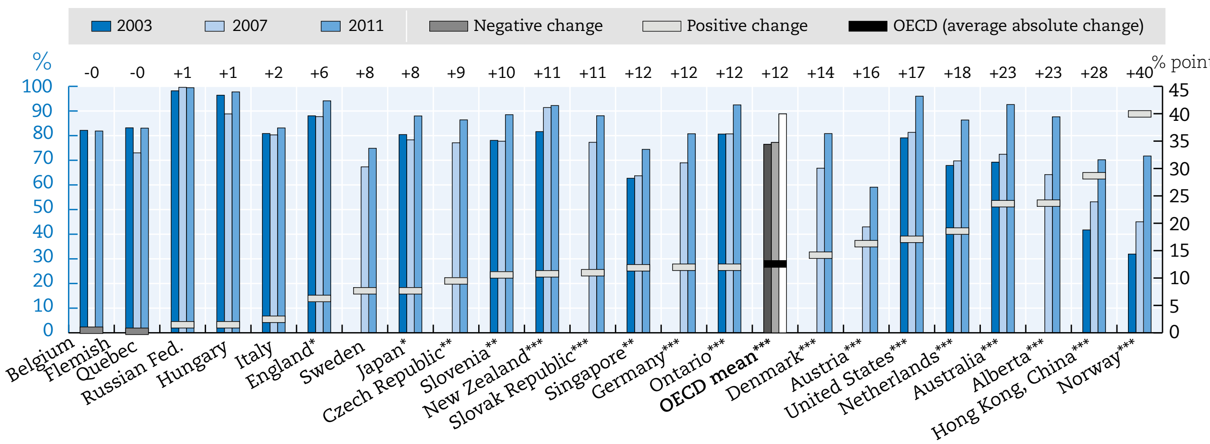
Source: Authors' calculations based on TIMSS (2007 and 2011)

Box 6.4 **Data source details for Figures 6.10 to 6.13**

TIMSS and PIRLS (2003, 2007 and 2011) survey asked teachers "In teaching mathematics/science to this class, how often do you usually ask students to do the following? g) Explain their answers a) Observe natural phenomena and describe what they see h) Give explanations about something they are studying", with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". TIMSS (2003 and 2007) survey asked students "How often do you do these things in your mathematics lessons? […] g) We explain our answers with answer options", with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 6.14 **Students explaining answers during 4th grade maths lessons, according to teachers**

Percentage of students whose teachers ask them to explain answers in at least half their lessons and change over time



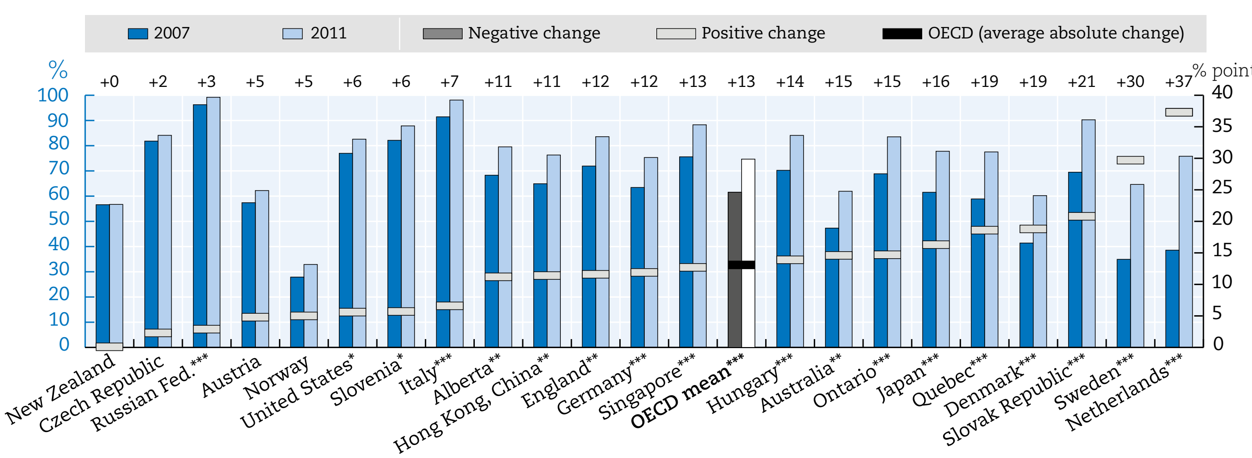
StatLink http://dx.doi.org/10.1787/888933083449

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 6.15 **Students explaining what they are studying during 4th grade science lessons, according to teachers**

Percentage of students whose teachers ask them to explain what they are studying in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083468

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2007 and 2011)

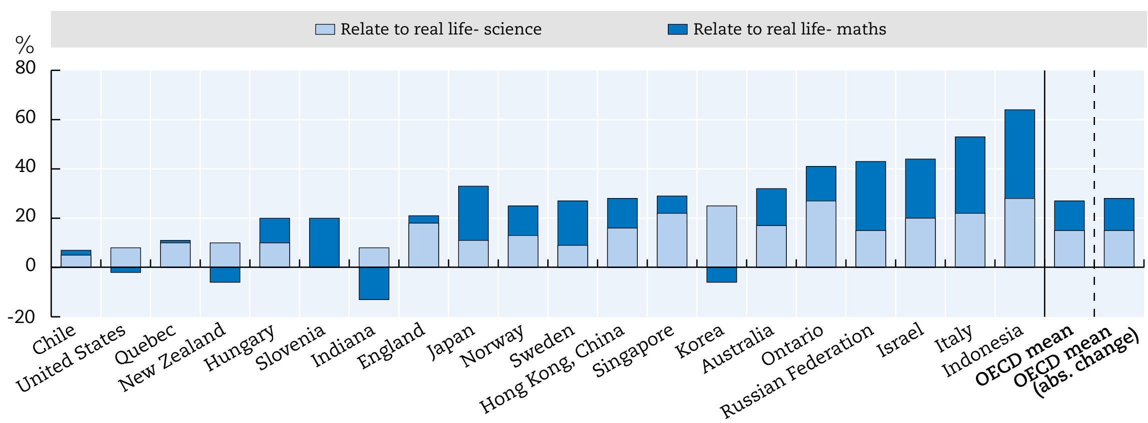
Box 6.5 **Data source details for Figures 6.14 to 6.15**

TIMSS (2003, 2007 and 2011) surveys asked 4th grade teachers: "In teaching mathematics/science to this class, how often do you usually ask students to do the following? [...] g) Explain their answers-[...] g) Give explanations about something they are studying" with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

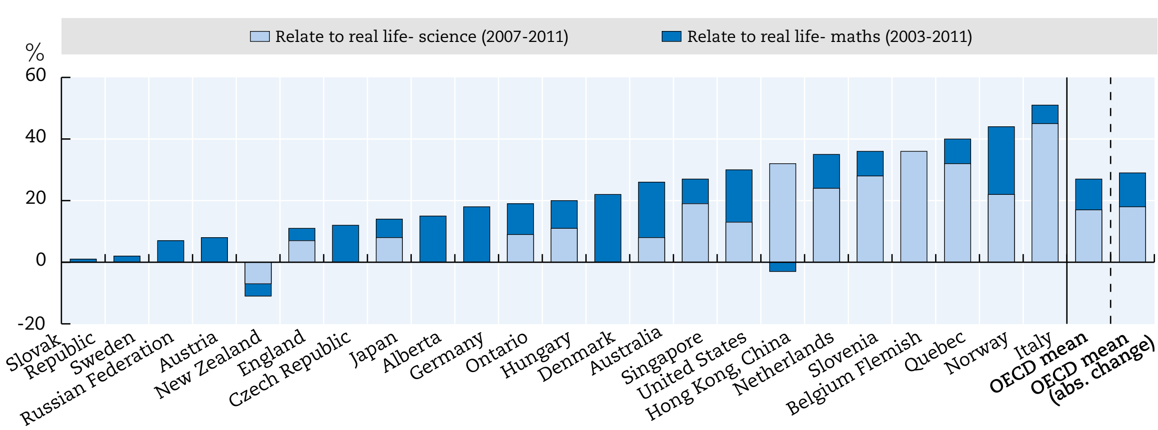
Innovation in the extent to which students have been asked to relate what they are learning to their daily lives has almost always manifested as an increase, and the practice has typically increased more in maths than science at both 8th grade and 4th grade. Innovation or significant change is also illustrated through an increase in the extent of student reasoning and self-directed work across disciplines and educational levels between the time frames analysed.

Figure 6.16 **Change in students relating what they learn to their daily lives in 8th grade**



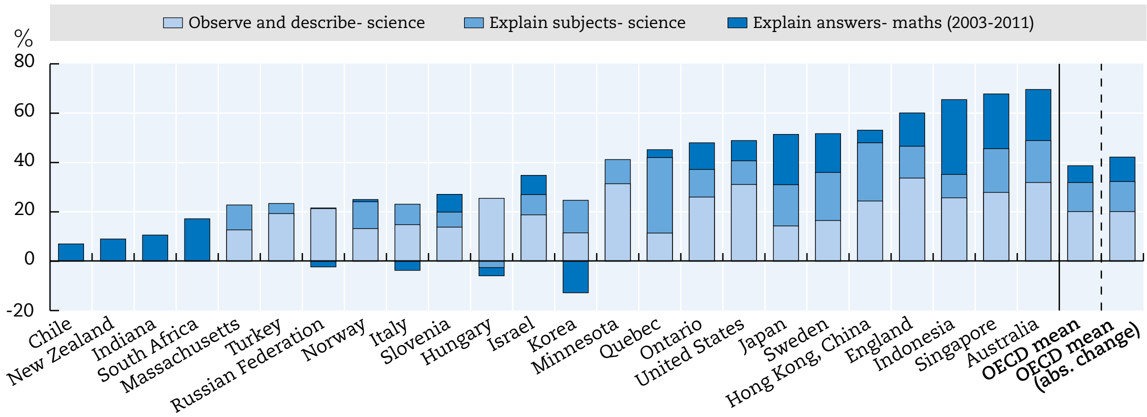
StatLink http://dx.doi.org/10.1787/888933083487

Figure 6.17 **Change in students relating what they learn to their daily lives in 4th grade**



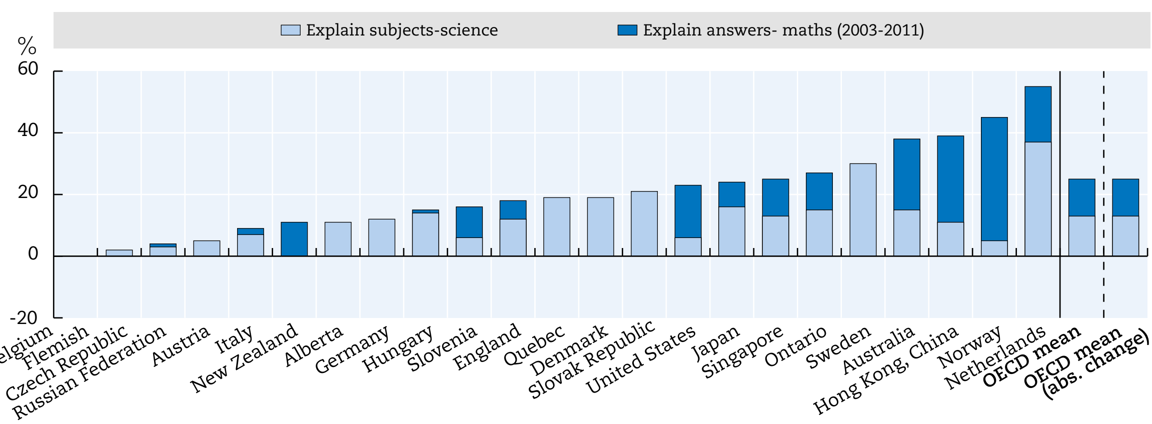
StatLink http://dx.doi.org/10.1787/888933083506

Figure 6.18 **Change in students' reasoning in 8th grade**



StatLink http://dx.doi.org/10.1787/888933083525

Figure 6.19 **Change in students' reasoning in 4th grade**



StatLink http://dx.doi.org/10.1787/888933083544

Notes: For details please see Figures 6.1, 6.3, 6.5, 6.6, 6.10, 6.12, 6.14 and 6.15.

Note on Israel

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.

Table 6.1 Effect sizes for changes in relating lessons to real life, interpreting data and text, and reasoning

	Change in student relating to real life							Data and text interpretation		Change in students' reasoning					
	8th grade				4th grade			8th grade	4th grade	8th grade				4th grade	
	Mathematics	Mathematics (student resp.)	Science	Science (student resp.)	Mathematics	Science	Reading	Mathematics (student resp.)	Reading	Explain answers in maths	Explain answers in maths (student resp.)	Explain subjects in science	Observe and describe in science	Explain answers in maths	Explain subjects in science
	03-11	03-07	03-11	03-07	07-11	03-07	01-11	03-07	01-11	03-11	03-07	07-11	07-11	03-11	03-11
Australia	0.30	0.10	0.37	-0.05	0.38	0.15	m	0.09	m	0.48	0.04	0.41	0.67	0.63	0.29
Austria	m	m	m	m	0.17	m	m	m	m	m	m	m	m	m	0.10
Belgium Flemish	m	m	m	m	m	0.78	m	m	m	m	m	m	m	-0.01	m
Canada	m	m	m	m	m	m	0.30	m	0.43	m	m	m	m	m	m
Alberta	m	m	m	m	0.31	m	m	m	m	m	m	m	m	m	0.26
Ontario	0.30	0.11	0.60	-0.07	0.20	0.20	0.52	0.07	0.43	0.32	0.04	0.27	0.57	0.36	0.35
Quebec	0.02	0.04	0.22	-0.04	0.17	0.68	-0.14	0.19	0.42	0.08	-0.04	0.74	0.24	0.00	0.40
Chile	0.06	m	0.23	m	m	m	m	m	m	0.22	m	m	m	m	m
Czech Republic	m	m	m	m	0.29	m	0.12	m	-0.06	m	m	m	m	m	0.06
Denmark	m	m	m	m	0.45	m	m	m	m	m	m	m	m	m	0.38
France	m	m	m	m	m	m	0.16	m	0.67	m	m	m	m	m	m
Germany	m	m	m	m	0.35	m	0.04	m	0.01	m	m	m	m	m	0.26
Hungary	0.22	0.19	0.34	m	0.22	0.36	0.31	-0.43	0.19	-0.18	-0.23	-0.06	0.59	0.08	0.33
Israel	0.49	0.05	0.51	-0.10	m	m	0.11	0.11	0.30	0.23	-0.04	0.22	0.41	m	m
Italy	0.63	0.12	0.53	-0.05	0.15	1.02	0.22	-0.08	0.43	-0.11	-0.09	0.35	0.30	0.06	0.32
Japan	0.30	0.41	0.21	0.04	0.12	0.16	m	0.37	m	0.41	0.92	0.35	0.29	0.21	0.36
Korea	-0.11	0.11	0.63	-0.02	m	m	m	0.34	m	-0.28	0.04	0.37	0.24	m	m
Netherlands	m	m	m	m	0.23	0.49	0.52	m	0.47	m	m	m	m	0.45	0.77
New Zealand	-0.12	m	0.23	m	-0.08	-0.13	0.18	m	0.34	0.22	m	m	m	0.32	0.00
Norway	0.24	0.14	0.27	0.03	0.44	0.44	0.78	-0.06	0.48	0.02	-0.05	0.23	0.39	0.82	0.11
Slovak Republic	m	m	m	m	0.03	m	0.16	m	0.86	m	m	m	m	m	0.54
Slovenia	0.43	0.34	-0.01	m	0.19	0.75	0.18	0.15	0.45	0.17	0.28	0.12	0.28	0.28	0.16
Basque country	m	0.13	m	-0.02	m	m	m	-0.01	m	m	-0.07	m	m	m	m
Sweden	0.37	0.30	0.21	m	0.04	m	0.16	0.00	0.26	0.34	0.12	0.41	0.41	m	0.60
Turkey	m	m	m	m	m	m	m	m	m	m	m	0.10	0.40	m	m
England	0.06	0.15	0.39	0.11	0.09	0.17	0.26	-0.05	0.27	0.36	-0.05	0.34	0.71	0.22	0.28
Scotland	m	0.18	m	0.03	m	m	m	0.06	m	m	0.01	m	m	m	m
United States	-0.05	0.04	0.20	-0.01	0.40	0.30	0.26	0.04	0.39	0.22	-0.01	0.27	0.64	0.55	0.14
Indiana	-0.26	m	0.22	m	m	m	m	m	m	0.24	m	m	m	m	m
Massachusetts	m	m	m	m	m	m	m	m	m	m	m	0.26	0.26	m	m
Minnesota	m	m	m	m	m	m	m	m	m	m	m	0.27	0.64	m	m
OECD (average)	0.25	0.16	0.35	-0.01	0.22	0.38	0.25	0.05	0.40	0.16	0.06	0.29	0.44	0.33	0.30
OECD (average absolute)	0.27	0.16	0.35	0.05	0.23	0.41	0.27	0.14	0.40	0.25	0.14	0.30	0.44	0.33	0.30
Hong Kong, China	0.26	0.01	0.36	0.04	-0.06	0.69	0.53	0.31	0.82	0.10	0.04	0.58	0.53	0.58	0.25
Indonesia	0.80	0.25	0.74	m	m	m	m	0.15	m	0.78	0.19	0.37	0.54	m	m
Russian Federation	0.59	0.36	0.39	m	0.15	0.00	0.13	0.21	0.16	-0.08	0.03	0.01	0.46	0.12	0.21
Singapore	0.15	0.10	0.50	0.02	0.17	0.44	0.26	0.14	0.40	0.46	0.00	0.45	0.61	0.25	0.33
South Africa	0.36	m	0.13	m	m	m	m	m	m	0.41	m	m	m	m	m

StatLink http://dx.doi.org/10.1787/888933083563

Notes: OECD average includes all OECD education systems for which data is available for all years concerned
= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003, 2007 and 20011) and PIRLS (2001, 2006 and 2011)

CHAPTER 7

Innovation in class organisation

Innovation in the classroom can also be seen through different ways of organising the class for different instructional purposes. Teachers may innovate by adapting the organisation of the class according to the subject and type of content they are delivering. Teachers may also give more or less autonomy to students through self- directed work or provide students with individualised instruction. The aim of increasing these types of instructional practices could be, for example, to facilitate collaborative learning between students, or to address specific educational needs whilst a decrease might reflect a wish to reduce the extent to which students regroup and move around the classroom or to increase the time they spend learning directly from the teacher.

Group work

General findings

Innovation in the classroom also included more or less use of group working within the class in secondary education (Figure 7.1 and Figure 7.2). Between 2003 and 2007 the OECD average absolute change regarding students working in small groups was 13% points for mathematics classes and 4% points for science classes. Japan (73% points) stands out as the country where the practice of having students working in small groups during mathematics lessons increased the most according to student own reporting. Korea (10% points), on the other hand, illustrates the case of a country where students group work decreased the most during science classes. These country changes exhibited medium and small effect sizes, while the OECD average exhibited small effect size in the case of mathematics lessons. Overall, student group work increased with at least small effect sizes in 12 countries during mathematics classes. In the case of science lessons the increases exhibited small effect sizes in one education system only.

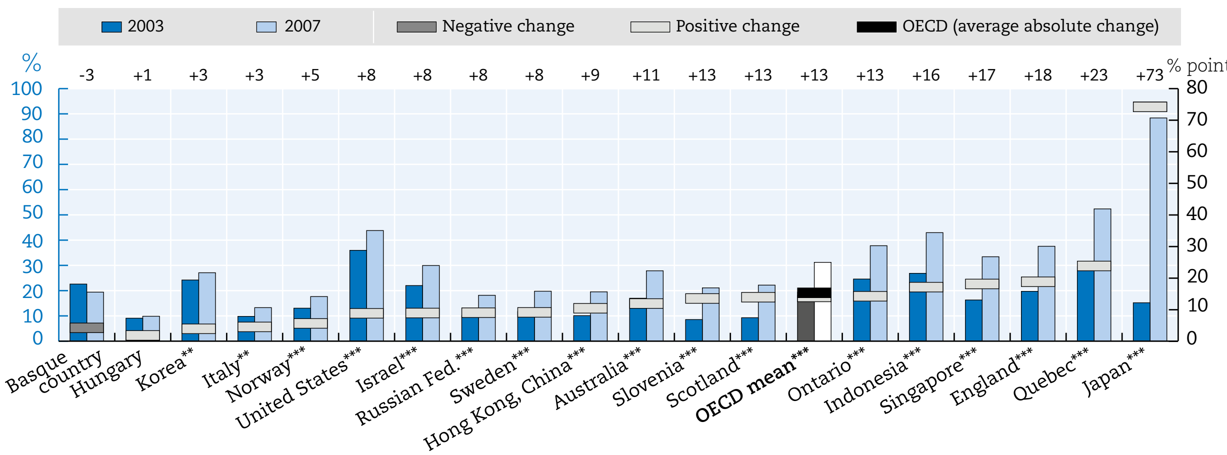
Innovation in primary education classrooms also encompassed more or less use of group working during reading and science classes (Figure 7.3 and Figure 7.4 4th). Between 2001 and 2006, the OECD average absolute change for students reading aloud in small groups or pairs was 8% points, while it amounted to 6% points in the case of students reporting that they worked in small groups during science lessons between 2003 and 2007. Hong Kong (26% points) was the education system showing the largest increase in group working during reading classes. In science classes, Slovenia (13% points) showed the largest increase in group working, whereas the Netherlands (22% points) showed the largest decrease in this respect. These education system changes presented medium and small effect size. Altogether, with at least small effect sizes, student group work in reading classes increased in seven education systems and decreased in one.

Country specificities

Hong Kong stood out as the education system where innovation was illustrated through more group working practices across disciplines and levels. There was an increase in the extent to which students in Hong Kong were grouped during 8th grade mathematics lessons between 2003 and 2007 with small effect size and during 4th grade reading lessons between 2001 and 2006 with medium effect size.

Figure 7.1 **8th grade maths students working in small groups, according to students**

Percentage of students working together in small groups in at least half their lessons and change over time



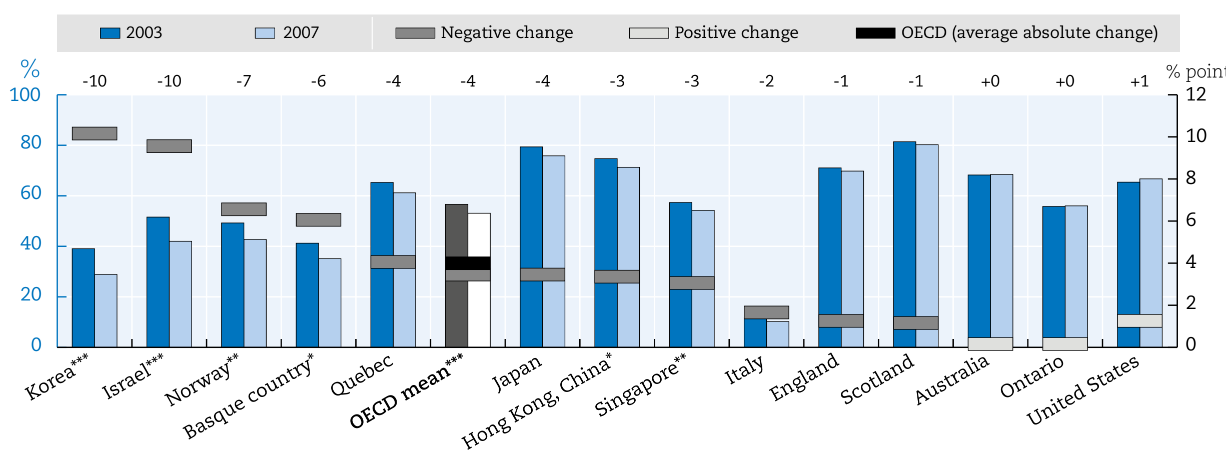
StatLink http://dx.doi.org/10.1787/888933083582

*** = Change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 7.2 **8th grade science students working in small groups, according to students**

Percentage of students working together in small groups in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083601

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

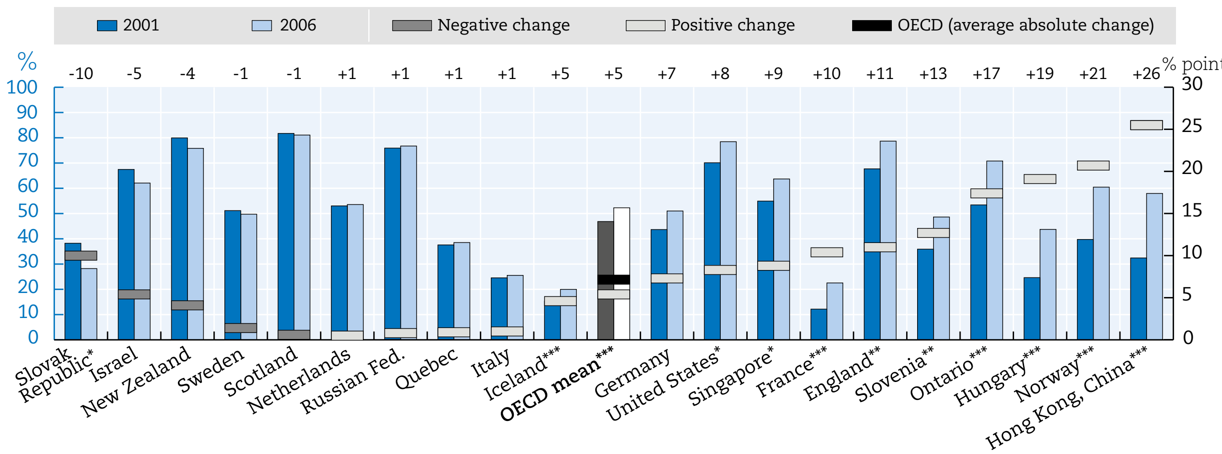
Source: Authors' calculations based on TIMSS (2003 and 2007)

Box 7.1 **Data source details for Figures 7.1 and 7.2**

TIMSS (2003 and 2007) surveys asked 8th grade students "How often do you do these things in your mathematics/ science lessons?[…] m) We work together in small groups […] e) We work in small groups on an experiment or investigation" with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 7.3 **4th grade students reading aloud in small groups or pairs, according to teachers**

Percentage of students whose teachers ask them to read aloud in small groups or pairs at least weekly and change over time



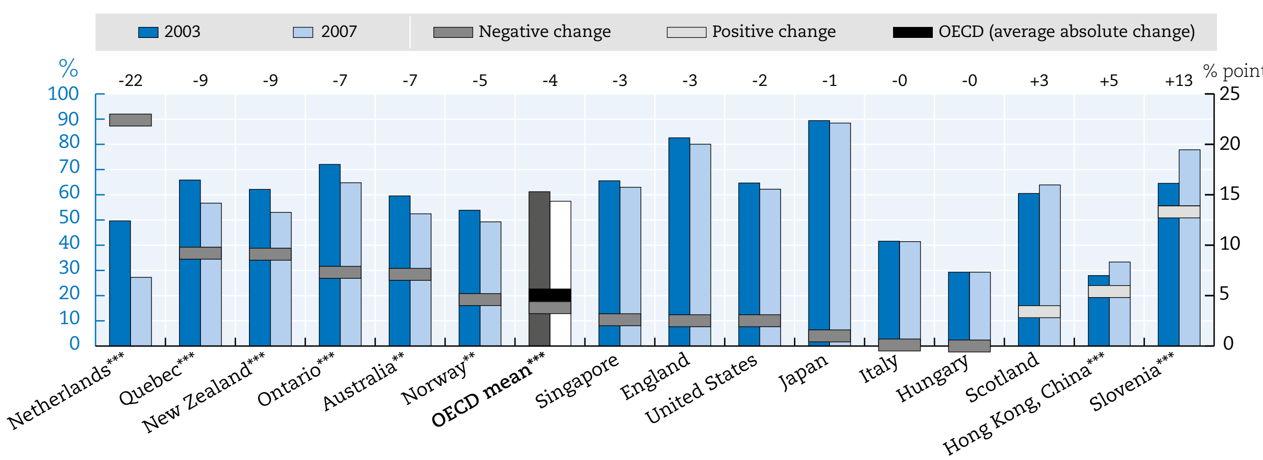
StatLink http://dx.doi.org/10.1787/888933083620

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PIRLS (2001 and 2006)

Figure 7.4 **4th grade science students working in small groups, according to students**

Percentage of students working together in small groups in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083639

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Box 7.2 **Data source details for Figures 7.3 and 7.4**

PIRLS (2001, and 2006) surveys asked teachers "When you have reading instruction and/or do reading activities with the students, how often do you do the following? [...] c) Ask students to read aloud in small groups or pairs" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". TIMSS (2003 and 2007) surveys asked 4th grade students: "In school, how often do you do these things? [...] e) I work with other students in a small group on a science experiment or investigation" with answer options "At least once a week; Once or twice a month; A few times a year; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

In-class ability grouping

General findings

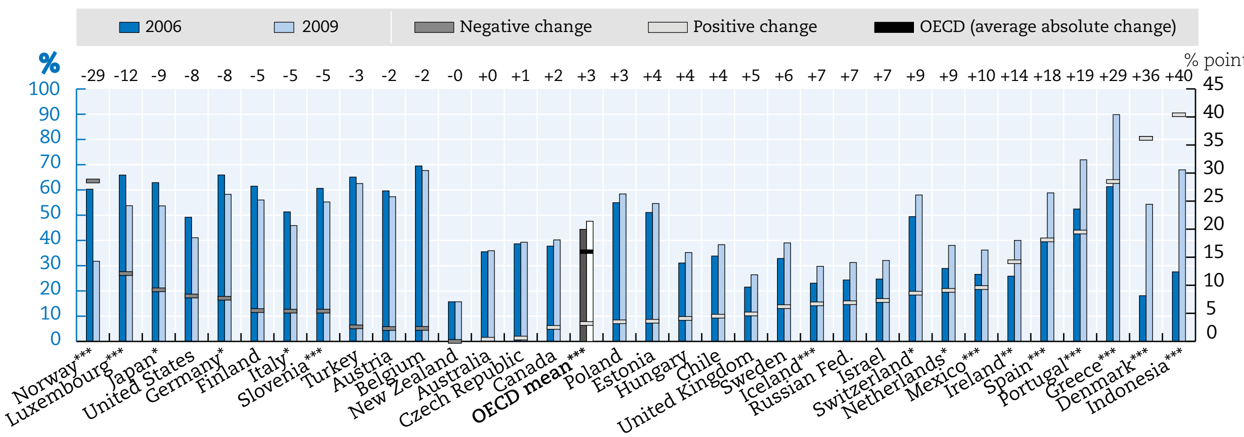
Innovation in the classroom has typically resulted in slightly higher use of in-class ability grouping in primary and secondary education but some large changes are observed in both directions (Figure 7.5 to Figure 7.7 4th). Between 2006 and 2009 the OECD average absolute change regarding the use of in-class ability grouping amounted to 9% points for secondary education students. In primary education the average absolute change in the regular use of same ability groups was 5% points, whereas OECD average absolute change for the regular use of mixed ability groups amounted to 2% points between 2001 and 2011. Indonesia (40% points), Denmark (36% points) and Greece (29% points) are the countries that showed the largest increase in use of ability grouping policies, while Norway (29% points) outranked all other countries for the decrease in this respect. The Czech Republic (70% points) exhibited the largest reduction in the regular use of mixed ability groups for 4th grade reading instruction. These country changes showed from medium to large effect sizes. Overall, ability grouping policies increased in seven education systems and decreased in two with small effect sizes. Similarly, regular use of same ability grouping increased in seven countries and decreased in one with small effect sizes, while regular use of mixed ability grouping increased and decreased in two education systems.

Country specificities

Indonesia is a country where innovation in the classroom was exemplified in a greater regular use of same ability grouping across educational levels. In Indonesia same ability grouping policies increased significantly between 2006 and 2009 in secondary education as regular use of same ability grouping increased significantly in primary education between 2001 and 2011, with at least small effect sizes.

Figure 7.5 Within class, same-ability grouping policy in secondary education

Percentage of 15 year-old students grouped by ability within class for at least some subjects and change over time



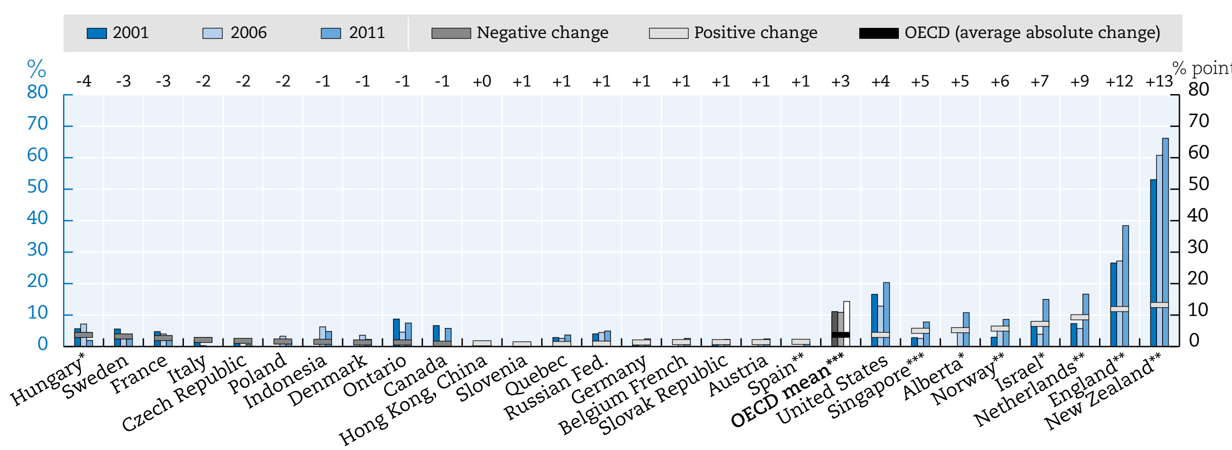
StatLink http://dx.doi.org/10.1787/888933083658

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2006 and 2009)

Figure 7.6 4th grade students in same-ability groups for reading, according to teachers

Percentage of students whose teachers often or always create same-ability groups when doing reading instruction or reading activities and change over time



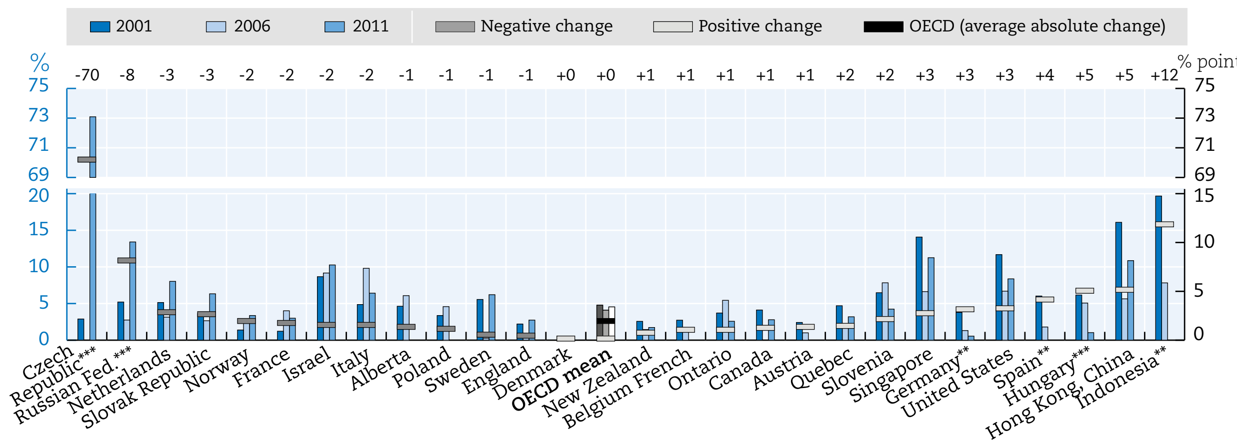
StatLink http://dx.doi.org/10.1787/888933083677

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Figure 7.7 **4th grade students in mixed-ability groups for reading, according to teachers**

Percentage of students whose teachers often or always create mixed-ability groups when doing reading instruction or reading activities and change over time



StatLink http://dx.doi.org/10.1787/888933083696

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Box 7.3 **Data source details for Figures 7.5 and 7.7**

PISA (2006 and 2009) surveys asked school principals and heads of schools "Some schools organise instruction differently for students with different abilities. What is your school's policy about this for students in <national modal grade for 15-year-olds>?[…] b) Students are grouped by ability within their classes" with answer options "For all subjects; For some subjects; Not for any subject". PIRLS (2001, 2006 and 2011) surveys asked 4th grade teachers: "When you have reading instruction and/or do reading activities, how often do you organize students in the following ways? […] b) I create same-ability groups […] b) I create mixed-ability groups" with answer options "Always or almost always; Often; Sometimes; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Self-directed work

General findings

Innovation in the classroom has also resulted in a change in the use of student self-directed work during lessons in secondary education (Figure 7.8 to Figure 7.11). OECD average absolute change in students being asked to decide procedures to solve complex mathematics problem was 8% points between 2003 and 2011, equivalent to students own reporting figure between 2003 and 2007. As for science classes, the average absolute change among OECD countries regarding students being asked to design and plan experiments was 8% points between 2003 and 2011, higher than students' reported figure of 5% points in the 2003-2007 time frame. In particular, there was an increase in students in Ontario (26% points) being asked to decide procedures for solving complex mathematics problems. In Minnesota (29% points) and England (26% points) teachers increased the extent to which they asked students to design or plan experiments. These education system changes exhibited medium effect sizes. Overall, during mathematics lessons, student self-directed work increased in seven education systems according to teachers' reporting; it increased in one and decreased in four education systems according to students own reporting, with at least small effect sizes. Self-directed work during science classes increased in 12 countries according to teacher reporting, with at least small effect sizes. However, within a shorter timeframe, it decreased significantly in one education system, according to students own reporting.

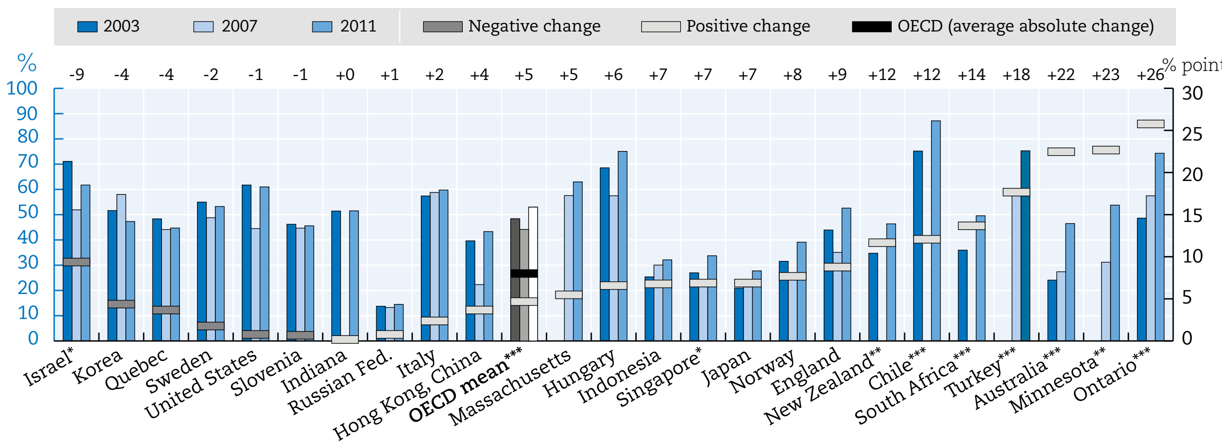
Innovation in the classroom was also illustrated through increases and decreases in student self-direct work during lessons in primary education (Figure 7.12 to Figure 7.15). Between 2003 and 2011 the average absolute change at OECD level for students being asked to design and plan scientific experiments was 10% points, as for student reported data between 2003 and 2007. OECD average absolute change was 11% points for students reading books of their own choice according to teacher reporting, whereas it was 6% points according to student reporting between 2001 and 2011. In Denmark (29% points), Singapore (28% points), Sweden (20% points) and Hong Kong (15% points) teachers asked students to plan and design experiments far more; on the contrary, the Netherlands (42% points) stood out as the country registering the largest decrease in this respect according to students own reporting. Norway (34% points), Hong Kong (25% points) and Italy (24% points) exhibited the largest increase in students choosing the books they would read during reading classes, while, according to students own reporting, the Czech Republic (29% points) registered the largest decrease in this respect. These education system changes presented large and medium effect sizes. The OECD average absolute change in student reported self-directed work in science showed a small effect size; whereas OECD average and average absolute changes exhibited small effect size with regard to teacher reported self-directed work in science and reading and average absolute change in science classes according to student reporting showed a small effect size. Altogether, with at least small effect sizes, self-directed work in science increased in 14 countries, while it increased in one education system and decreased in three according to student own reporting. In reading classes, self-directed work increased in 16 countries while decreasing in one according to teacher reports; student reported data registered an increase in one education system and decreases in five, with at least small effect sizes.

Country specificities

Australia, New Zealand and South Africa are countries where innovation was illustrated in more self-directed work across disciplines and levels. South Africa, for example, experienced a significant increase in students being asked to decide procedures for solving complex mathematics in 8th grade between 2003 and 2011, as well as in students being asked to read books they chose themselves during 4th grade reading classes in the period from 2001 to 2011.

Figure 7.8 8th grade maths students asked to decide on procedures for solving complex problems, according to teachers

Percentage of students whose teachers ask them to decide on their own procedures for solving complex problems in at least half their lessons and change over time



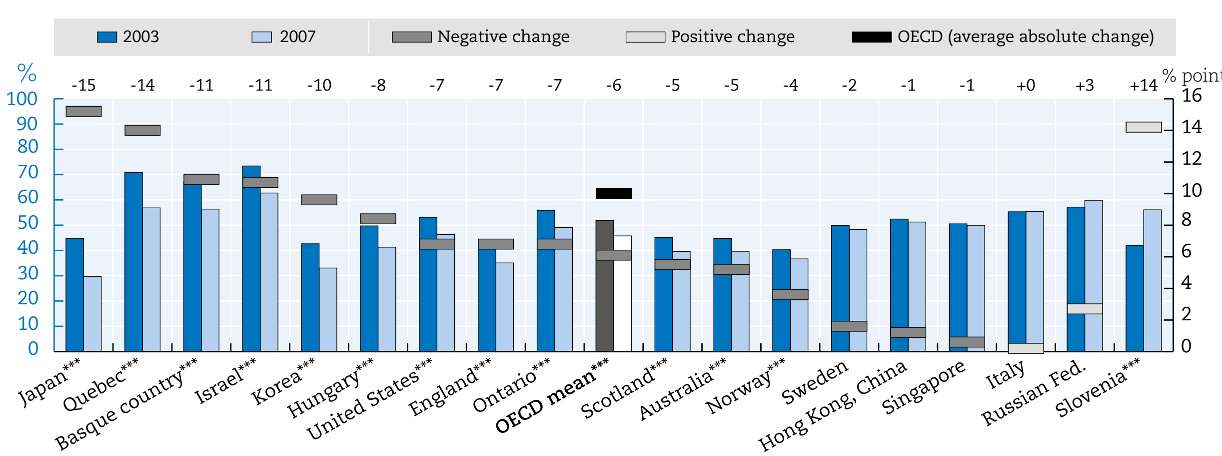
StatLink http://dx.doi.org/10.1787/888933083715

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 7.9 8th grade maths students asked to decide on procedures for solving complex problems, according to students

Percentage of students deciding on their own procedures for solving complex problems in at least half their lessons and change over time



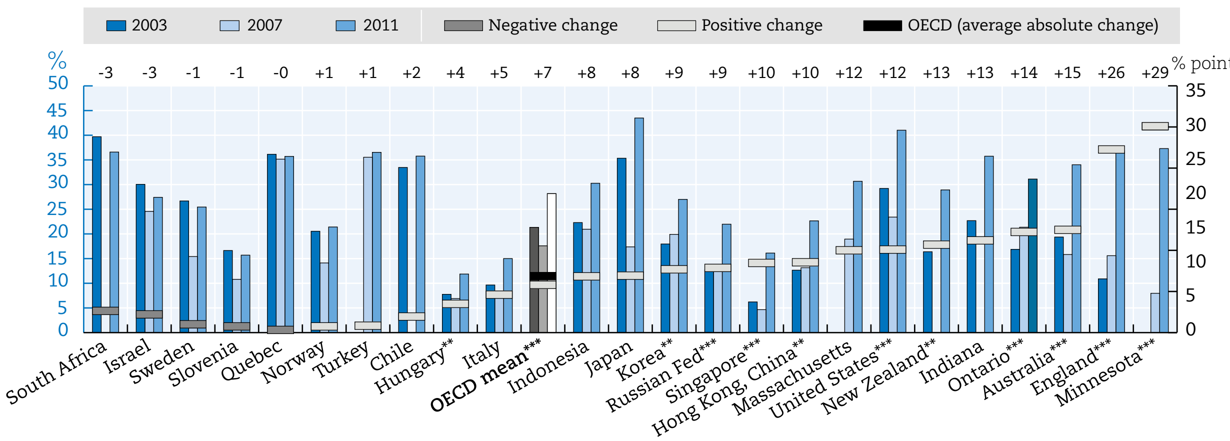
StatLink http://dx.doi.org/10.1787/888933083734

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 7.10 **8th grade science students asked to design or plan experiments, according to teachers**

Percentage of students whose teachers ask them to design or plan experiments or investigations in at least half their lessons and change over time



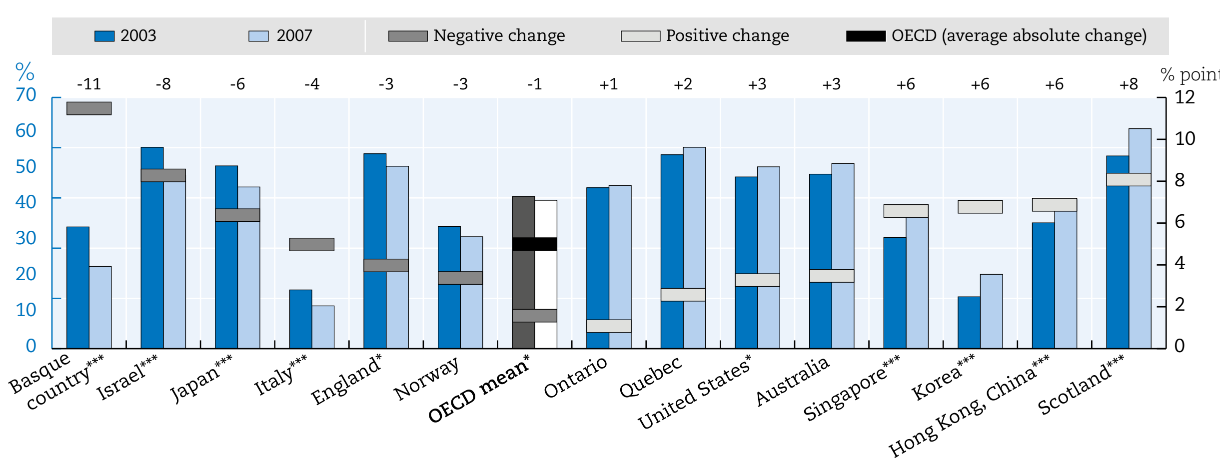
StatLink http://dx.doi.org/10.1787/888933083753

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 7.11 **8th grade science students asked to design or plan experiments, according to students**

Percentage of students whose teachers ask them to design or plan experiments or investigations in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083772

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

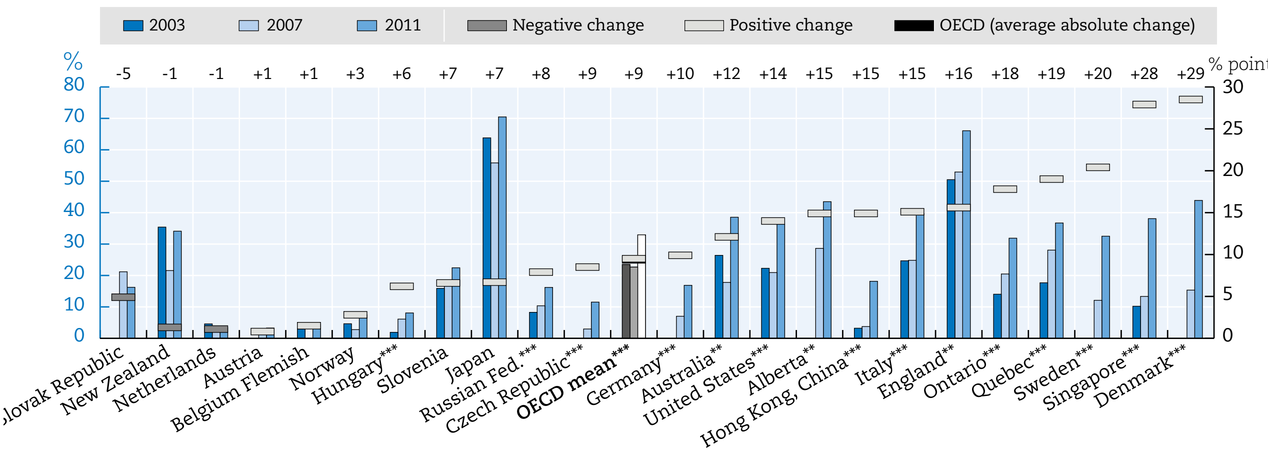
Source: Authors' calculations based on TIMSS (2003 and 2007)

Box 7.4 **Data source details for Figures 7.8 to 7.11**

TIMSS and PIRLS (2003, 2007 and 2011) surveys asked teachers "In teaching mathematics/science to this class, how often do you usually ask students to do the following? […] i) Decide on their own procedures for solving complex problems […]c) Design or plan experiments or investigations" with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never".. TIMSS (2003 and 2007) surveys asked students: "How often do you do these things in your mathematics/science lessons? […] i)

Figure 7.12 4th grade science students asked to design or plan experiments, according to teachers

Percentage of students whose teachers ask them to design or plan experiments or investigations at least once a month and change over time



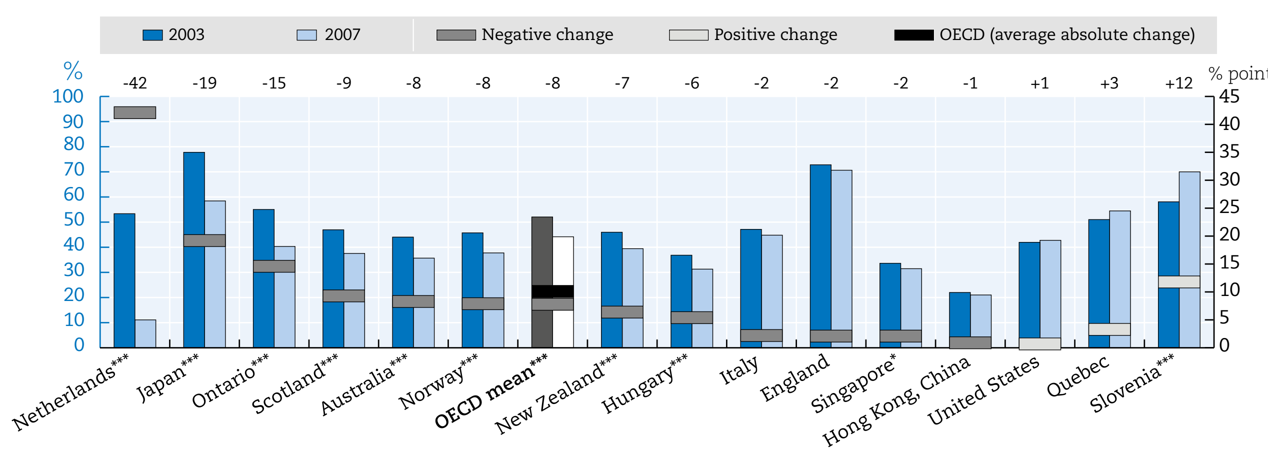
StatLink http://dx.doi.org/10.1787/888933083791

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 7.13 4th grade science students asked to design or plan experiments, according to students

Percentage of students who design or plan experiments or investigations in at least half their lessons and change over time



StatLink http://dx.doi.org/10.1787/888933083810

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

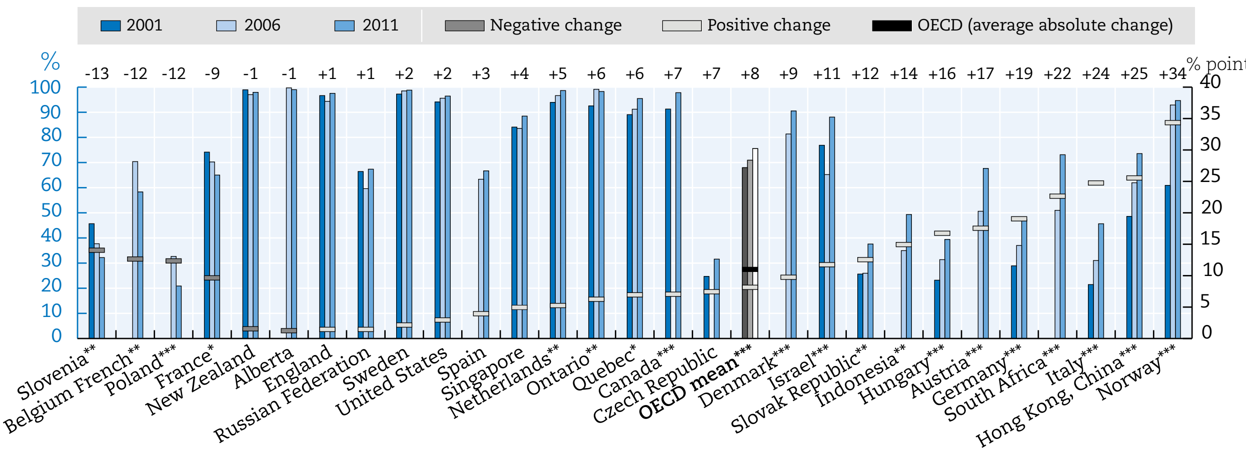
Source: Authors' calculations based on TIMSS (2003 and 2007)

Box 7.5 Data source details for Figures 7.12 to 7.13

We decide on our own procedures for solving complex problems [...]c) We design or plan an experiment or investigation" with answer options "Every or almost every lesson; About half the lessons; Some lessons; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 7.14 4th grade students reading books that they choose themselves, according to teachers

Percentage of students whose teachers give them time to read books of their own choosing at least once a month and change over time



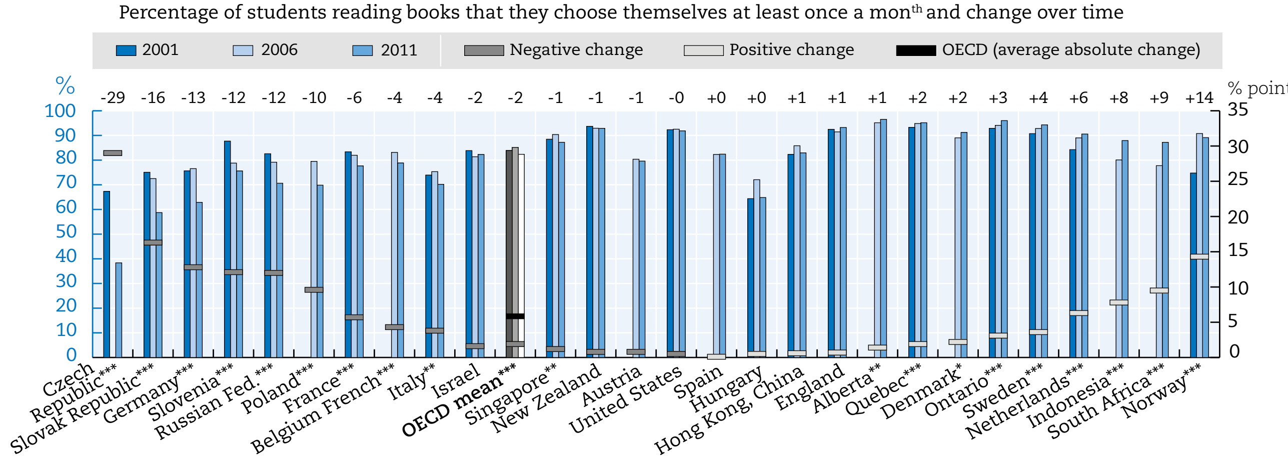
StatLink http://dx.doi.org/10.1787/888933083829

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Figure 7.15 4th grade students reading books that they choose themselves, according to students

Percentage of students reading books that they choose themselves at least once a month and change over time



StatLink http://dx.doi.org/10.1787/888933083848

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland, South Africa and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Box 7.6 Data source details for Figures 7.14 to 7.15

TIMSS (2003 and 2007) surveys asked students: "In school, how often do you do these things? […]c) I design or plan a science experiment or investigation […] with answer options "At least once a week; Once or twice a month; A few times a year; Never". PIRLS (2001, 2006 and 2011) asked 4th grade teachers: "When you have reading instruction and/or do reading activities with the students, how often do you do the following? […] d) Give students time to read books of their own choosing" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". PIRLS (2001, 2006 and 2011) surveys also asked students: "In school, how often do these things happen? […] b) I read books that I choose myself" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

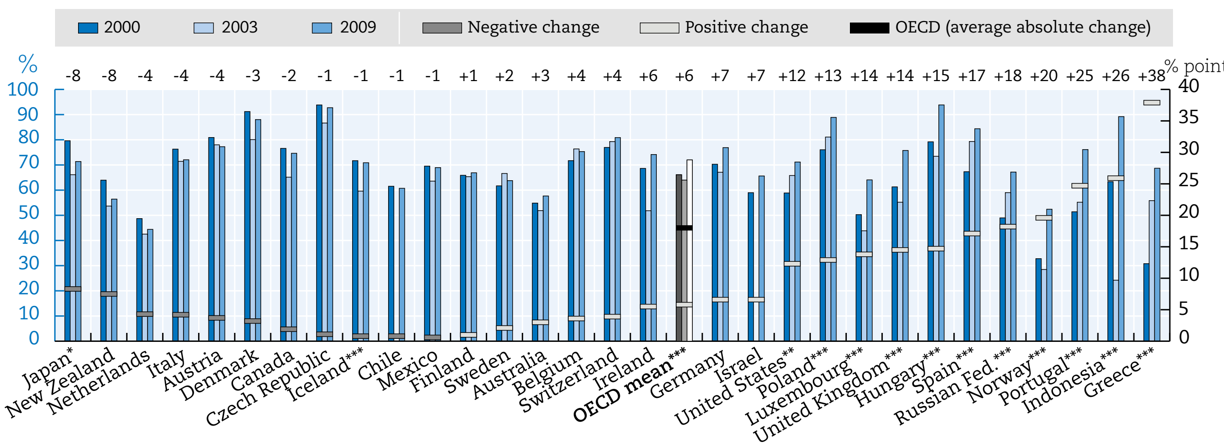
Individualisation

General findings

Innovation in the classroom has also been indicated through an increase in individualisation practices in primary and secondary education (Figure 7.16 to Figure 7.18). Between 2000 and 2009 the OECD average absolute change in the ability of teachers to meet individual students' needs amounted to 10% points, while it amounted to 5% points with regard to student perception of their teachers' willingness to help students individually in secondary education. In primary education, OECD average absolute change concerning the regular use of individualised instruction during reading classes was 17% points between 2001 and 2011. Greece (38% points), Indonesia (26% points) and Portugal (25% points) are the countries where teachers increased their capacity to address students' needs the most. Likewise, Israel (47% points), Hungary (32% points), the Slovak Republic (29% points) and the United States (27% points) outranked all other countries by using regular individualised instruction more widely than before. These education system changes showed from medium to large effect sizes, while OECD average absolute effect size was small concerning student perception of teachers' willingness to help. The OECD average and average absolute change effect sizes in the regular use of individualised instruction in reading were small. Overall, teachers' responsiveness to individual students' needs increased in 11 countries with at least small effect sizes, while student perception of teachers' willingness to help increased in four. Regular use of individualised instruction increased with at least small effect sizes in 13 education systems and decreased in five.

Figure 7.16 Teachers meeting individual students' needs in secondary education

Percentage of 15 year-old students in schools where the principal reports that learning is not at all hindered, or hindered very little, by teachers not meeting individual students' needs and change over time



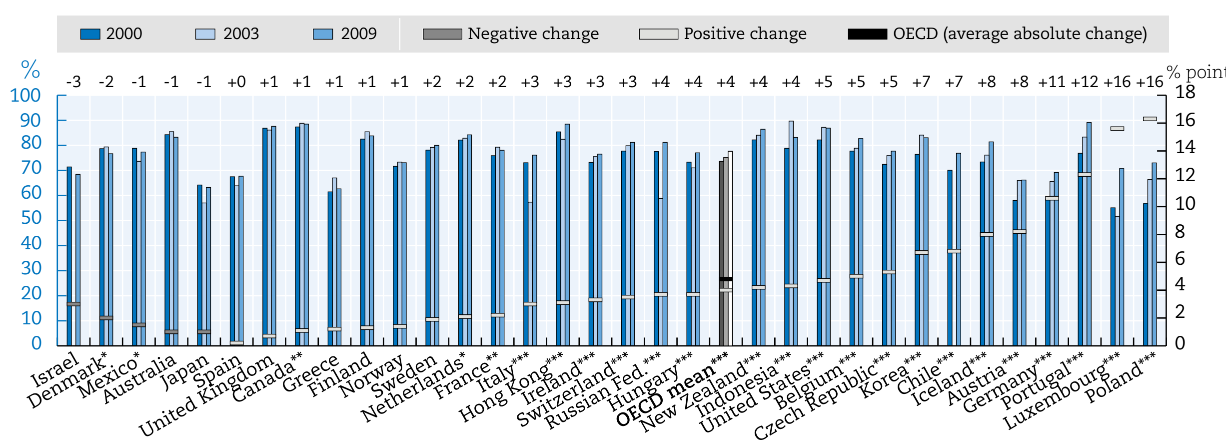
StatLink http://dx.doi.org/10.1787/888933083867

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PISA (2000, 2003 and 2009)

Figure 7.17 Student perception of teacher willingness to help them individually in secondary education

Percentage of 15 year-old students who agree or strongly agree that if they need extra help, they will receive it from their teachers and change over time



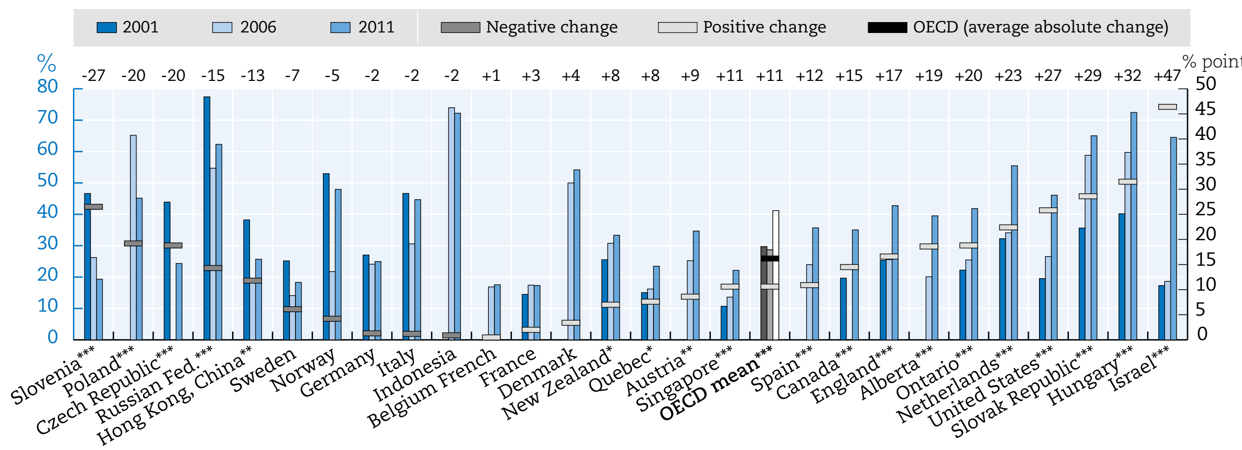
StatLink http://dx.doi.org/10.1787/888933083886

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PISA (2000, 2003 and 2009)

Figure 7.18 **4th grade students receiving individualised instruction in reading, according to teachers**

Percentage of students whose teachers always or almost always use individualised instruction for reading and change over time



StatLink http://dx.doi.org/10.1787/888933083905

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2006 and 2011 instead of 2001 and 2011 for Austria, Belgium French, Canada (Alberta), Denmark, Indonesia, Poland and Spain. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PIRLS (2001, 2006 and 2011)

Box 7.7 **Data source details for Figures 7.16 to 7.18**

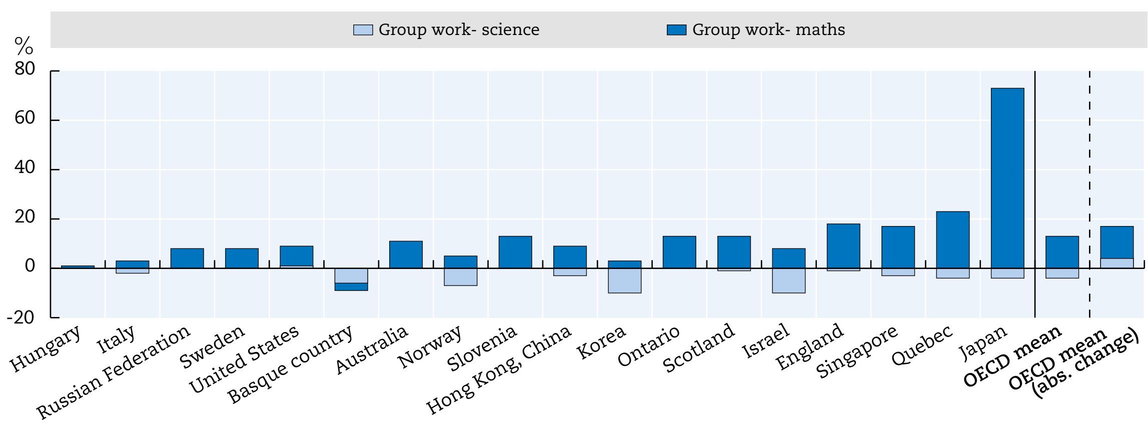
PISA (2000, 2003 and 2009) surveys asked secondary principals "In your school, to what extent is the learning of students hindered by the following phenomenon? […] e) Teachers not meeting individual students' needs" with answer options "Not at all; Very little; To some extent; A lot". They also asked secondary students: "How much do you disagree or agree with each of the following statements about teachers at your school? […] d) If I need extra help, I will receive it from my teachers" with answer options "Strongly disagree; Disagree; Agree; Strongly agree".

PIRLS (2001, 2006 and 2011) surveys asked 4th grade teachers: "When you have reading instruction and/or do reading activities, how often do you organize students in the following ways? […] d) I use individualized instruction for reading" with answer options "Always or almost always; Often; Sometimes; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

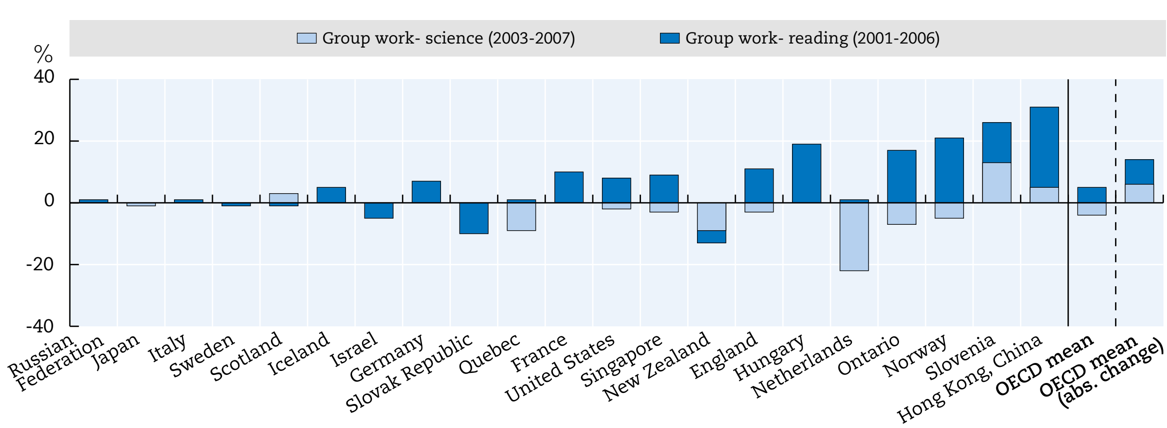
Innovation or significant change in instructional practices has been illustrated through an increase in the extent of student self-directed work across disciplines and educational levels between the analysed time frames. Similarly, innovation in instructional practices in relation to students working in small groups resulted in an increase across levels in mathematics and reading and a decrease in science.

Figure 7.19 **Change in 8th grade students working in small groups, according to students**



StatLink http://dx.doi.org/10.1787/888933083924

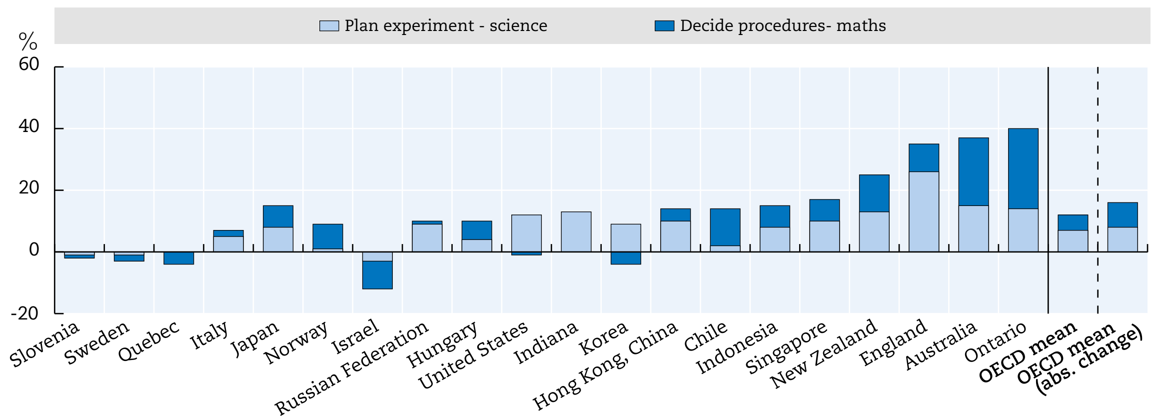
Figure 7.20 **Change in 4th grade students working in small groups, according to students**



StatLink http://dx.doi.org/10.1787/888933083943

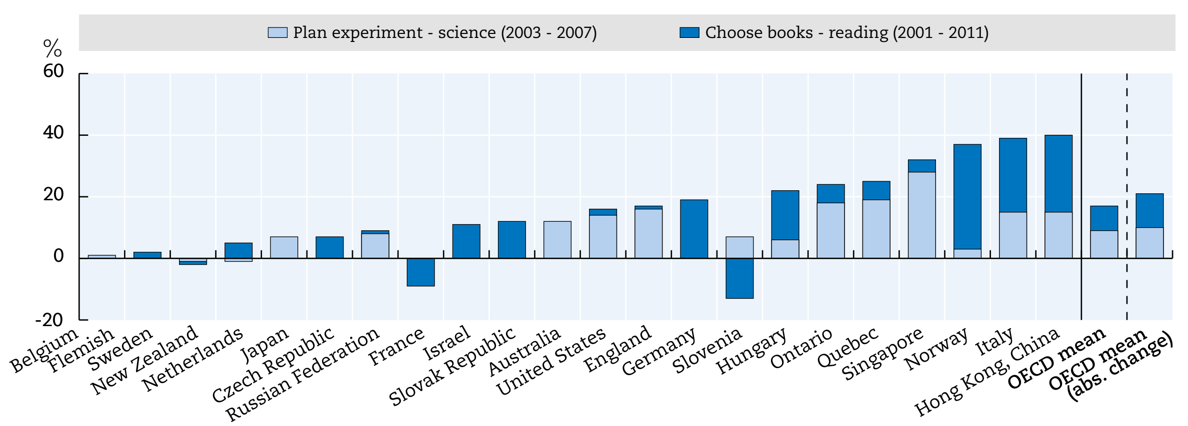
Notes : For details please see Figure 7.1, 7.2, 7.3 and 7.4

Figure 7.21 **Change in 8th grade students being asked to decide and design procedures**



StatLink http://dx.doi.org/10.1787/888933083962

Figure 7.22 **Change in 4th grade students being asked to decide and design procedures**



StatLink http://dx.doi.org/10.1787/888933083981

Notes : For details please see Figure 7.8, 7.10, 7.12 and 7.14

Note on Israel

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.

Table 7.1. Effect sizes for changes in the use of grouping, self-directed work and individualisation in classrooms

	Group work				In-class ability grouping			Change in students' self-directed work								Individualisation		
	8th grade		4th grade grade		8th grade	4th grade		8th grade				4th grade				8th grade		4th grade
	Mathematics	Science	Reading	Science	School policy	Reading same ability groups	Reading mixed ability groups	Decide procedures in maths	Decide procedures in maths (student resp.)	Design and plan experiments in science	Design and plan experiments in science (student resp.)	Design and plan experiments in science	Design and plan experiments in science (student resp.)	Choose books to read	Choose book to read (student resp.)	Teachers meeting individual needs	Perception of willingness to help	Use of individualised instruction in reading
	03-07	03-07	01-06	03-07	06-09	01-11	01-11	03-11	03-07	03-11	03-07	03-11	03-07	01-11	01-11	00-09	00-09	01-11
Australia	0.26	0.00	m	-0.14	0.01	m	m	0.47	-0.11	0.33	0.06	0.26	-0.17	m	m	0.06	-0.03	m
Austria	m	m	m	m	-0.05	m	m	m	m	m	m	m	m	m	m	-0.09	0.17	m
Belgium	m	m	m	m	-0.04	m	m	m	m	m	m	m	m	m	m	0.08	0.13	m
Belgium Flemish	m	m	m	m	m	m	m	m	m	m	m	0.08	m	m	m	m	m	m
Canada	m	m	m	m	0.05	-0.04	0.07	m	m	m	m	m	m	0.30	m	-0.05	0.03	0.35
Ontario	0.29	0.00	0.36	-0.16	m	-0.05	0.07	0.54	-0.14	0.34	0.01	0.43	-0.30	0.29	0.14	m	m	0.43
Quebec	0.47	-0.08	0.02	-0.19	m	0.05	0.08	-0.07	-0.29	-0.01	0.04	0.43	0.07	0.25	0.08	m	m	0.21
Chile	m	m	m	m	0.09	m	m	0.31	m	0.05	m	m	m	m	m	-0.02	0.15	m
Czech Republic	m	m	m	m	0.01	-0.16	-1.71	m	m	m	m	m	m	0.15	-0.59	-0.04	0.12	-0.42
Denmark	m	m	m	m	0.78	m	m	m	m	m	m	m	m	m	m	-0.10	-0.05	m
Estonia	m	m	m	m	0.07	m	m	m	m	m	m	m	m	m	m	m	m	m
Finland	m	m	m	m	-0.11	m	m	m	m	m	m	m	m	m	m	0.02	0.03	m
France	m	m	0.28	m	m	-0.15	-0.13	m	m	m	m	m	m	-0.20	-0.14	m	0.05	0.08
Germany	m	m	0.15	m	-0.16	0.10	0.24	m	m	m	m	m	m	0.38	-0.28	0.15	0.22	-0.05
Greece	m	m	m	m	0.69	m	m	m	m	m	m	m	m	m	m	0.78	0.02	m
Hungary	0.03	m	0.41	0.00	0.09	-0.20	0.30	0.14	-0.17	0.14	m	0.30	-0.12	0.35	0.01	0.45	0.09	0.66
Iceland	m	m	0.12	m	0.15	m	m	m	m	m	m	m	m	m	m	-0.02	0.19	m
Ireland	m	m	m	m	0.30	m	m	m	m	m	m	m	m	m	m	0.12	0.08	m
Israel	0.18	-0.19	-0.11	m	0.16	0.23	-0.05	-0.20	-0.23	-0.06	-0.16	m	m	0.30	-0.04	0.14	-0.06	1.01
Italy	0.11	-0.05	0.02	0.00	-0.11	-0.29	-0.07	0.05	0.00	0.16	-0.13	0.32	-0.05	0.52	-0.08	-0.10	0.07	-0.04
Japan	1.64	-0.08	m	-0.03	-0.19	m	m	0.16	-0.32	0.17	-0.12	0.14	-0.42	m	m	-0.19	-0.02	m
Korea	0.07	-0.22	m	m	m	m	m	-0.09	-0.20	0.22	0.17	m	m	m	m	m	0.17	m
Luxembourg	m	m	m	m	-0.25	m	m	m	m	m	m	m	m	m	m	0.28	0.33	m
Mexico	m	m	m	m	0.21	m	m	m	m	m	m	m	m	m	m	-0.01	-0.04	m
Netherlands	m	m	0.01	-0.47	0.19	0.29	-0.12	m	m	m	m	-0.06	-0.96	0.26	0.19	-0.09	0.06	0.47
New Zealand	m	m	-0.10	-0.19	0.00	0.27	0.06	0.24	m	0.30	m	-0.03	-0.13	-0.08	-0.03	-0.15	0.12	0.17
Norway	0.13	-0.13	0.42	-0.09	-0.58	0.25	-0.13	0.16	-0.07	0.02	-0.06	0.12	-0.16	0.88	0.38	0.40	0.03	-0.10
Poland	m	m	m	m	0.07	m	m	m	m	m	m	m	m	m	m	0.34	0.34	m
Portugal	m	m	m	m	0.41	m	m	m	m	m	m	m	m	m	m	0.52	0.33	m
Slovak Republic	m	m	-0.21	m	m	0.12	-0.13	m	m	m	m	m	m	0.26	-0.35	m	m	0.60
Slovenia	0.36	m	0.26	0.30	-0.11	0.17	0.10	-0.01	0.28	-0.03	m	0.17	0.25	-0.28	-0.32	m	m	-0.59
Spain	m	m	m	m	0.36	m	m	m	m	m	m	m	m	m	m	0.40	0.00	m
Basque country	-0.08	-0.13	m	m	m	m	m	m	-0.22	m	-0.25	m	m	m	m	m	m	m
Sweden	0.22	m	-0.03	m	0.13	-0.17	-0.03	-0.04	-0.03	-0.03	m	m	m	0.11	0.14	0.04	0.05	-0.17
Switzerland	m	m	m	m	0.17	m	m	m	m	m	m	m	m	m	m	0.10	0.09	m
Turkey	m	m	m	m	-0.05	m	m	m	m	m	m	m	m	m	m	m	m	m
United Kingdom	m	m	m	m	0.11	m	m	m	m	m	m	m	m	m	m	0.31	0.02	m
England	0.40	-0.03	0.25	-0.06	m	0.25	-0.03	0.17	-0.14	0.63	-0.07	0.32	-0.05	0.05	0.03	m	m	0.37

Table 7.1. Effect sizes for changes in the use of grouping, self-directed work and individualisation in classrooms (continued)

	Group work				In-class ability grouping			Change in students' self-directed work								Individualisation		
	8th grade		4th grade grade		8th grade	4th grade		8th grade				4th grade				8th grade		4th grade
	Mathematics	Science	Reading	Science	School policy	Reading same ability groups	Reading mixed ability groups	Decide procedures in maths	Decide procedures in maths (student resp.)	Design and plan experiments in science	Design and plan experiments in science (student resp.)	Design and plan experiments in science	Design and plan experiments in science (student resp.)	Choose books to read	Choose book to read (student resp.)	Teachers meeting individual needs	Perception of willingness to help	Use of individualised instruction in reading
	03-07	03-07	01-06	03-07	06-09	01-11	01-11	03-11	03-07	03-11	03-07	03-11	03-07	01-11	01-11	00-09	00-09	01-11
Scotland	0.36	-0.03	-0.02	0.07	m	m	m	m	-0.11	m	0.15	m	-0.19	m	m	m	m	m
United States	0.16	0.03	0.19	-0.05	-0.16	0.10	0.11	-0.02	-0.14	0.25	0.06	0.31	0.02	0.11	-0.02	0.26	0.13	0.58
Indiana	m	m	m	m	m	m	m	0.00	m	0.29	m	m	m	m	m	m	m	m
OECD (average)	0.31	-0.08	0.12	-0.08	0.08	0.06	0.02	0.10	-0.13	0.16	-0.02	0.23	-0.17	0.21	-0.02	0.14	0.10	0.24
OECD (av. absolute)	0.32	0.08	0.17	0.13	0.19	0.18	0.11	0.16	0.16	0.18	0.11	0.24	0.22	0.29	0.15	0.11	0.20	0.37
Hong Kong, China	0.27	-0.08	0.52	0.12	m	0.01	0.15	0.07	-0.02	0.26	0.13	0.52	-0.02	0.52	0.02	m	0.09	-0.27
Indonesia	0.34	m	m	m	0.83	m	m	0.15	m	0.18	m	m	m	m	m	0.63	0.11	m
Russian Federation	0.23	m	0.02	m	0.15	0.04	-0.29	0.02	0.05	0.25	m	0.25	m	0.02	-0.28	0.37	0.09	-0.33
Singapore	0.40	-0.06	0.18	-0.05	m	0.23	0.08	0.15	-0.01	0.32	0.13	0.68	-0.05	0.13	-0.04	m	m	0.31
South Africa	m	m	m	m	m	m	m	0.28	m	-0.06	m	m	m	m	m	m	m	m

StatLink http://dx.doi.org/10.1787/888933084000

Notes: OECD average includes all OECD education systems for which data is available for all years concerned
= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011), PIRLS (2001, 2006 and 2011) and PISA (2000, 2006 and 2009).

CHAPTER 8

Innovation in the use of textbooks in classrooms

Innovation in the classroom can also incorporate different approaches to the use of textbooks as instructional material. Teachers may choose to make more or less use of textbooks either as a basis for instruction or as supplementary tools. The aim of innovation with regard to the use of textbooks could be, for example, to align classroom curriculum with standards through a stricter or a more lenient adherence with textbook contents, while reduced use of textbooks could reflect an intention to introduce alternative sources such as Open Educational Resources, or to champion more active pedagogies.

Use of textbooks as primary resources

General findings

Innovation in the classroom has been illustrated through an increased use of textbooks as a basis for instruction during mathematics and science classes in secondary education (Figure 8.1 and Figure 8.2). Between 2003 and 2011 the average absolute change within the OECD area regarding the use of textbooks as a basis for instruction amounted to 15% points in both 8th grade mathematics and science. Turkey (42% points), Israel (40% points), South Africa (37% points), Slovenia (35% points), Italy (34% points), Indonesia (21% points), and Chile (19% points) are countries registering the largest increases in the use of textbooks as primary resources for mathematics instruction. Likewise, textbooks were employed considerably more extensively as a basis for science instruction in Indonesia (75% points), Turkey (37% points), Sweden (35% points), South Africa (31% points), Israel (29% points) and Slovenia (25% points). These changes were characterised by large and medium effect sizes, while the OECD average and average absolute changes presented small effect sizes in 8th grade mathematics and science . Overall and with at least small effect sizes, textbooks were used more widely as a basis for mathematics instruction in ten education systems and less widely in four, while they were used more widely for science instruction in 14 countries and less in three, with at least small effect sizes.

Classroom innovation regarding the use of textbooks as a basis for instruction in primary education showed slightly more variation than those characterising secondary education (Figure 8.3 to Figure 8.5). The OECD average absolute change regarding use of textbooks as primary resources for instruction was 14% points in 4th grade science and 13% points in 4th grade mathematics, between 2003 and 2011. It amounted to 8% points in the case of 4th grade reading instruction, although within a shorter time period – from 2001 to 2006. Slovenia (63% points), Italy (38% points), Austria (32% points), Norway (30% points), the Slovak Republic (30% points) and the Czech Republic (25% points) were the leading education systems in terms of an increase in the use of textbooks as a basis for science instruction. Similarly, textbooks were used more widely as a basis for mathematics instruction in Italy (34% points), the Slovak Republic (32% points) and Slovenia (32% points); while opposite was true in Flanders (46% points). The Netherlands (43%) stood out as the country that used textbooks more widely as a basis for reading instruction in the 4th grade. These education system changes presented from medium to large effect sizes; while the OECD average absolute change effect sizes across all subjects were small and both average and average absolute change effect sizes were small for science. Altogether, textbooks were used more as primary science instruction resources in 12 education systems and less in one, with at least small effect sizes, while in the case of mathematics instruction textbooks were more widely used in eight countries and less in five. As for reading instruction, the number of countries (three) exhibiting an increase in textbook use equalised that of those countries diminishing use, with at least small effect sizes.

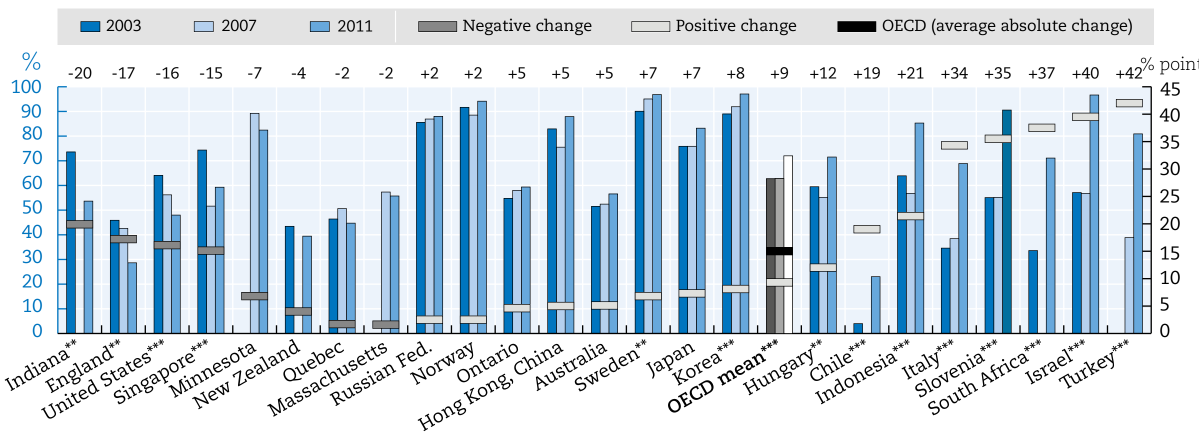
Country specificities

Innovation in Italy and Slovenia is indicated through a comprehensive increase in the use of textbooks as a basis for instruction across disciplines and levels. In Slovenia, for example, textbooks were used more widely as primary resources for mathematics, science and reading instruction both in 8th and 4th grade, with at least small effect size.

In contrast, innovation in England manifested through a lower use of textbooks as a basis for instruction across disciplines and levels. English teachers used textbooks less as a basis for mathematics, science and reading instruction in 2011 than in 2003 in both primary and secondary education, with small effect sizes.

Figure 8.1 **Textbooks as a primary resource for 8th grade mathematics instruction**

Percentage of students whose teachers use textbooks as a basis for instruction and change over time



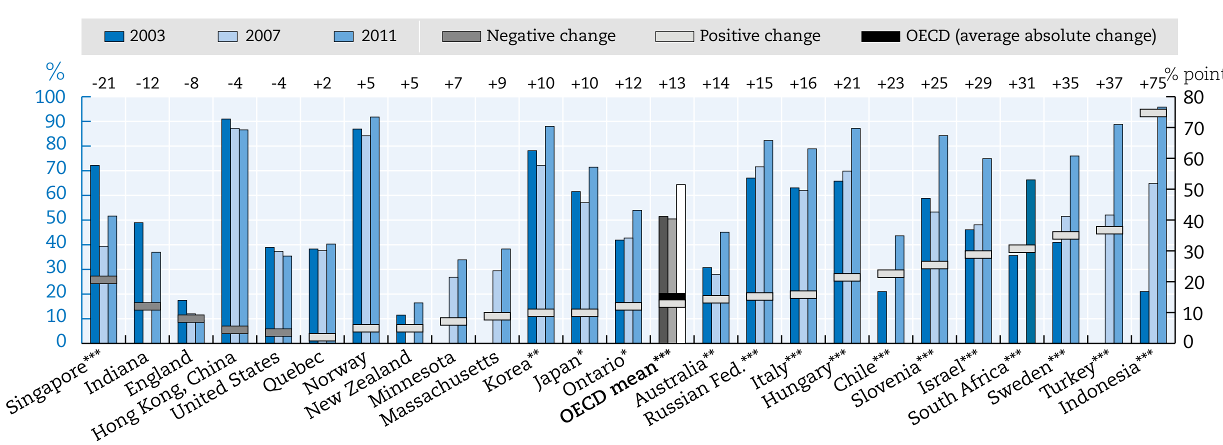
StatLink http://dx.doi.org/10.1787/888933084019

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 8.2 **Textbooks as a primary resource for 8th grade science instruction**

Percentage of students whose teachers use textbooks as a basis for instruction and change over time



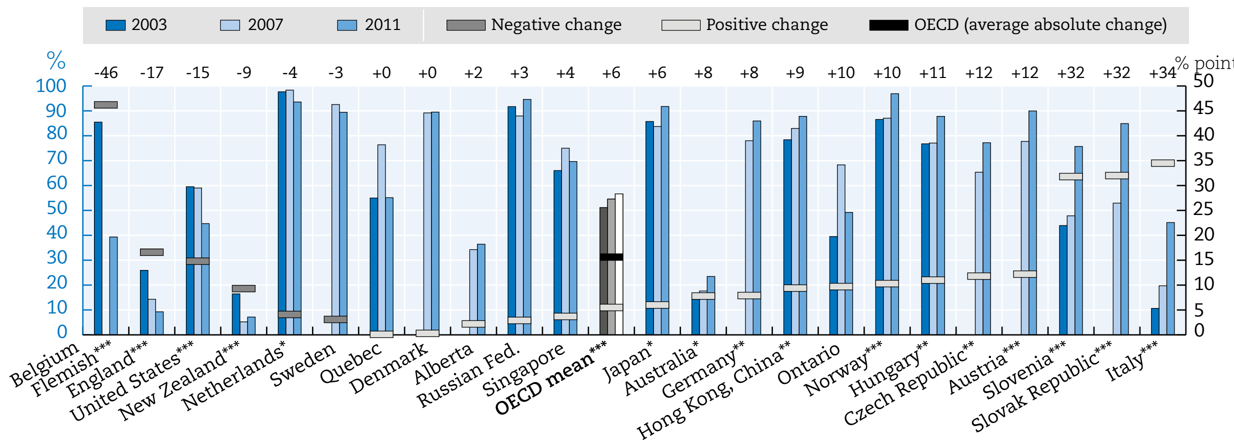
StatLink http://dx.doi.org/10.1787/888933084038

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 8.3 Textbooks as a primary resource for 4th grade mathematics instruction

Percentage of students whose teachers use textbooks as a basis for instruction and change over time



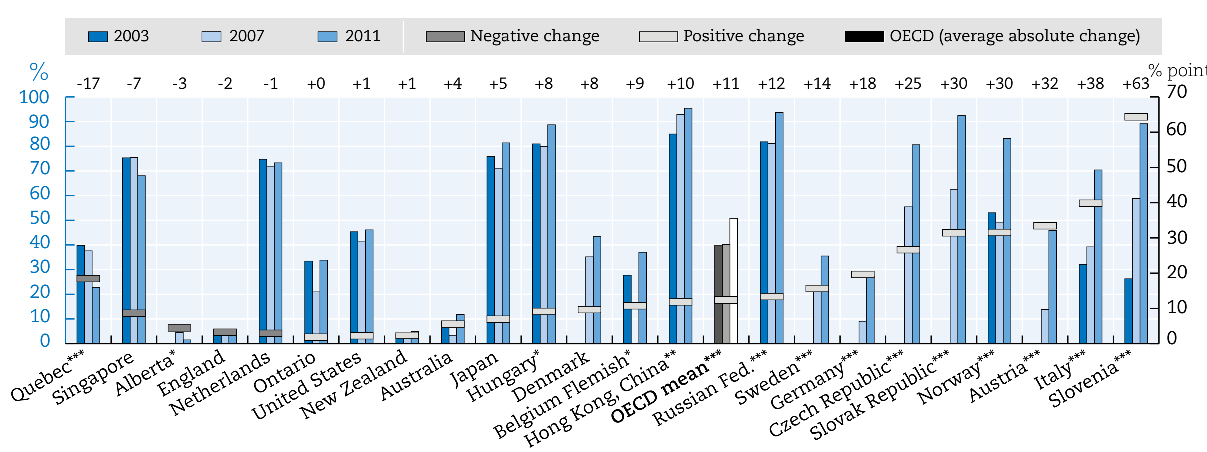
StatLink http://dx.doi.org/10.1787/888933084057

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 8.4 Textbooks as a primary resource for 4th grade science instruction

Percentage of students whose teachers use textbooks as a basis for instruction and change over time



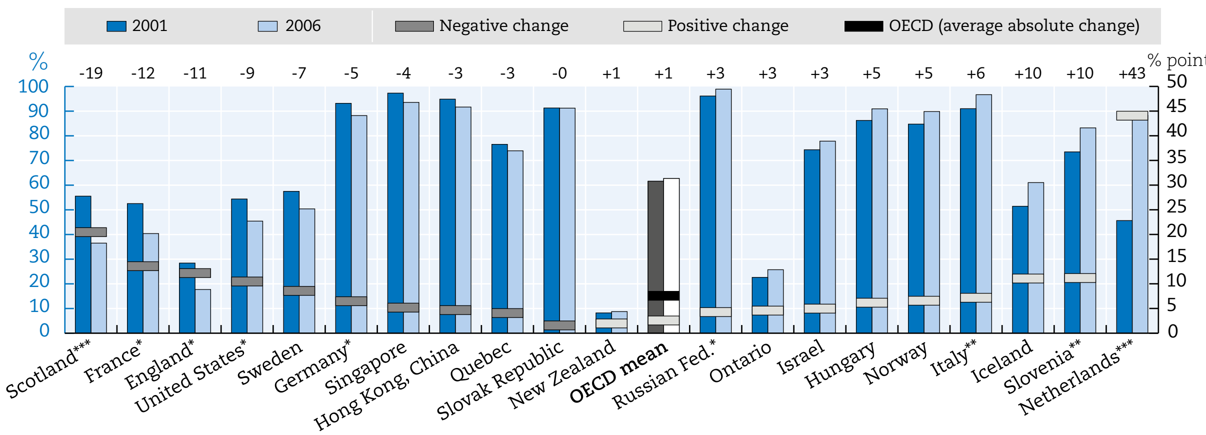
StatLink http://dx.doi.org/10.1787/888933084076

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 8.5 **Textbooks as a primary resource for 4th grade reading instruction**

Percentage of students whose teachers use textbooks as a basis for instruction and change over time



StatLink http://dx.doi.org/10.1787/888933084095

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PIRLS (2001 and 2006)

Box 8.1 **Data source details for Chapter 8**

TIMSS (2003, 2007 and 2011) surveys asked 4th and 8th grade teachers "When you teach mathematics/science to this class, how do you use the following resources? [...] a) textbooks" with answer options "Basis for instruction; Supplement; Not used". PIRLS (2001 and 2006) survey asked 4th grade teachers: "When you have reading instruction and/or do reading activities with the students, how often do you use the following resources? [...] a) textbooks" with answer options "Every day or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Use of textbooks as supplementary resources

General findings

Innovation in classrooms was exemplified also by a reduction in the use of textbooks as supplementary resources for instruction in secondary education (Figure 8.6 and Figure 8.7). At the OECD level, average absolute change regarding the use of textbooks as supplementary resources for mathematics and science instruction amounted to 13% points between 2003 and 2011. Textbook use as a supplementary resource for mathematics instruction diminished strikingly in Israel (38% points), Turkey (36% points), Slovenia (35% points), South Africa (33% points), Italy (31% points) and Indonesia (22% points). As for science instruction, textbooks were used significantly less as supplementary resources in Turkey (34% points), Sweden (33% points), Israel (28% points), South Africa (28% points) Slovenia (26% points), Hungary (22% points) and Indonesia (20% points). These country changes presented large and medium effect sizes; while the OECD average and average absolute change effect sizes weresmall for textbook use as a supplementary resource for mathematics and science instruction. Overall, textbooks were used more as supplementary resources for mathematics instruction in three education systems and less in ten, with at least small effect sizes, while in the case of science instruction textbooks were more widely used in two countries and less in 11.

In comparison with secondary education, innovation resulted in some reduction in textbook use as a supplementary resource in primary education instruction (Figure 8.8 and Figure 8.9). The average absolute change at OECD level in the use of textbooks as supplements for both mathematics and science instruction was 11% points in the period from 2003 to 2011. The Slovak Republic (33% points), Slovenia (31% points), and Italy (25% points) exhibited the largest decrease in the use of textbooks to supplement mathematics instruction, whereas the opposite was true in the Flanders (24% points). Textbooks were used significantly less as supplements to science instruction in Slovenia (46% points), Italy (33% points), the Slovak Republic (30% points), the Czech Republic (27% points) and Norway (25% points), whereas New Zealand (29% points) and Quebec (23% points) showed an increase in supplementary use of textbooks in science classes. These education system changes exhibited large and medium effect sizes, while the OECD average absolute change effect size was small. Altogether, textbooks were used more widely as a supplement for mathematics instruction in three education systems and less widely in ten, while their use as a supplement for science instruction increased in five countries and decreased in 11, with at least small effect sizes.

Country specificities

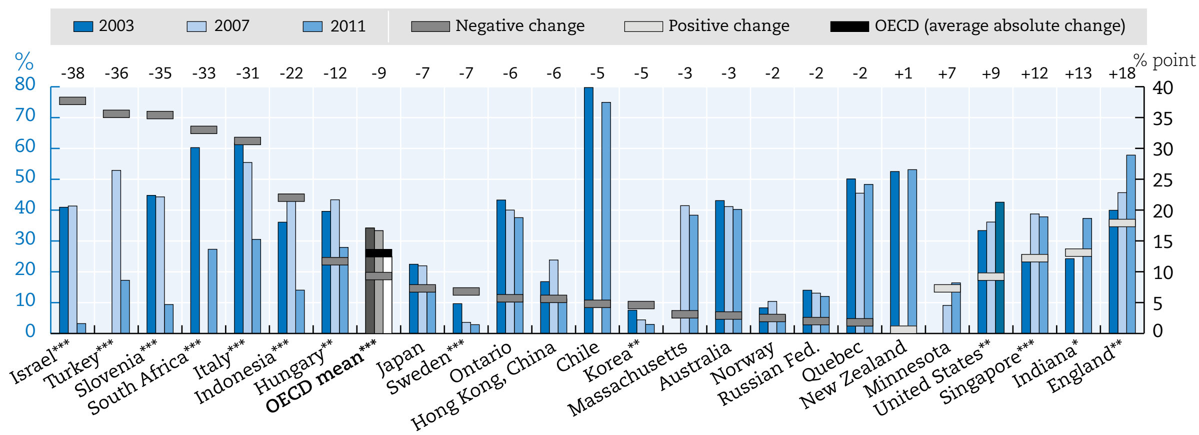
Innovation regarding supplementary use of textbooks in the United States and Singapore is indicated through a significant increase across disciplines in primary and secondary education. In the United States, for example, teachers used textbooks as supplementary instruction tools for both 4th grade mathematics and science classes between 2003 and 2011, with small effect sizes.

Italy and Slovenia, on the contrary stood out as countries where innovation exemplified in a lower use of textbooks for supplementary instruction across disciplines and levels. Italian teachers used textbooks significantly less as supplementary resources for mathematics and science instruction in 4th and 8th grade between 2003 and 2011, with at least small effect sizes.

The direction of innovation concerning textbook use was not consistent across disciplines and levels in England. English teachers used textbooks more widely as supplementary resources for 8th grade mathematics instruction and less for 4th grade science instruction between 2003 and 2011.

Figure 8.6 **Textbooks as a supplementary resource for 8th grade mathematics instruction**

Percentage of students whose teachers use textbooks as a supplementary resource and change over time



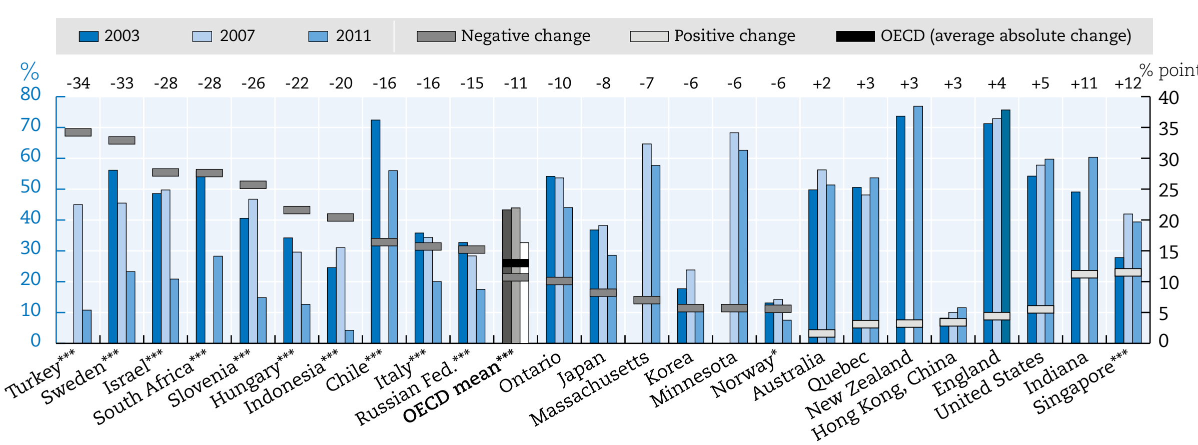
StatLink http://dx.doi.org/10.1787/888933084114

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 8.7 **Textbooks as a supplementary resource for 8th grade science instruction**

Percentage of students whose teachers use textbooks as a supplementary resource and change over time



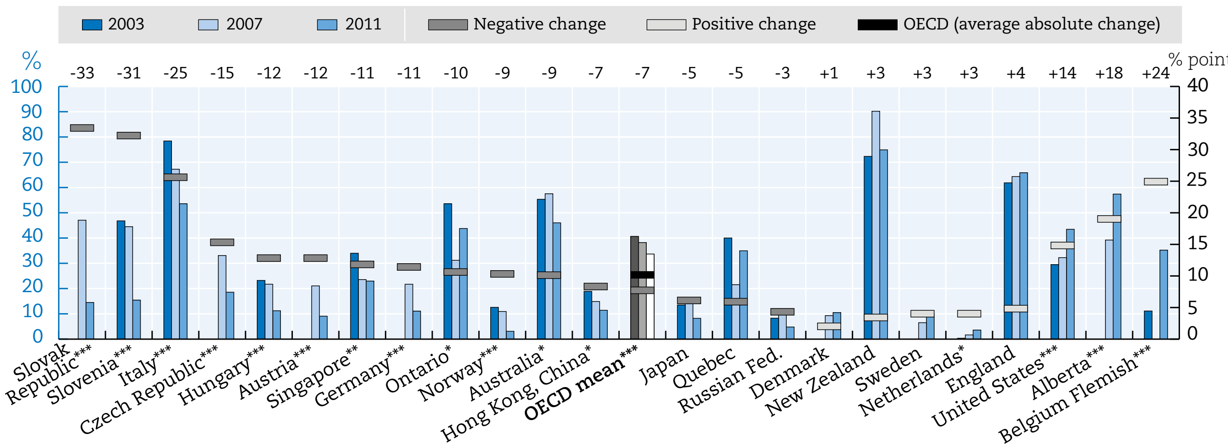
StatLink http://dx.doi.org/10.1787/888933084133

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 8.8 **Textbooks as a supplementary resource for 4th grade mathematics instruction**

Percentage of students whose teachers use textbooks as a supplementary resource and change over time



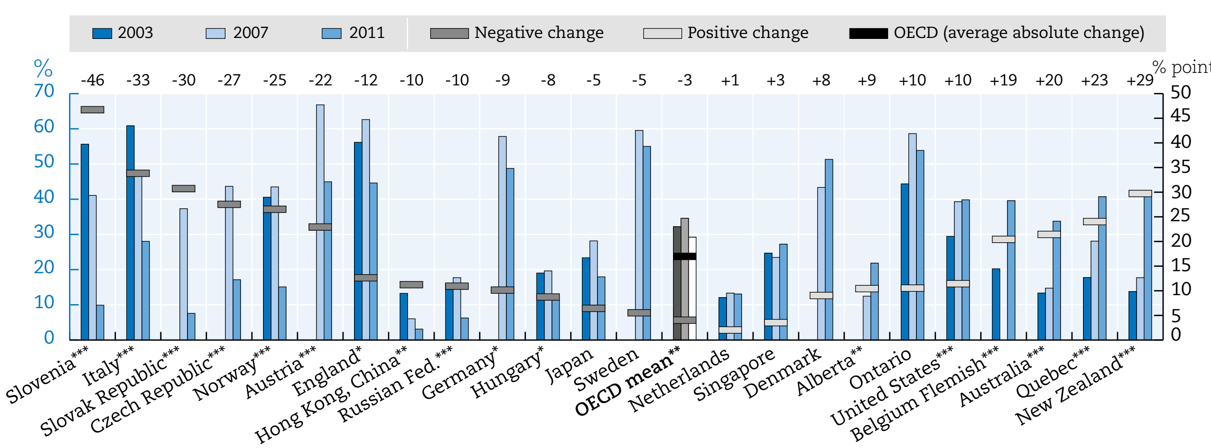
StatLink http://dx.doi.org/10.1787/888933084152

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 8.9 **Textbooks as a supplementary resource for 4th grade science instruction**

Percentage of students whose teachers use textbooks as a supplementary resource and change over time



StatLink http://dx.doi.org/10.1787/888933084171

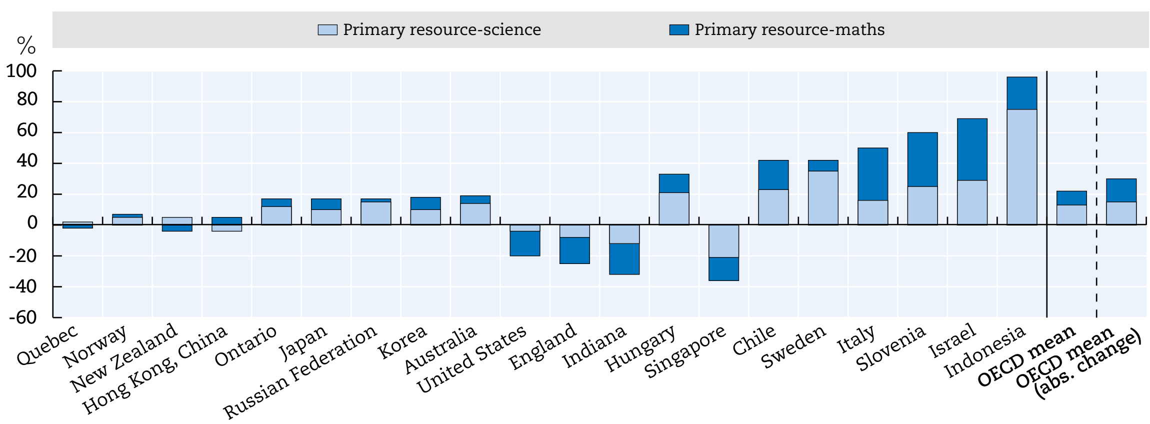
Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Summary

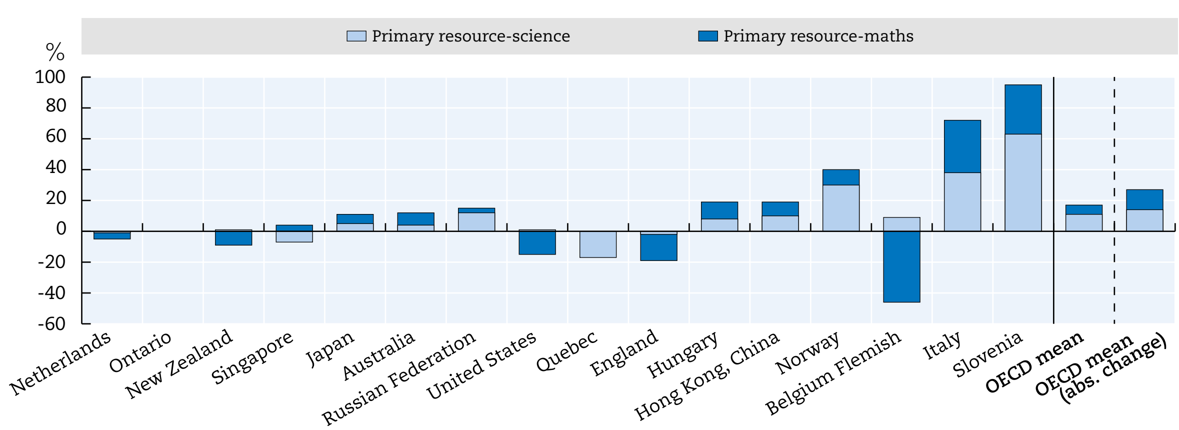
Innovation – or significant change – in the use of textbooks during lessons varied across countries and extent. Change between 2003 and 2011 in the OECD area is illustrated through a wider adoption of textbooks as a basis for instruction rather than as supplementary resources, both in primary and secondary education and consistently across disciplines.

Figure 8.10 **Change in the use of textbooks as a primary resource for 8th grade instruction**



StatLink http://dx.doi.org/10.1787/888933084190

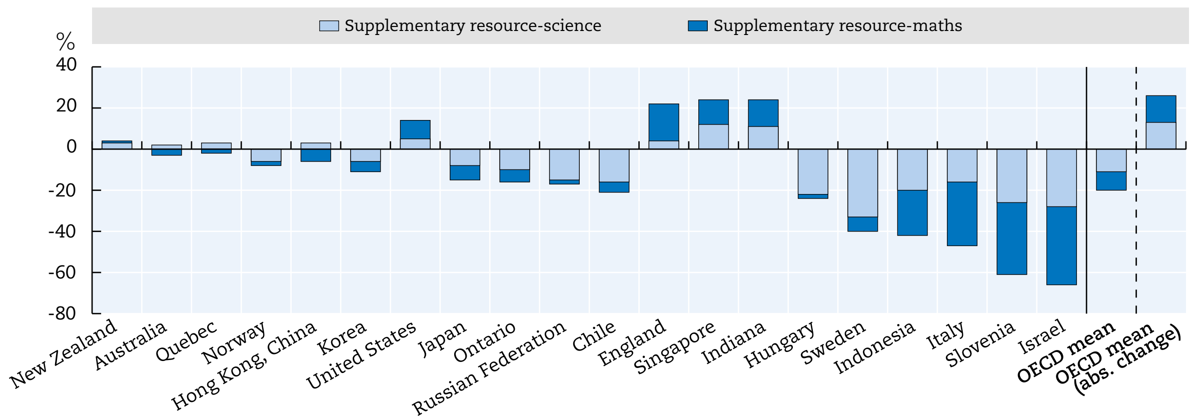
Figure 8.11 **Change in the use of textbooks as a primary resource for 4h grade instruction**



StatLink http://dx.doi.org/10.1787/888933084209

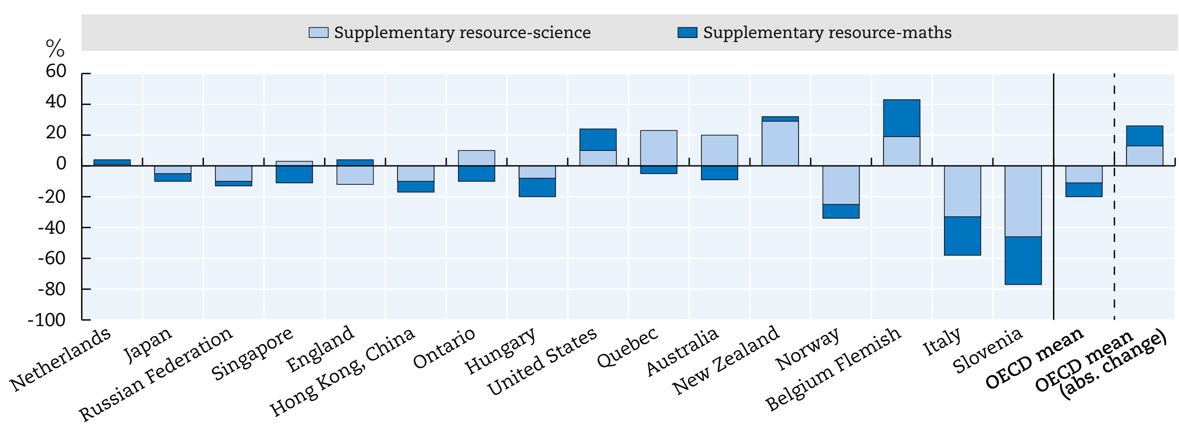
Notes : For details, please see Figures 8.1, 8.2, 8.3 and 8.4.

Figure 8.12 **Change in the use of textbooks as a supplementary resource for 8th grade instruction**



StatLink http://dx.doi.org/10.1787/888933084228

Figure 8.13 **Change in the use of textbooks as a supplementary resource for 4th grade instruction**



StatLink http://dx.doi.org/10.1787/888933084247

Notes : OECD average includes all OECD education systems. For details, please see Figures 8.5, 8.6, 8.7 and 8.8.

Note on Israel

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.

Table 8.1. **Effect sizes for changes in the use of textbooks**

	As primary resource for instruction					As supplementary resource for instruction			
	8th grade		4th grade			8th grade		4th grade	
	Mathematics	Science	Mathematics	Science	Reading	Mathematics	Science	Mathematics	Science
	03-11	03-11	03-11	03-11	01-06	03-11	03-11	03-11	03-11
Australia	0.10	0.30	0.20	0.14	m	-0.06	0.03	-0.19	0.49
Belgium Flemish	m	m	-1.00	0.20	m	m	m	0.59	0.43
Ontario	0.09	0.24	0.20	0.01	0.07	-0.12	-0.20	-0.20	0.19
Quebec	-0.03	0.04	0.00	-0.37	-0.06	-0.04	0.06	-0.10	0.51
Chile	0.60	0.49	m	m	m	-0.12	-0.34	m	m
France	m	m	m	m	-0.24	m	m	m	m
Germany	m	m	m	m	-0.17	m	m	m	m
Hungary	0.25	0.52	0.29	0.22	0.15	-0.25	-0.52	-0.32	-0.22
Iceland	m	m	m	m	0.19	m	m	m	m
Israel	1.06	0.60	m	m	0.08	-1.03	-0.59	m	m
Italy	0.70	0.35	0.81	0.79	0.24	-0.64	-0.35	-0.53	-0.67
Japan	0.18	0.21	0.19	0.13	m	-0.19	-0.18	-0.17	-0.13
Korea	0.33	0.27	m	m	m	-0.21	-0.16	m	m
Netherlands	m	m	-0.21	-0.03	0.96	m	m	0.26	0.03
New Zealand	-0.08	0.14	-0.29	0.05	0.02	0.01	0.08	0.06	0.66
Norway	0.10	0.16	0.40	0.66	0.15	-0.10	-0.19	-0.37	-0.58
Slovak Republic	m	m	m	m	0.00	m	m	m	m
Slovenia	0.84	0.58	0.66	1.39	0.24	-0.84	-0.59	-0.70	-1.04
Sweden	0.28	0.73	m	m	-0.14	-0.29	-0.69	m	m
England	-0.36	-0.24	-0.45	-0.09	-0.26	0.36	0.10	0.08	-0.23
Scotland	m	m	m	m	-0.38	m	m	m	m
United States	-0.33	-0.07	-0.30	0.02	-0.18	0.19	0.11	0.29	0.22
Indiana	-0.42	-0.24	m	m	m	0.28	0.23	m	m
OECD (average)	0.25	0.28	0.13	0.24	0.04	-0.25	-0.24	-0.16	-0.06
OECD (average absolute)	0.36	0.33	0.33	0.32	0.21	0.33	0.29	0.27	0.42
Hong Kong, China	0.14	-0.14	0.25	0.36	-0.13	-0.16	0.11	-0.21	-0.39
Indonesia	0.50	1.78	m	m	m	-0.52	-0.62	m	m
Russian Federation	0.07	0.35	0.12	0.37	0.19	-0.06	-0.35	-0.14	-0.32
Singapore	-0.32	-0.43	0.08	-0.16	-0.18	0.26	0.25	-0.24	0.06
South Africa	0.77	0.62	m	m	m	-0.68	-0.57	m	m

StatLink http://dx.doi.org/10.1787/888933084266

Notes: OECD average includes all OECD education systems for which data is available for all years concerned
= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: TIMSS 2003, 2007 and 2011 and PIRLS 2001, 2006 and 2011.

CHAPTER 9

Innovation in the methods of assessment used in classrooms

Innovation in classrooms can include a change in the methods teachers use to assess the students over time. Teachers may innovate by administering different types of tests, as well as by evaluating students through their daily activities and outputs. The aim of innovation in this respect could be, for example, to change the type of assessment in order to better monitor student performance or to better address students' needs and identify potential solutions for improving their learning outcomes.

Test based assessment

General Findings

Innovation in classrooms has meant more or less use of different types of tests for assessing students (Figure 9.1 and Figure 9.2). The use of teacher-developed tests for 15-year-olds across the OECD has shown an average absolute change of 8% points between 2003 and 2009 of, while the use of standardised test registered an average absolute change of 3% points among OECD countries. In Turkey (23% points), teacher-developed tests were used considerably more widely in 2009 than in 2003, while schools in Hungary (24% points) used this method significantly less for assessment in 2009 than 2003. In the Netherlands (21% points) and Indonesia (16% points) schools significantly increased the use of standardised tests for student assessment. These country changes presented medium effect sizes. Overall, teacher-developed tests were used more frequently in 2009 than in 2003 in six countries, while the opposite was true for four countries, with at least small effect sizes. Similarly, use of standardised tests became more frequent in eight countries and less in three, with at least small effect sizes.

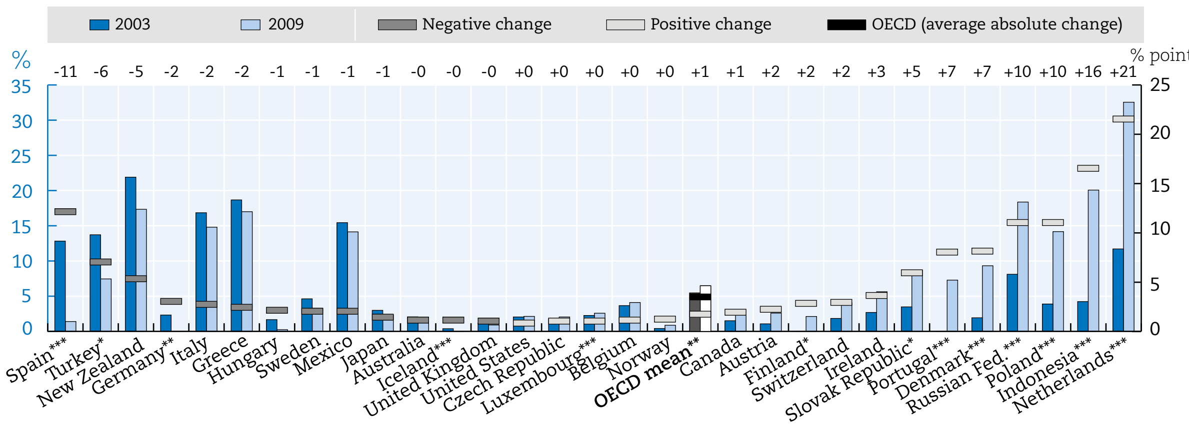
Country specificities

Poland, Denmark and the Russian Federation are countries where innovation is illustrated through an increase in the use of test based assessments. Danish schools, for example, tested their students more widely both through standardised and teacher-developed tests in 2009 than 2003 with small effect sizes.

Turkey illustrates the case of a country where the direction of innovation regarding use of test based assessment varied according to the approach under investigation. Between 2003 and 2009, Turkish schools used more teacher developed tests and less standardised test to assess their students, with small effect sizes.

Figure 9.1 **Use of standardised tests as an assessment method in classrooms**

Percentage of 15-year old students enrolled in schools where standardised tests are used for assessment at least monthly and change over time



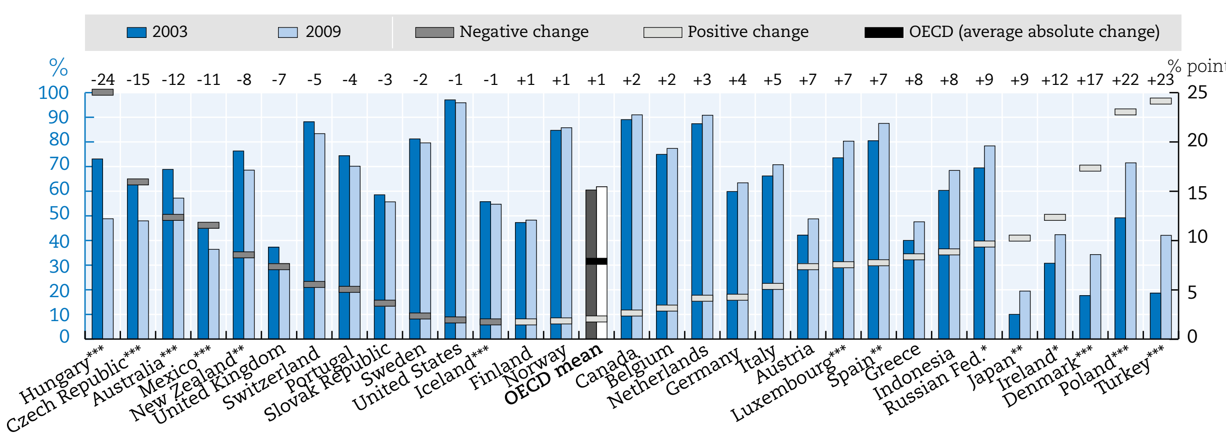
StatLink http://dx.doi.org/10.1787/888933084285

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2003 and 2009)

Figure 9.2 **Use of teacher-developed tests as an assessment method**

Percentage of 15-year old students enrolled in schools where teacher-developed tests are used for assessment at least monthly and change over time



StatLink http://dx.doi.org/10.1787/888933084304

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2003 and 2009)

Box 9.1 **Data source details for Chapter 9**

PISA (2003, 2009) surveys asked school principals "Generally, in your school, how often are students in <national modal grade for 15-year-olds> assessed using the following methods? […] ''Standardised tests",[…] ''Teacher developed tests", […] ''Teachers' judgmental ratings", […] ''Students' portfolio", […] ''Student assignments/ projects/homework ", with answer options ''Never; 1-2 times a year; 3-5 times a year; monthly; more than once a month". Same data restrictions as in PISA international surveys (2000, 2003, 2006, 2009) apply to these data.

Non-test based assessments

General Findings

Innovation in classroom assessment methods typically occurred as an increase in the use of non-test based teacher-guided assessments among OECD countries (Figure 9.3). Between 2003 and 2009 the OECD average absolute change regarding the use of teachers' judgmental ratings as tools for assessment amounted to 13% points. Poland (67% points), Finland (62% points) and Denmark (27% points) are countries where teachers' judgmental ratings use increased most, while teachers in the United States (25% points) used this method of assessment significantly less in 2009 than in 2003. These country changes presented from medium to large effect sizes, while the OECD average and average absolute effect sizes were small. Overall use of judgmental ratings as an assessment method increased in 12 education systems and decreased in two.

Innovation in the use of non-test based assessment also took the form of a more widespread evaluation of student outputs (Figure 9.4 and Figure 9.5). OECD average absolute change was 9% points for the use of students' portfolios for assessment, while it amounted to 8% points regarding the of students' assignments, projects or homework. Between 2003 and 2009, there was a noteable increase in the use of student portfolios as assessments in schools in Indonesia (by 40% points), Denmark (36% points) and Greece (29% points) and a decrease in this practice in Norway (29% points).

With regard to the frequency of use of student assignments, projects or homework for assessment, Hungary (38% points) stood out as a country showing the largest decrease. These country changes presented from medium to large effect sizes. Altogether, use of students' portfolios increased in seven countries and decreased in two with at least small effect sizes, while students' assignments were used more widely for assessment in eight countries and less in four.

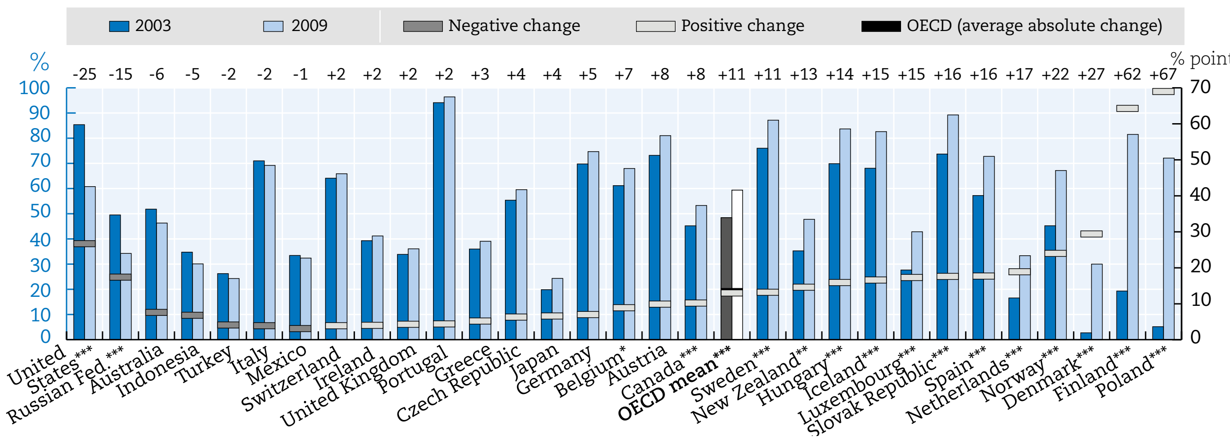
Country Specificities

Portugal and Greece are countries where innovation was exemplified in additional use of non-test based methods to assess students. In the period between 2003 and 2009, Portuguese and Greek schools assessed their students more by evaluating their portfolios and assignments, projects or homework with at least small effect sizes.

The cases of Luxembourg and Norway illustrate that innovation in non-test based assessment methods could occur as changes in both directions. Between 2003 and 2009, schools in Norway assessed their students more through teachers' judgmental ratings and less through students' portfolios, with at least small effect sizes.

Figure 9.3 **Use of teachers' judgmental ratings as an assessment method**

Percentage of 15-year olds assessed by teachers' judgmental ratings at least monthly and change over time



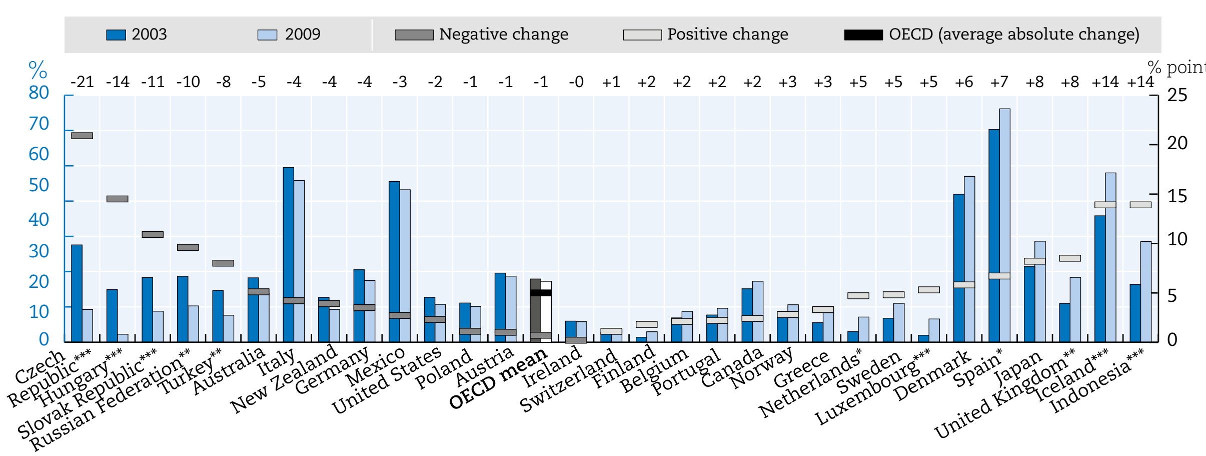
StatLink http://dx.doi.org/10.1787/888933084323

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2003 and 2009)

Figure 9.4 **Use of students' portfolio as an assessment method**

Percentage of 15-year old students enrolled in schools where students' portfolios are used for assessment at least monthly and change over time



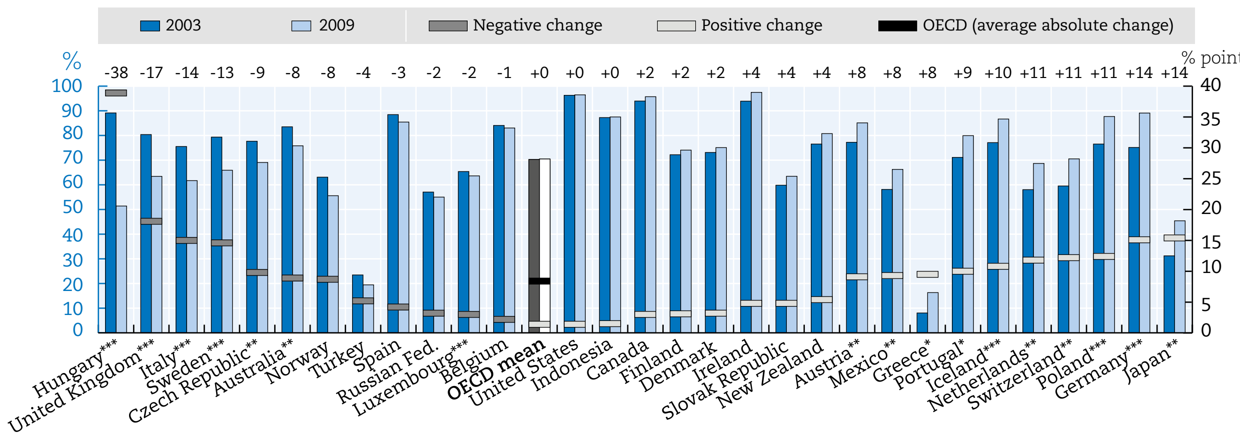
StatLink http://dx.doi.org/10.1787/888933084342

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2003 and 2009)

Figure 9.5 **Use of students' assignments/projects/homework as an assessment method**

Percentage of 15-year old students enrolled in schools where students' portfolios are used for assessment at least monthly and change over time



StatLink http://dx.doi.org/10.1787/888933084361

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

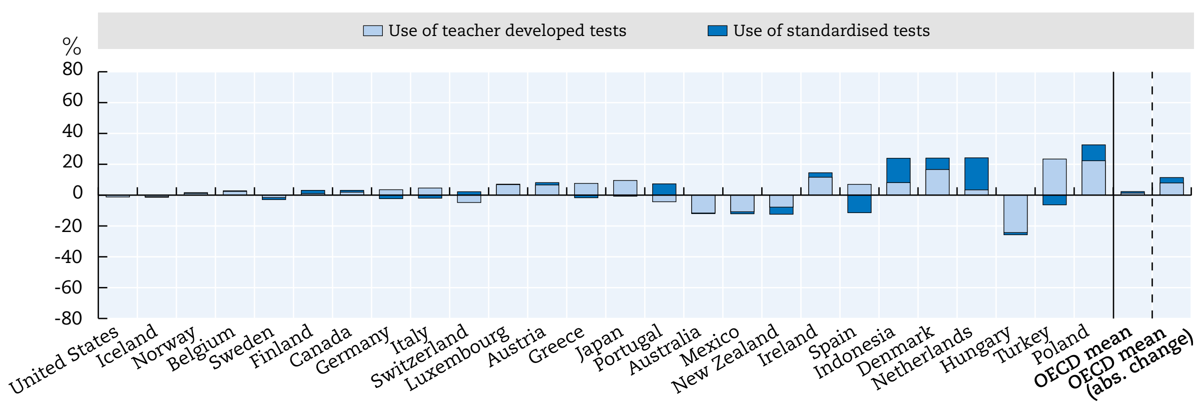
Source: Authors' calculations based on PISA (2003 and 2009)

Summary

Innovation – or significant change – regarding assessment methods has meant, with a few exceptions, a more frequent use of non-test based assessments in classroom between 2003 and 2009. Similarly, but to a lesser extent, use of test based assessment methods increased among OECD countries. Interestingly, these different types of assessment methods seemed to be regarded as complementary, with no significant substitution trends observed between test and non-test based assessments.

Figure 9.6 **Change in the use of test-based assessment methods in classrooms**

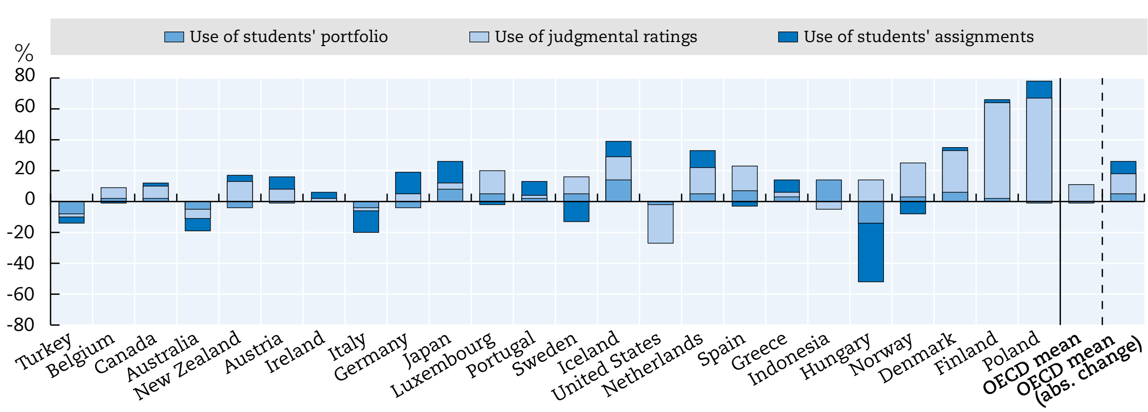
15-year old students enrolled in schools where different types of tests are used for assessment



StatLink http://dx.doi.org/10.1787/888933084380

Figure 9.7 **Change in the use of non-test-based assessment methods in classrooms**

15-year old students enrolled in schools where assessment occurs outside of a formal testing practice



StatLink http://dx.doi.org/10.1787/888933084399

Notes : For details, please see Figures 9.1,9. 2,9.3 and 9.4.

Table 9.1 Effect sizes for changes in assessment methods

	Use of test based assessments		Use of non-test based assessments		
	Use of standardized tests	Use of teacher-developed tests	Use of teachers' judgmental ratings	Use of students' portfolio	Use of students' assignements, projects and homework
	03-09	03-09	03-09	03-09	03-09
Australia	-0.03	-0.24	-0.11	0.13	-0,19
Austria	0.12	0.13	0.19	-0.02	0,20
Belgium	0.02	0.06	0.14	0.07	-0,03
Canada	0.09	0.06	0.16	0.06	0,08
Czech Republic	0.02	-0.31	0.09	-0.53	0,04
Denmark	0.34	0.38	0.83	0.12	0,04
Finland	0.29	0.02	1.34	0.12	0,26
Germany	-0.31	0.07	0.11	-0.09	-0,87
Greece	-0.04	0.15	0.06	0.12	0,25
Hungary	-0.16	-0.50	0.33	-0.53	0,18
Iceland	-0.12	-0.02	0.34	0.28	-0,30
Ireland	0.15	0.24	0.04	-0.01	0,29
Italy	-0.06	0.10	-0.04	-0.08	0,17
Japan	-0.04	0.27	0.11	0.18	0,22
Luxembourg	0.02	0.16	0.32	0.25	0,10
Mexico	-0.04	-0.22	-0.02	-0.05	-0,15
Netherlands	0.52	0.11	0.39	0.21	0,29
New Zealand	-0.12	-0.17	0.25	-0.12	0,21
Norway	0.06	0.03	0.45	0.09	0,07
Poland	0.37	0.46	1.57	-0.03	-0,09
Portugal	0.55	-0.10	0.11	0.07	-0,30
Slovak Republic	0.22	-0.06	0.41	-0.30	0,23
Spain	-0.50	0.19	0.33	0.15	-0,38
Sweden	-0.07	-0.04	0.29	0.16	0,01
Switzerland	0.13	-0.14	0.04	0.06	0,01
Turkey	-0.21	0.52	-0.05	-0.24	0,20
United Kingdom	-0.03	-0.14	0.05	0.23	0,01
United States	0.01	-0.06	-0.57	-0.07	-0,04
OECD (average)	0.05	0.04	0.24	-0.02	0.01
OECD (average absolute)	0.17	0.18	0.31	0.16	0.20
Indonesia	0.51	0.17	-0.10	0.32	0.01
Russian Federation	0.31	0.20	-0.31	-0.26	-0.04

StatLink http://dx.doi.org/10.1787/888933084418

Notes: OECD average includes all OECD education systems for which data is available for all years concerned
= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on PISA (2003 and 2009)

CHAPTER 10

Innovation in the availability of computers and the internet in the classroom

Innovation in the classroom can take the form of providing students with access to computers and the internet. Schools may choose to invest in more computer and network equipment in their classes to be used as a tool for instruction during lessons, or they may reduce computer use in the classroom, possibly in favour of using technology in other ways or collecting ICT together in dedicated technology suites. The aim of innovation with regard to increasing computer and internet availability could be, for example, to make students familiar with the use of ICT and to facilitate the pedagogical use of technology in classrooms.

Computer availability

General findings

Innovation in classroom practices translated into a greater availability of computers for pedagogical purposes in secondary education in some education systems, and less availability in others (Figure 10.1 and Figure 10.2). Between 2003 and 2011, the average absolute change within the OECD area regarding computer availability was 12% points in 8th grade mathematics classes and 9% points in 8th grade science classes. the Russian Federation (33% points) particularly increased computer availability during 8th grade mathematics classes relative to other countries, while computer availability decreased significantly in New Zealand (42% points) and Japan (28% points). The Russian Federation (41% points) also led the increase in computer availability in 8th grade science classes, whereas Japan (30% points) registered the largest decrease in this respect. These changes were characterised by large and medium effect sizes, while the OECD average absolute change in 8th grade maths classes presented a small effect size. Overall, computer availability in 8th grade mathematics classes increased with at least small effect sizes in six education systems and decreased in eight. As for 8th grade science classes, computer availability increased in four countries and decreased in five, presenting at least small effect sizes.

As to primary education, innovation in the form of students having more or fewer computers available was as pronounced as in secondary education (Figure 10.3 and Figure 10.4). OECD countries registered an average absolute change of 12% points in computer availability in 4th grade mathematics and science classes, indicating the magnitude of innovation between 2003 and 2011. The Russian Federation (27% points) showed the most prominent increase in computer availability during classes in 4th grade mathematics; on the contrary, Japan (27% points) and Denmark (24% points) decreased significantly in this respect. The Russian Federation (30% points) also showcased the largest increase in computer availability during 4th grade science classes, closely followed by the Netherlands (26% points). These country changes presented from medium to large effect sizes whilst OECD average absolute changes presented small effect sizes. Altogether, computer availability during 4th grade mathematics classes significantly increased in four countries and decreased in eight with at least small effect sizes. During 4th grade science classes, computer availability increased in seven countries and decreased in five, with at least small effect sizes.

Country specificities

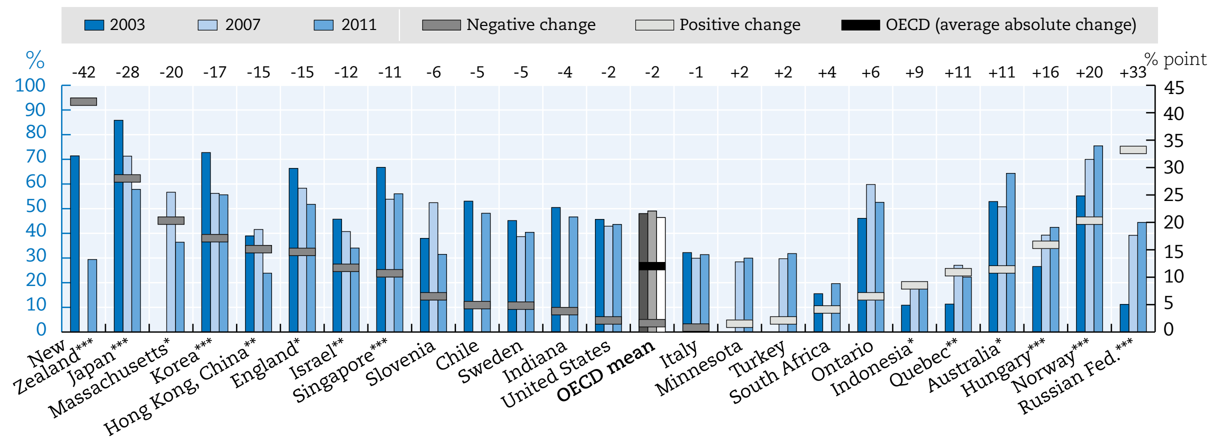
Computer availability for students during classes increased simultaneously in several levels or disciplines in the Russian Federation and Norway. With at least medium effect sizes, the Russian Federation, for example, experienced increases in computer availability during mathematics and science classes both at 8th and 4th grades between 2003 and 2011.

By contrast, computer availability decreased in a comprehensive manner in Japan. Both during mathematics and science classes' computer availability decreased in Japanese primary and secondary education with at least small effect sizes between 2003 and 2011.

Direction of innovation regarding computer availability has not been consistent across education levels and disciplines in New Zealand. As for mathematics classes, computer availability significantly increased in 4th grade from 2003 to 2011, while decreasing substantially with large effect size in 8th grade.

Figure 10.1 **Computer availability in 8th grade maths lessons**

Percentage of students with computers available to use and change over time



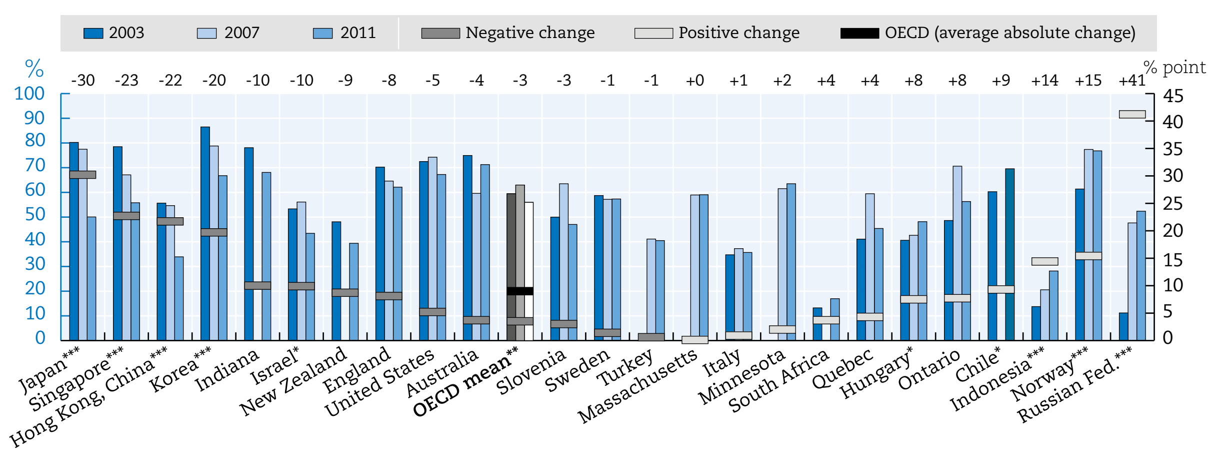
StatLink http://dx.doi.org/10.1787/888933084437

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 10.2 **Computer availability in 8th grade science classrooms**

Percentage of students with computers available to use and change over time



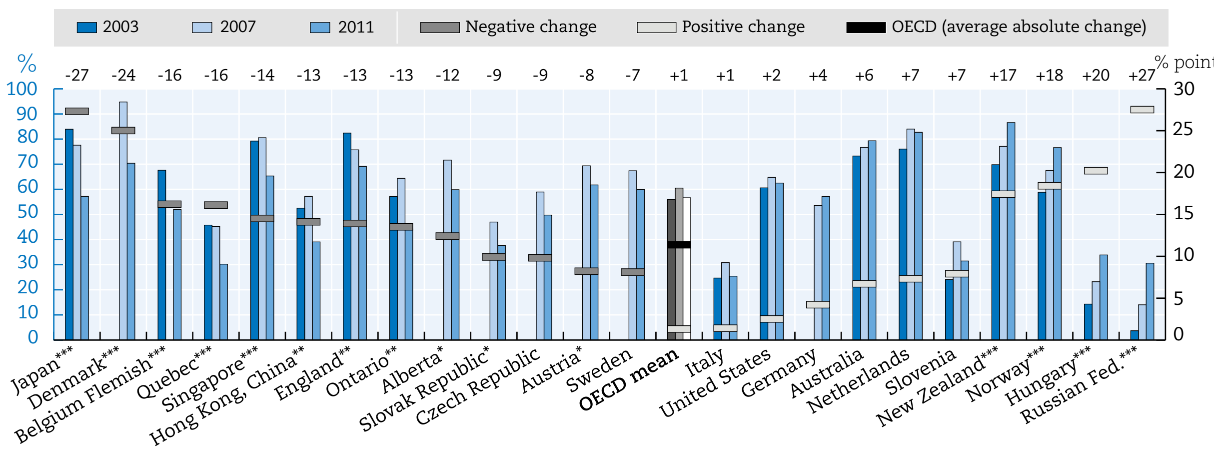
StatLink http://dx.doi.org/10.1787/888933084456

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 10.3 **Computer availability in 4th grade maths classrooms**

Percentage of students with computers available to use and change over time



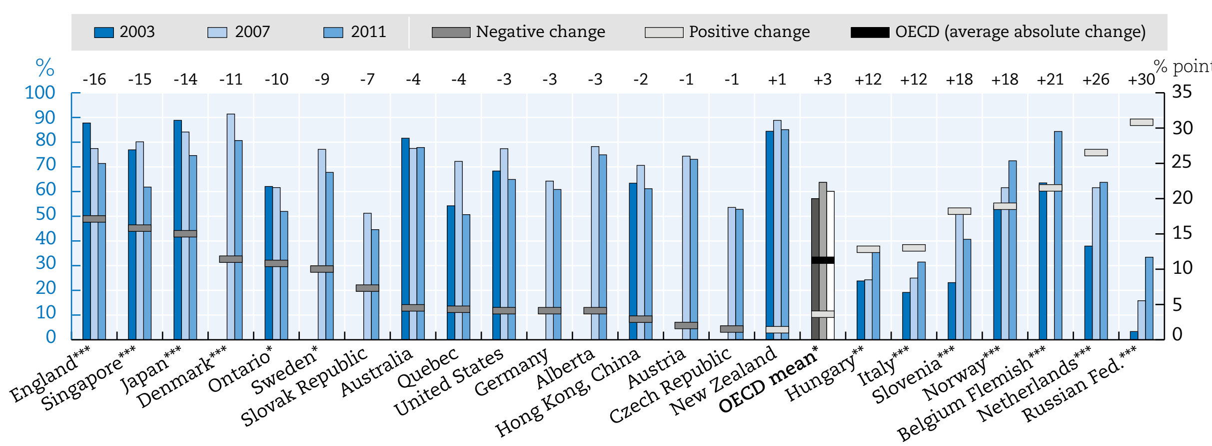
StatLink http://dx.doi.org/10.1787/888933084475

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 10.4 **Computer availability in 4th grade science classrooms**

Percentage of students with computers available to use and change over time



StatLink http://dx.doi.org/10.1787/888933084494

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 10.1 **Data source details for Figures 10.1 to 10.4**

TIMSS (2003, 2007 and 2011) surveys asked 8th grade teachers "Do the students in this class have computer(s) available to use during their mathematics/science lessons?" with answer options "Yes/No". TIMSS-PIRLS (2001, 2006 and 2011) survey asked teachers "Do the <fourth-grade> students in the <PIRLS/TIMSS> class have computer(s) available to use during their mathematics/science lessons?", with response options "Yes/No". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Network accessibility

General findings

Innovation in classrooms is also observed through an increased or reduced availability of Internet network accessibility during lessons. At OECD level, average absolute change in accessibility to the Internet during 8th grade mathematics classes was 12% points, representing the magnitude of change between 2003 and 2011(Figure 10.5 and Figure 10.6). Likewise, OECD average absolute change in Internet accessibility during science classes was 10% points. As for mathematics classes, the country showing the most significant increase was the Russian Federation (33% points), in contrast with Japan (28% points) outranking all other countries for a decrease in Internet accessibility during classes. The Russian Federation (36% points) also stood out in terms of an increase in Internet accessibility during science classes, while decreases were particularly remarkable in Japan (30% points) and Korea (23% points). These country changes presented large and medium effect sizes. OECD average absolute changes exhibited small effect sizes for maths and science. Overall, Internet accessibility during mathematics classes increased substantially in six countries and decreased in seven, with small effect sizes. As for science classes, the increase in Internet availability had at least small effect sizes in four countries, while the decrease had small effect sizes in five countries.

In comparison with secondary education, innovation in the form of a change in Internet accessibility during classes was slightly more pronounced in primary education (Figure 10.7 and Figure 10.8). Between 2003 and 2011, the average absolute change for the OECD area regarding Internet availability during 4th grade classes amounted to 14% points for mathematics and 12% points science. In 4th grade mathematics classes the most prominent increases were registered in Norway (33% points), the Russian Federation (23% points), New Zealand (22% points) and in Hungary (19% points), whereas the decreases were substantial in Japan (27% points) and in Denmark (24% points). As for 4th grade science classes, the Flanders (35% points) and Netherlands (28% points) stood out as education systems with the largest increases in Internet accessibility during classes. These education system changes presented medium effect size, while the OECD average absolute changes had small effect sizes. Overall, Internet accessibility during 4th grade mathematics classes increased in seven and decreased in six education systems, with at least small effect size; as for Internet accessibility in 4th grade mathematics, the increases exhibited at least small effect sizes in six countries while decreases were significant in five countries.

Country specificities

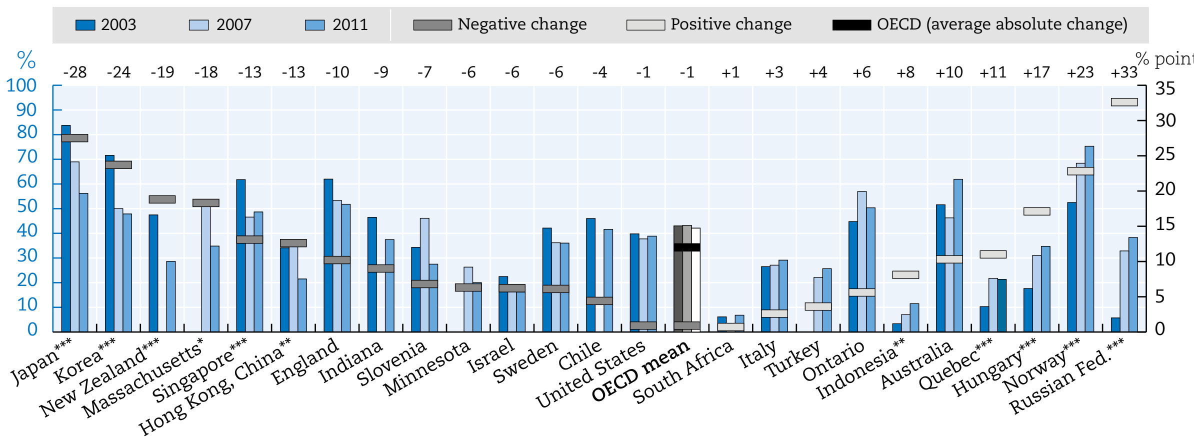
The Russian Federation, Norway and Hungary stand out as education systems where innovation took the form of a widespread increase in Internet accessibility simultaneously across disciplines and educational levels. For example, with at least small effect sizes, Norway saw increases in the availability of Internet connected computers during mathematics and science classes, both in primary and secondary education between 2003 and 2011.

On the contrary, Japan, Singapore and Hong Kong showcased that innovation may result in a simultaneous decrease in Internet accessibility during classes of different disciplines and educational levels. Especially Japan experienced a consistent decrease in the availability of Internet connected computers in both mathematics and science classes of 4th and 8th grade with at least small effect sizes.

New Zealand illustrates the case of a country where innovation concerning Internet accessibility in classrooms has not been consistent across education levels. New Zealand schools made available more Internet connected computers for mathematics classes in 4th grade and less in 8th grade in the period from 2003 to 2011.

Figure 10.5 **Internet availability in the 8th grade maths classrooms**

Percentage of students with Internet access in the classroom and change over time



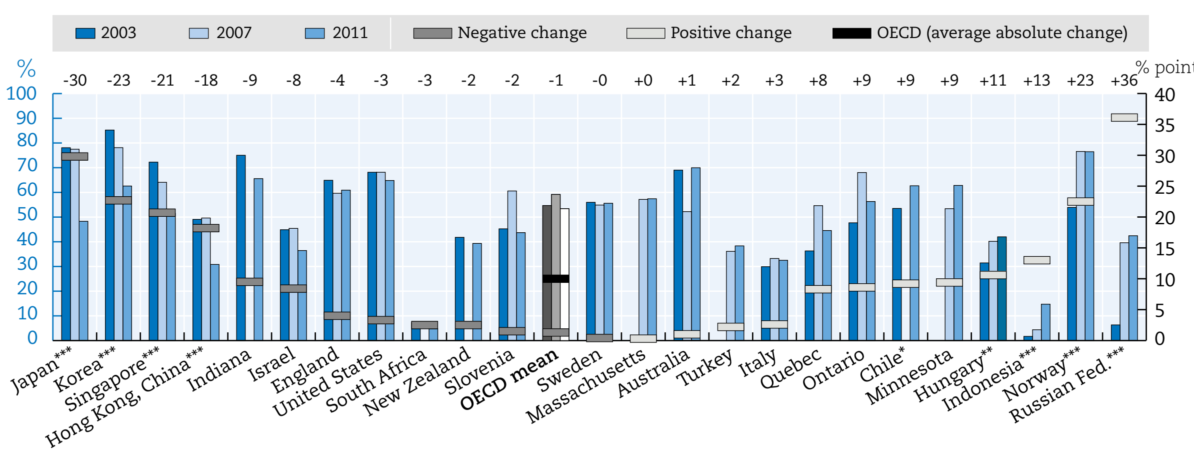
StatLink http://dx.doi.org/10.1787/888933084513

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 10.6 **Internet availability in the 8th grade science classrooms**

Percentage of students with Internet access in the classroom and change over time



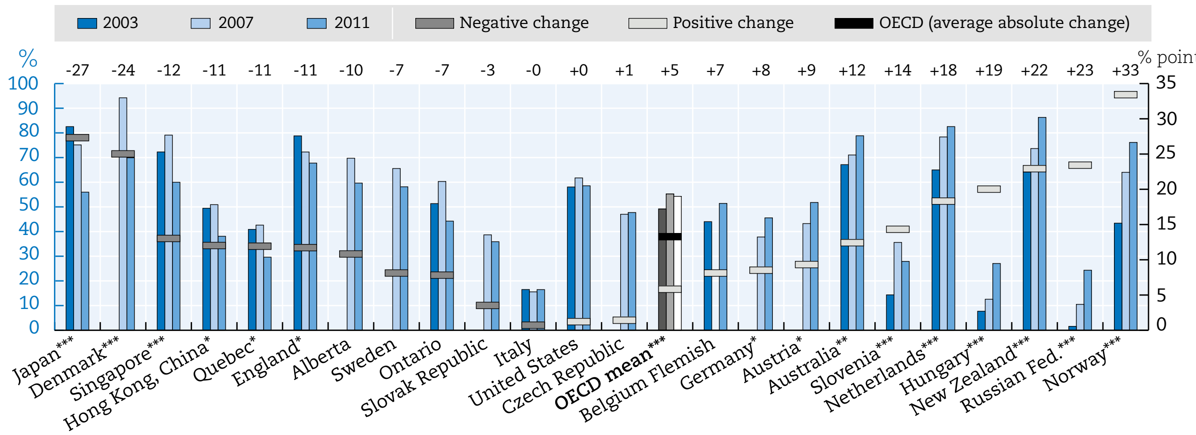
StatLink http://dx.doi.org/10.1787/888933084532

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 10.7 **Internet availability in the 4th grade maths classrooms**

Percentage of students with Internet access in the classroom and change over time



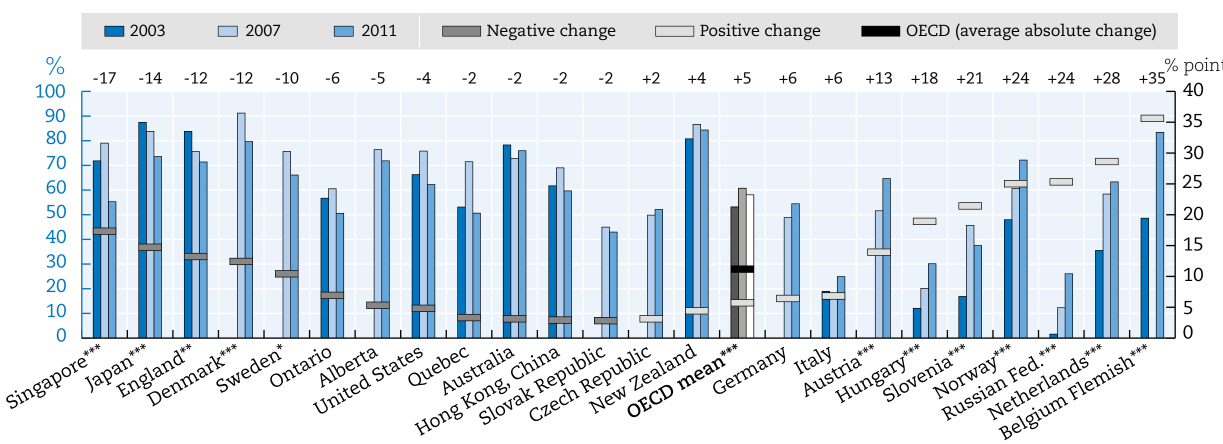
StatLink http://dx.doi.org/10.1787/888933084551

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 10.8 **Internet availability in the 4th grade science classrooms**

Percentage of students with Internet access in the classroom and change over time



StatLink http://dx.doi.org/10.1787/888933084570

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

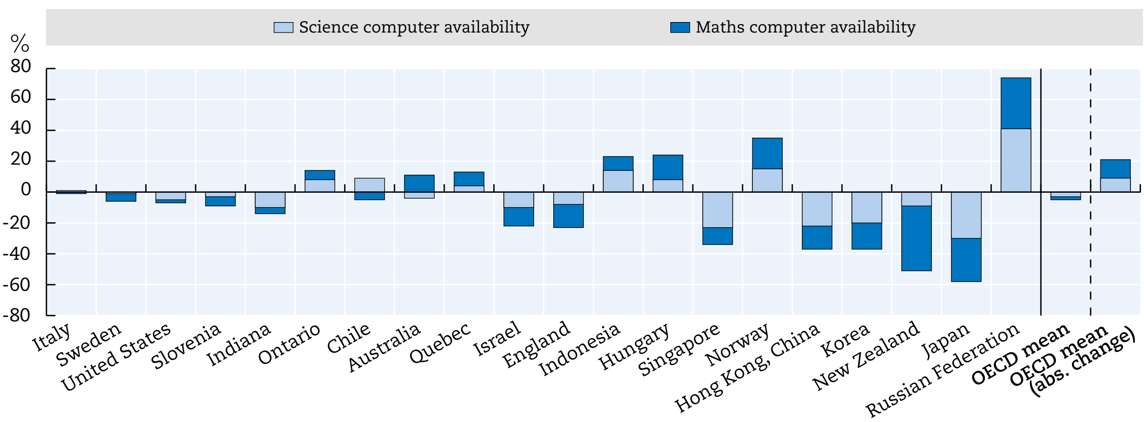
Box 10.2 **Data source details for Figures 10.5 to 10.8**

TIMSS (2003, 2007 and 2011) surveys asked 4th and 8th grade teachers "Do the students in this class have computer(s) available to use during their mathematics/science lessons?" with answer options "Yes/No". Conditional on answering "Yes" to this question teacher are asked "Do any of the computer(s) have access to the Internet?" with answer options "Yes/No". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

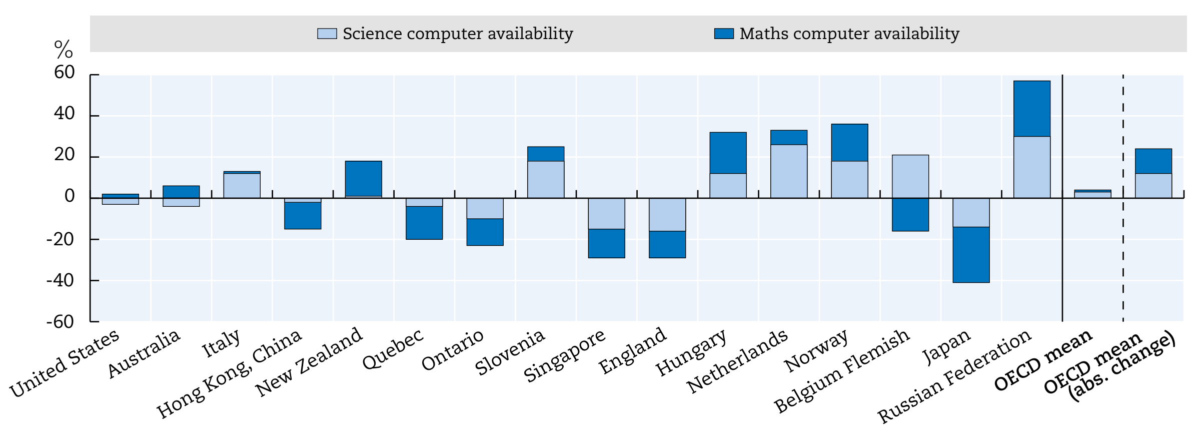
Innovation – or significant change – in computer and Internet availability during lessons has resulted in slightly more availability in primary education and slightly less in secondary education. Change in the OECD area was balanced across disciplines and levels with some countries showing consistent increases and decreases across disciplines and levels between 2003 and 2011 as in the case of the Russian Federation and Japan.

Figure 10.9 **Change in computer availability in 8th grade classrooms**



StatLink http://dx.doi.org/10.1787/888933084589

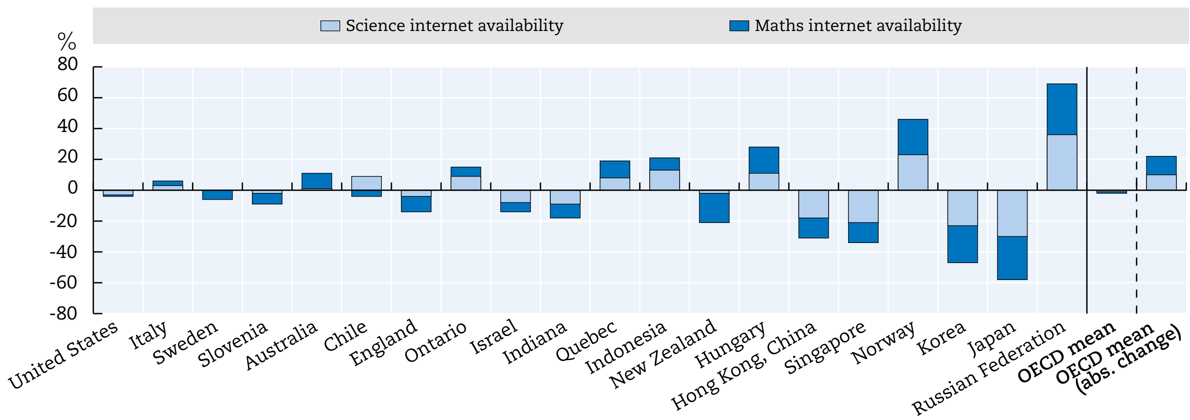
Figure 10.10 **Change in computer availability in 4th grade classrooms**



StatLink http://dx.doi.org/10.1787/888933084608

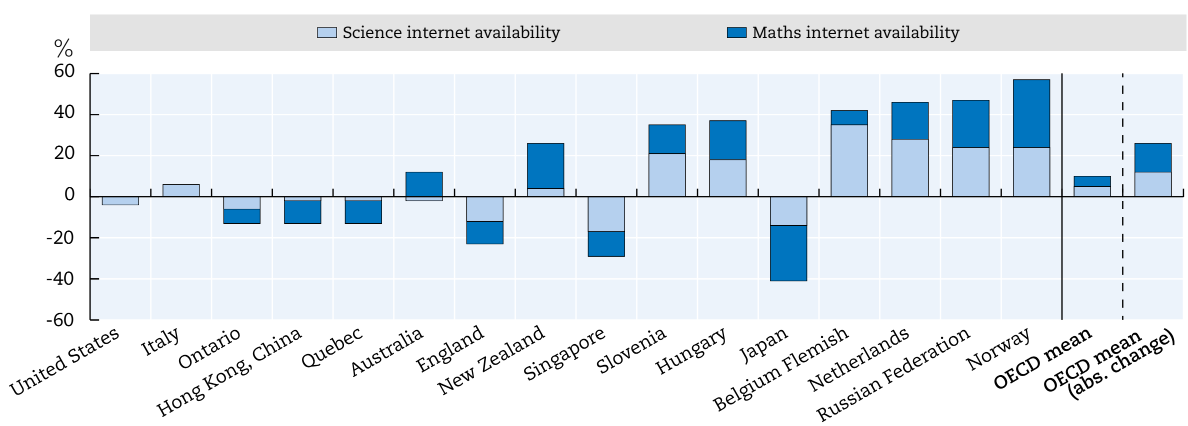
Notes: For details, please see Figures 10.1,10. 2, 10.3 and 10.4.

Figure 10.11 **Change in Internet availability in 8th grade classrooms**



StatLink http://dx.doi.org/10.1787/888933084627

Figure 10.12 **Change in Internet availability in 4th grade classrooms**



StatLink http://dx.doi.org/10.1787/888933084646

Notes: OECD average includes all OECD education systems. For details, please see Figures 10.5,10.6, 10.7 and 10.8.

Note on Israel

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.

Table 10.1 Effect sizes for changes in the availability of computers and the internet in classrooms

	Change in computer availability				Change in network availability			
	8th grade		4th grade		8th grade		4th grade	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-11
Australia	0.23	-0.08	0.14	-0.09	0.21	0.02	0.27	-0.06
Belgium Flemish	m	m	-0.32	0.48	m	m	0.15	0.76
Ontario	0.13	0.15	-0.26	-0.20	0.11	0.17	-0.14	-0.12
Quebec	0.30	0.09	-0.32	-0.07	0.31	0.17	-0.24	-0.05
Chile	-0.10	0.20	m	m	-0.09	0.19	m	m
Hungary	0.34	0.15	0.47	0.27	0.39	0.22	0.53	0.45
Israel	-0.24	-0.20	m	m	-0.16	-0.17	m	m
Italy	-0.02	0.02	0.02	0.28	0.06	0.06	0.00	0.14
Japan	-0.64	-0.65	-0.60	-0.38	-0.62	-0.63	-0.59	-0.36
Korea	-0.36	-0.48	m	m	-0.49	-0.53	m	m
Netherlands	m	m	0.17	0.52	m	m	0.40	0.56
New Zealand	-0.87	-0.18	0.41	0.02	-0.39	-0.05	0.53	0.09
Norway	0.43	0.34	0.38	0.38	0.48	0.48	0.68	0.50
Slovenia	-0.14	-0.06	0.16	0.38	-0.15	-0.03	0.34	0.47
Sweden	-0.10	-0.03	m	m	-0.12	-0.01	m	m
England	-0.30	-0.17	-0.31	-0.41	-0.21	-0.08	-0.25	-0.30
United States	-0.04	-0.11	0.04	-0.07	-0.02	-0.07	0.01	-0.08
Indiana	-0.08	-0.23	m	m	-0.18	-0.21	m	m
OECD (average)	-0.03	-0.08	0.02	0.05	-0.02	-0.03	0.13	0.10
OECD (average absolute)	0.25	0.19	0.27	0.26	0.26	0.20	0.33	0.27
Hong Kong, China	-0.33	-0.44	-0.27	-0.05	-0.28	-0.38	-0.23	-0.04
Indonesia	0.24	0.36	m	m	0.32	0.53	m	m
Russian Federation	0.78	0.94	0.78	0.87	0.85	0.91	0.78	0.82
Singapore	-0.22	-0.49	-0.31	-0.33	-0.26	-0.43	-0.26	-0.35
South Africa	0.11	0.10	m	m	0.03	-0.11	m	m

StatLink http://dx.doi.org/10.1787/888933084665

Notes: OECD average includes all OECD education systems for which data is available for all years concerned
= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

CHAPTER 11

Innovation in the use of computers in the classroom

Innovation in the classroom includes different possibilities for using computers during classroom instruction across subjects. Teachers may choose to integrate their instruction with a wider or narrower use of computers to serve different pedagogical purposes. The aim of innovation with regard computer use could be, for example, for students to develop an adequate set of digital competencies in primary school and to make students more aware of the usefulness of computers for their learning. A reduction in ICT use in the classroom may result from innovations such as a decision to provide computers for the home, or a preference for providing hands on experience through real objects and experiments rather than virtual ones.

Use of computers for practising skills and procedures

General findings

Innovation in the classroom has taken the form of greater and lesser use of computers to practice skills and procedures during mathematics and science lessons in secondary education (Figure 11.1 and Figure 11.2). Between 2003 and 2011 the average absolute change within the OECD area for computer use to practice skills and procedures was 10% points in 8th grade science and 9% points in 8th grade mathematics. The Russian Federation (41% points) showed the largest increase in the practice of skills and procedures in science classes through computersand also led as the education system presenting the largest increase in skills and procedures practice through computers in 8th grade mathematics classes (33% points). On the contrary, in Korea (26% points) and Japan (12% points) students practiced skills and procedures less frequently via computer in 2011 than in 2003. These changes were characterised by large and medium effect sizes, while the OECD average absolute change for 8th grademaths and science presented small effect sizes. Overall and with at least small effect sizes, computer use to practice skills and procedures during science lessons augmented in nine education systems and diminished in three, whereas, in the case of mathematics classes, it increased in five countries and decreased in three.

Primary education reflected secondary education in terms of the change in the use of computers to practice skills and procedures (Figure 11.3 and Figure 11.4). OECD average absolute change regarding the use of computers to practice skills and procedures was 13% points in 4th grade mathematics and 10% points in 4th grade science, between 2003 and 2011. In New Zealand (33% points) and the Russian Federation (24% points) practising skills and procedures through computers during mathematics classes became particularly more common in 2011 than it was in 2003, while the opposite was true in Japan (23% points) and Denmark (22% points). The Russian Federation (30% points) and Norway (25% points) showcased the most notable increases in computer use for skills and procedures practise during science lessons. These country changes presented from medium to large effect sizes; while the OECD average absolute change effect sizeswere small. Altogether, use of computers to practise skills and procedures during 4th grade mathematics classes significantly increased in four countries and decreased in ten with at least small effect sizes. As for 4th grade science classes, skills and procedures practice through computers increased in seven countries and decreased in one, with at least small effect sizes.

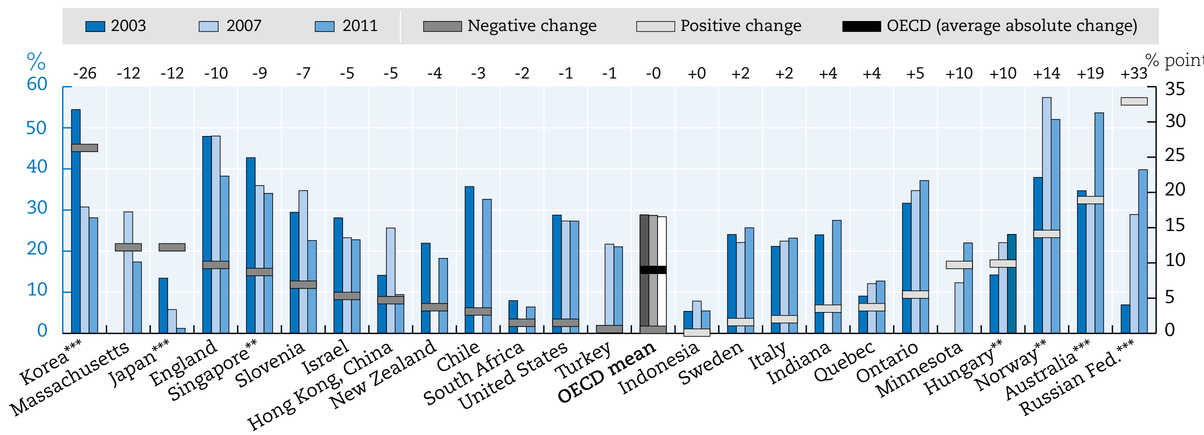
Country specificities

Use of computers to practice skills and procedures increased across disciplines and levels in the Russian Federation, Norway and Hungary. With at least small effect sizes, The use of computers to practice skills and procedures during mathematics and science lessons by Hungarian students increased between 2003 and 2011, at both 8th and 4th grades .

In contrast, practising skills and procedures through computers decreased significantly across disciplines in Korea, Japan and Singapore. Korean students used computers less to practice skills and procedures during 8th grade mathematics and science classes with at least small effect sizes between 2003 and 2011.

Figure 11.1 Computer use to practice skills and procedures in 8th grade maths

Percentage of students using computers to practice skills and procedures at least sometimes and change over time



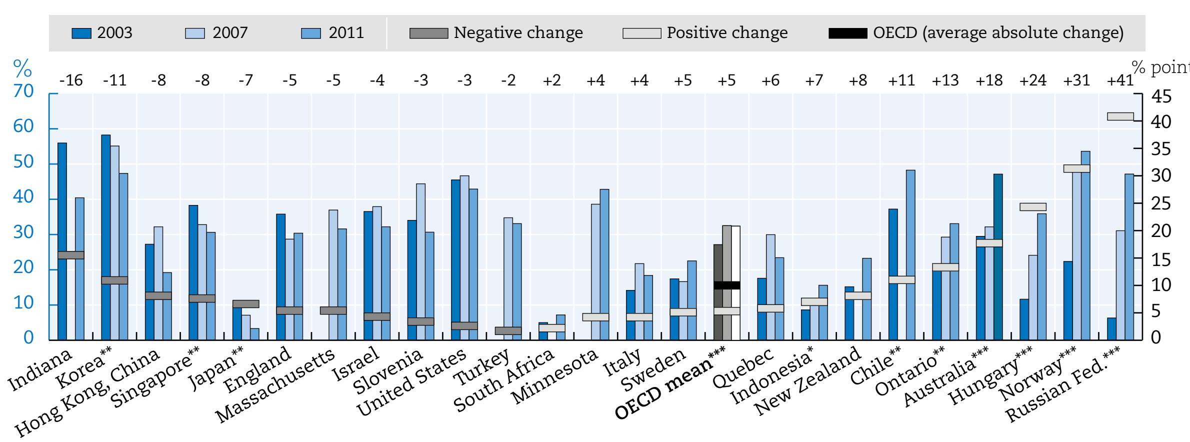
StatLink http://dx.doi.org/10.1787/888933084684

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.2 Computer use to practice skills and procedures in 8th grade science

Percentage of students using computers to practice skills and procedures at least sometimes and change over time



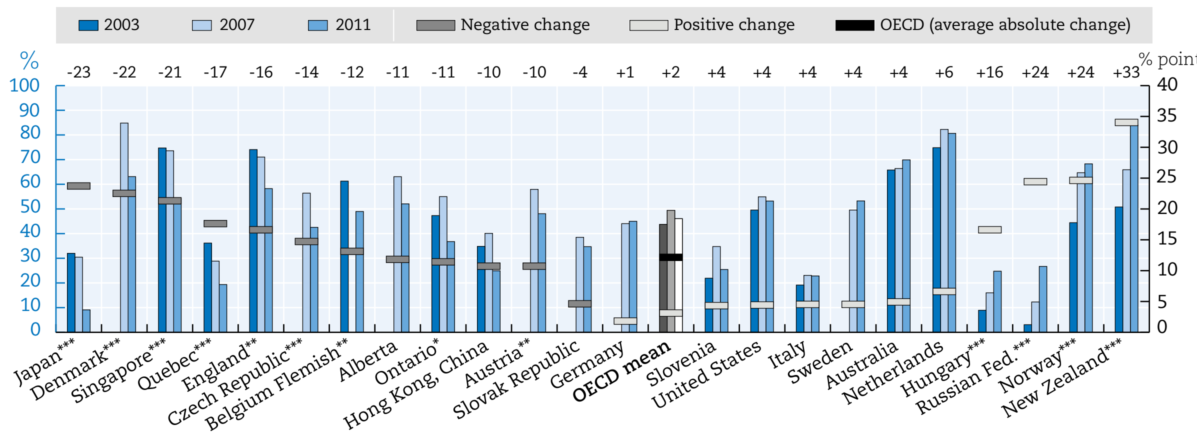
StatLink http://dx.doi.org/10.1787/888933084703

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.3 **Computer use to practice skills and procedures in 4th grade maths**

Percentage of students using computers to practice skills and procedures at least sometimes and change over time



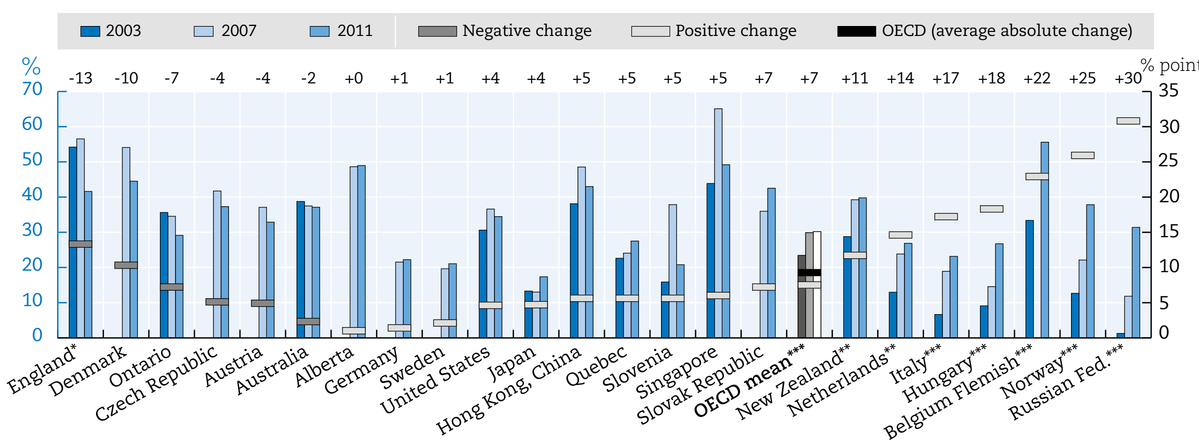
StatLink http://dx.doi.org/10.1787/888933084722

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.4 **Computer use to practice skills and procedures in 4h grade science**

Percentage of students using computers to practice skills and procedures at least sometimes and change over time



StatLink http://dx.doi.org/10.1787/888933084741

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 11.1 **Data source details for Figures 11.1 to 11.4**

TIMSS (2003, 2007 and 2011) surveys asked 4th and 8th grade teachers "Do the students in this class have computer(s) available to use during their mathematics/science lessons?" with answer options "Yes/No". Conditional on answering "yes" to this question teachers are asked "How often do you have the students do the following computer activities during mathematics/science lessons? a) Practice skills and procedures". The response codes to this question vary across questionnaires. The results count all responses except those indicating 'Never'. The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Use of computers for information research

General findings

Innovation in classrooms was also exemplified in a larger or smaller student use of computers to look up information during lessons in secondary education (Figure 11.5 and Figure 11.6). At OECD level, average absolute change in students using computers to look up information during lessons was 10% points both in 8th grade mathematics and science between 2003 and 2011. Use of computers for information research during mathematics lessons increased particularly in the Russian Federation (35% points) while substantially decreasing in Korea (35% points). The Russian Federation (37% points) also outranked all other education systems in relation to the increase in student use of computers for information research during science lessons; the largest decreases in such use were found in Singapore (27% points), Japan (26% points) and Hong Kong (24% points). These education system changes presented large and medium effect sizes; while the OECD average absolute change effect sizes were small. Overall, students used computers more to look up information during mathematics and science classes in four education systems and less in seven, with at least small effect sizes.

In comparison with secondary education, innovation regarding computer use for information research purposes was slightly more pronounced in primary education (Figure 11.7 and Figure 11.8). The average absolute change at the OECD level in the use of computers to look up information in 4th grade was 13% points during science lessons and 11% during mathematics lessons in the period from 2003 to 2011. Students in science classes used computers more to look up information especially in the Netherlands (27% points) and the Russian Federation (26% points). During mathematics classes, use of a computer for information research increased particularly in the Russian Federation (20% points), while decreasing significantly in Denmark (28% points). These changes presented large and medium effect sizes while the OECD average absolute change effect sizes were small. Altogether, use of computers for information research purposes increased in seven education systems and decreased in seven during 4th grade science classes, whereas it increased in five systems and decreased in six during mathematics lessons, with at least small effect sizes.

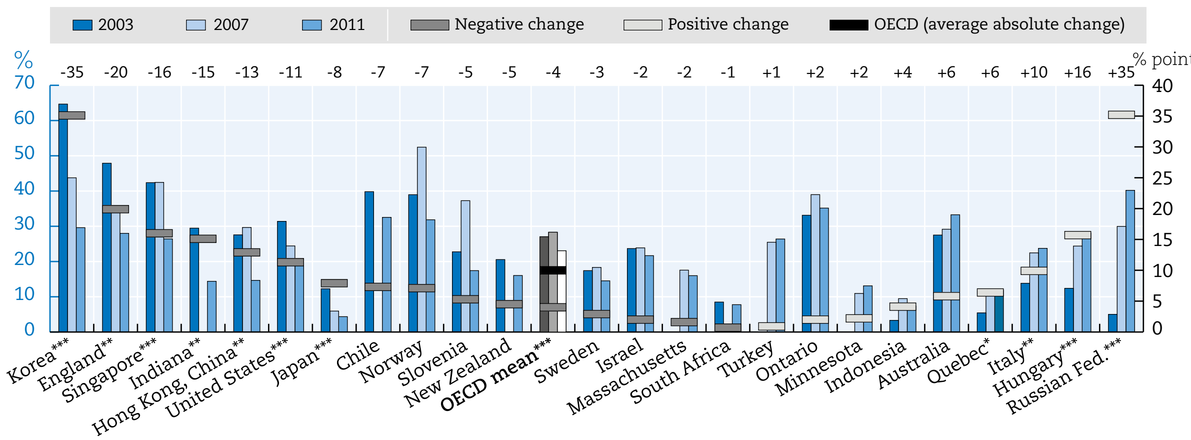
Country specificities

The Russian Federation and Hungary stood out as education systems where innovation in the form of a broader use of computers to look up information during classes occurred simultaneously across disciplines and educational levels. For example, with at least small effect sizes, Hungarian students used computers more often to look up information during mathematics and science classes and in primary and secondary education between 2003 and 2011.

Singapore, England and Hong Kong are education systems where innovation is illustrated in reduced use of computers across disciplines and levels to look up information. Fourth-grade and 8th grade English students, for example, used computers significantly less to look up information during mathematics and science lessons in the period from 2003 to 2011 with small effect sizes.

Figure 11.5 **Computer use to look up ideas and information in 8th grade maths**

Percentage of students using computers to look up ideas and information at least sometimes and change over time



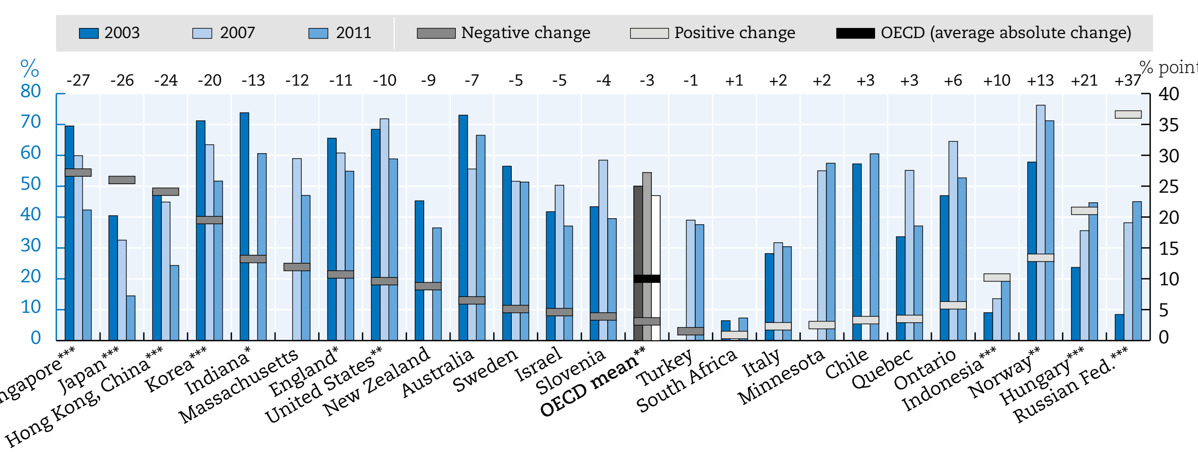
StatLink http://dx.doi.org/10.1787/888933084760

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.6 **Computer use to look up ideas and information in 8th grade science**

Percentage of students using computers to look up ideas and information at least sometimes and change over time



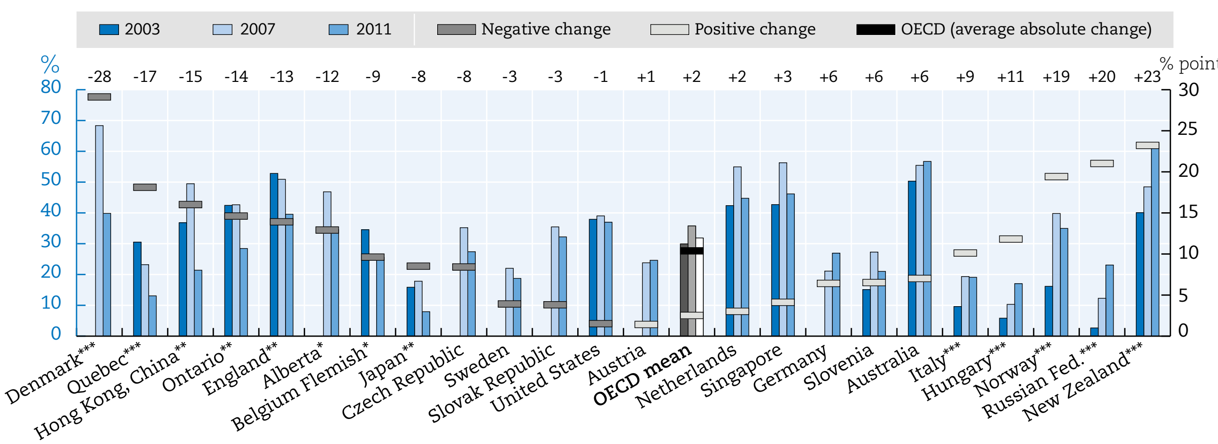
StatLink http://dx.doi.org/10.1787/888933084779

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.7 Computer use to look up ideas and information in 4th grade maths

Percentage of students using computers to look up ideas and information at least sometimes and change over time



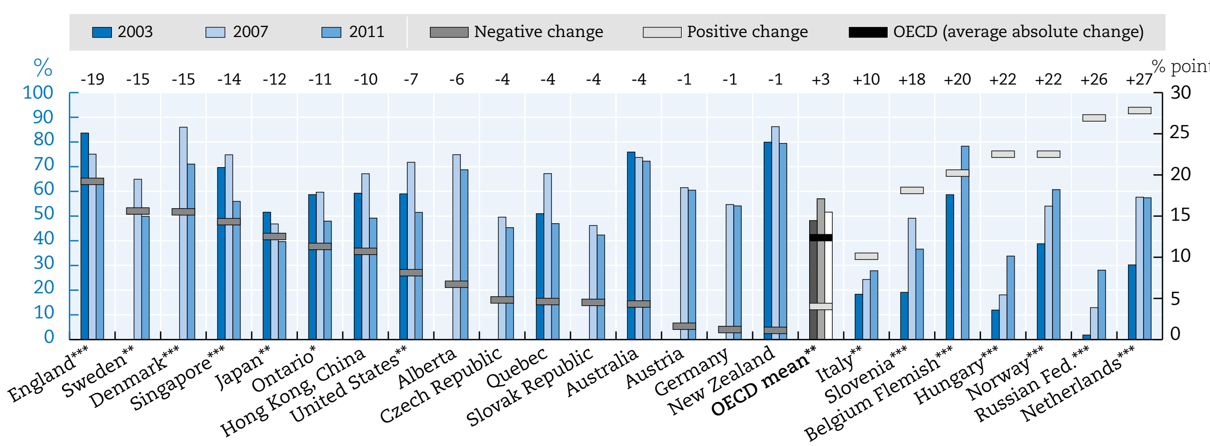
StatLink http://dx.doi.org/10.1787/888933084798

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.8 Computer use to look up ideas and information in 4th grade science

Percentage of students using computers to look up ideas and information at least sometimes and change over time



StatLink http://dx.doi.org/10.1787/888933084817

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 11.2 Data source details for Figures 11.5 to 11.8

TIMSS (2003, 2007 and 2011) surveys asked 4th and 8th grade teachers "Do the students in this class have computer(s) available to use during their mathematics/science lessons?" with answer options "Yes/No". Conditional on answering "yes" to this question teachers are asked "How often do you have the students do the following computer activities during mathematics/science lessons? b) Look up ideas and information" with answer options "Every or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Use of computers for data analysis and scientific experimentation

General findings

Increased and reduced use of computers to analyse data during lessons in secondary education has also been observed across education systems (Figure 11.9 and Figure 11.10). Between 2003 and 2011 the OECD average absolute change in the use of computers to analyse data was 10% points during mathematics lessons and 7% points during science lessons. Students' use of computers to analyse data during mathematics lessons increased especially in the Russian Federation (22% points), while decreasing remarkably in England (29% points) and Korea (25% points). Again, the Russian Federation (27% points) stood out as the country where students used computers more often for data analysis purposes during science classes in 2011 than 2003. These country changes exhibited medium effect sizes, while the OECD average absolute presented a small effect size in computer use during science lessons. Overall, students used computers more often to analyse data during mathematics lessons in 2011 than in 2003 in four education systems, while the opposite was true for six, with at least small effect sizes. Use of computers for data analysis during science classes increased in three education systems and decreased in six, with small effect sizes.

Innovation in classrooms also encompassed a greater or lower use of computers for scientific experimentations (Figure 11.11 and Figure 11.12). Between 2003 and 2011, OECD average absolute change concerning students using computers to conduct scientific experiments during 8th grade science lessons was 11% points, while in 4th grade classes it amounted to 8% points with regard to the use of computers for studying natural phenomena through simulations. The Russian Federation (21% points) outranked all other countries in the increase of students using computers to conduct experiments during 8th science classes, whereas the opposite trend was particularly pronounced in Korea (32% points). Similarly, the Russian Federation (18% points) exhibited the largest increase in the use of computers for studying natural phenomena in 4th grade. These country changes presented medium effect sizes, whereas OECD average absolute change showed a small effect size as per 4th grade students using computers for the studying natural phenomena. Altogether, 8th grade students made larger use of computers to conduct scientific experiments in eight education systems, while the opposite was true for seven education systems between 2003 and 2011, with at least small effect sizes. Likewise, with small effect sizes 4th grade students used computers more for studying natural phenomena in 11 education systems.

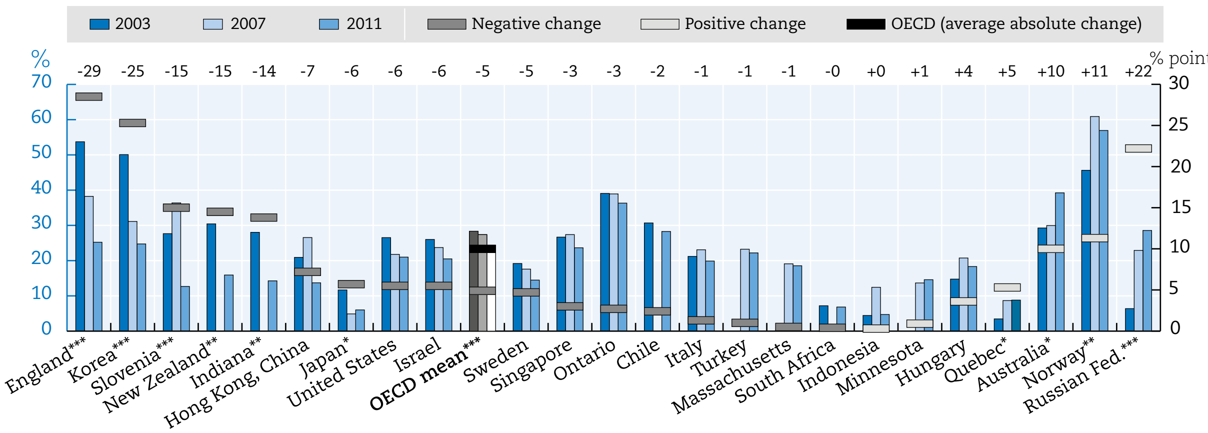
Country specificities

The Russian Federation, Hungary and Norway stood out as education systems where innovation was illustrated in a broader use of computers for data analysis and scientific experimentation simultaneously across educational levels. For example, with at least small effect sizes, Norwegian students used computers more to analyse data during mathematics and science classes and to conduct scientific experiments in primary and secondary education between 2003 and 2011.

In contrast, innovation in England and Korea was characterised by lower use of computers to process and analyse data and conduct scientific experiments simultaneously across disciplines. Eighth-grade Korean students, for example, used computers significantly less to analyse data during mathematics and science lessons and to conduct scientific experiments in 2011 than 2003 with at least small effect sizes.

Figure 11.9 **Computer use to analyse data in 8th grade maths**

Percentage of students using computers to analyse data at least sometimes and change over time



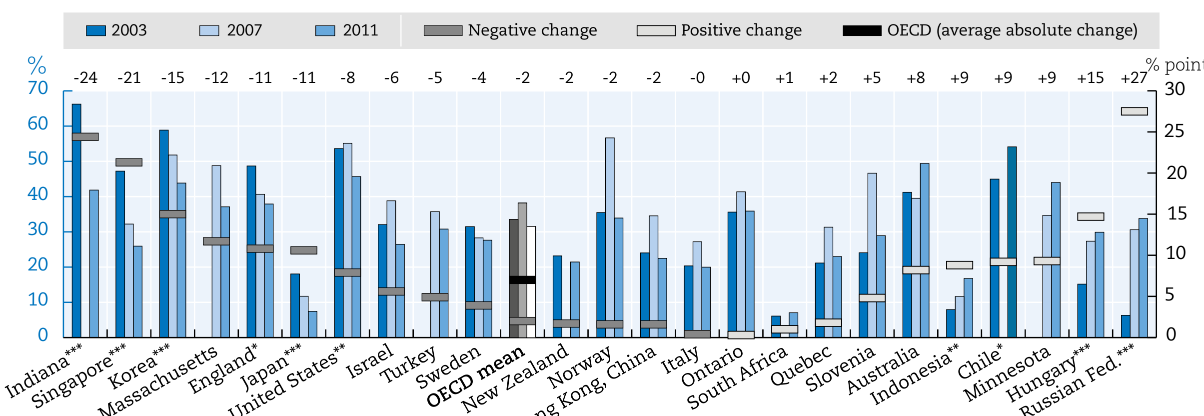
StatLink http://dx.doi.org/10.1787/888933084836

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.10 **Computer use to analyse data in 8th grade science**

Percentage of students using computers to analyse data at least sometimes and change over time



StatLink http://dx.doi.org/10.1787/888933084855

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

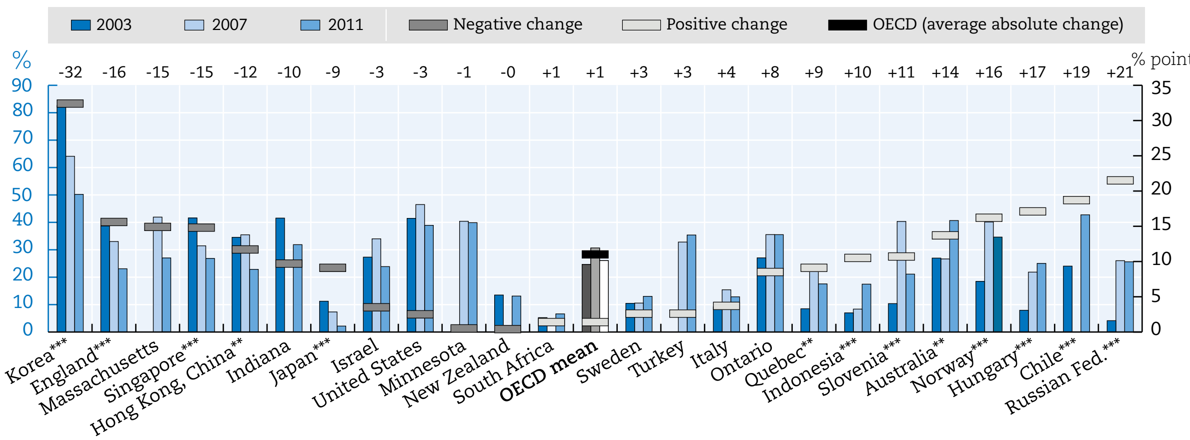
Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 11.3 **Data source details for Figures 11.9 to 11.10**

TIMSS (2003, 2007 and 2011) surveys asked 8th grade teachers "Do the students in this class have computer(s) available to use during their mathematics/science lessons?" with answer options "Yes/No". Conditional on answering "yes" to this question teachers are asked "How often do you have the students do the following computer activities during mathematics/science lessons? c) Process and analyse data" with answer options "Every or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 11.11 **Computer use to conduct scientific experiments in 8th grade science**

Percentage of students using computers to analyse data at least sometimes and change over time



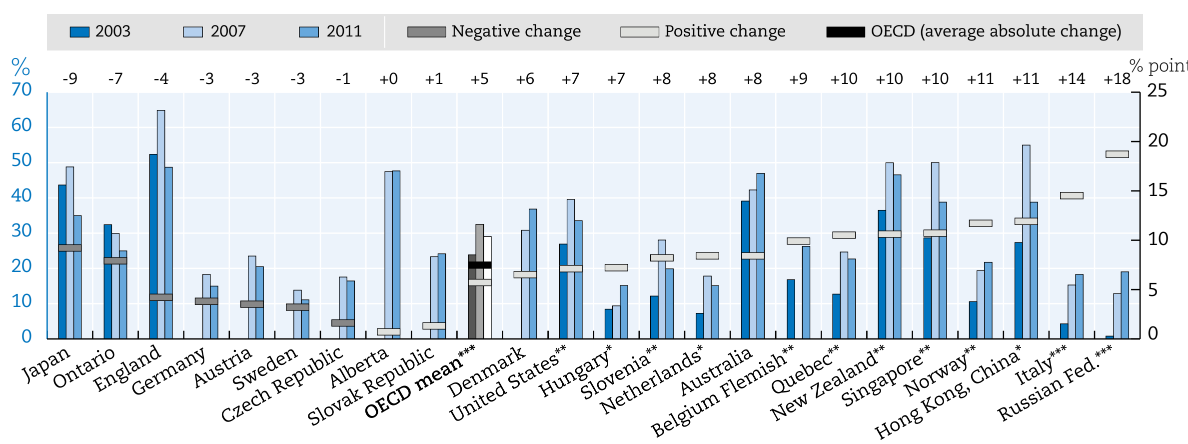
StatLink http://dx.doi.org/10.1787/888933084874

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 11.12 **Computer use to study natural phenomena through simulations in 4th grade science**

Percentage of students using computers to analyse data at least sometimes and change over time



StatLink http://dx.doi.org/10.1787/888933084893

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 11.4 **Data source details for Figures 11.11 to 11.12**

TIMSS (2003, 2007 and 2011) surveys asked 4th and 8th grade teachers "Do the students in this class have computer(s) available to use during their science lessons?" with answer options "Yes/No". Conditional on answering "yes" to this question teachers are asked "How often do you have the students do the following computer activities during science lessons? c) Do scientific procedures or experiments, d) Study natural phenomena through simulations" with answer options "Every or almost every day; Once or twice a week; Once or twice a month; never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Use of computers for reading and writing

General findings

Innovation in the classroom has also resulted in either increased or decreased student use of computers to read and write text in primary education (Figure 11.13 and Figure 11.14). Between 2001 and 2006 the OECD average absolute change regarding students using computers to read text was 7% points, while it amounted to 8% for the use of computers to write text in primary education. Hong Kong (39% points), the Netherlands (19% points) and the Slovak Republic (12% points) are the education systems showing the largest increases in the use of computers for reading purposes with medium to large effect sizes.The OECD exhibited a small average absolute change effect size on this aspect of computer use at 4^{th} grade. The Slovak Republic (11% points) exhibited the most substantial increase concerning writing text on computers in primary with a medium effect size. Overall, reading text on computers increased in nine education systems and decreased in three with at least small effect sizes, while writing text on computers broadened in six education systems and diminished in four with at least small effect sizes.

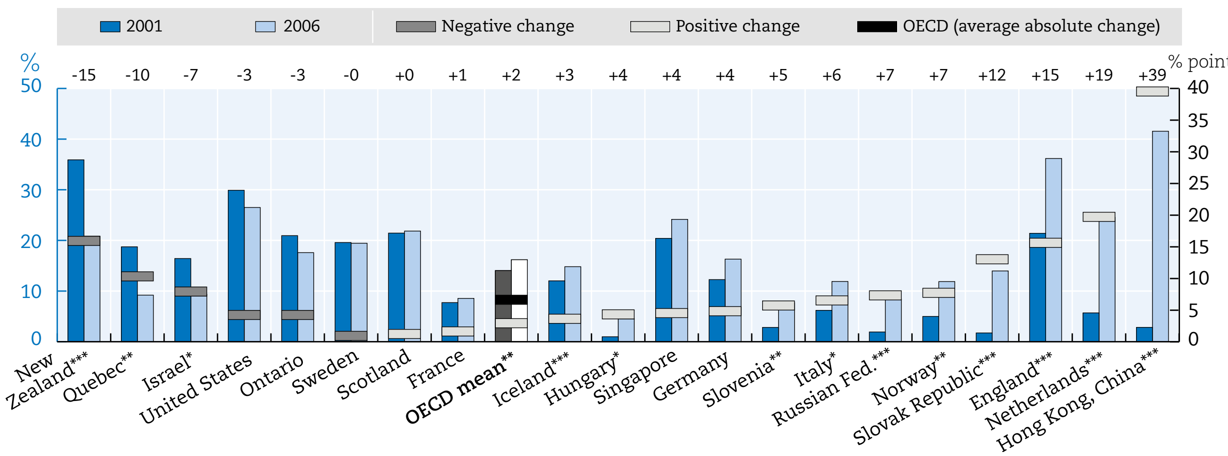
Country specificities

The Slovak Republic, the Netherlands and Norway are countries where innovation was exemplified in additional use of computers for reading and writing. In these countries, students used computers more widely to read and write text between 2001 and 2006, with at least small effect sizes.

In contrast, use of computers to read and write text particularly decreased in New Zealand and Israel. $Four^{th}$ grade students in these countries made less use of computers to read and write text in 2006 than in 2001, with small effect sizes.

Figure 11.13 **Computer use to read text in 4th grade**

Percentage of students using computers to read stories or other texts at least once or twice a week and change over time



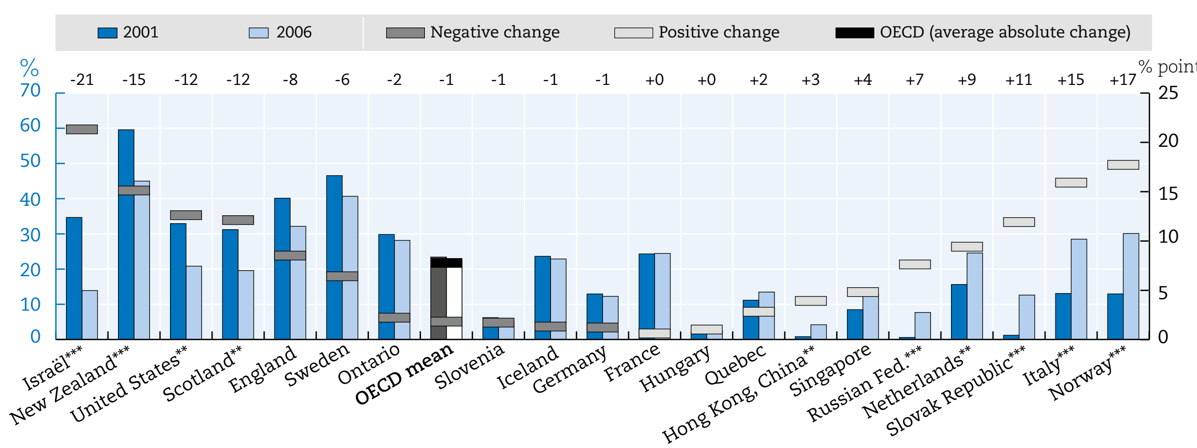
StatLink http://dx.doi.org/10.1787/888933084912

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PIRLS (2001 and 2006)

Figure 11.14 **Computer use to write text in 4th grade**

Percentage of students using computers to read stories or other texts at least once or twice a week and change over time



StatLink http://dx.doi.org/10.1787/888933084931

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PIRLS (2001 and 2006)

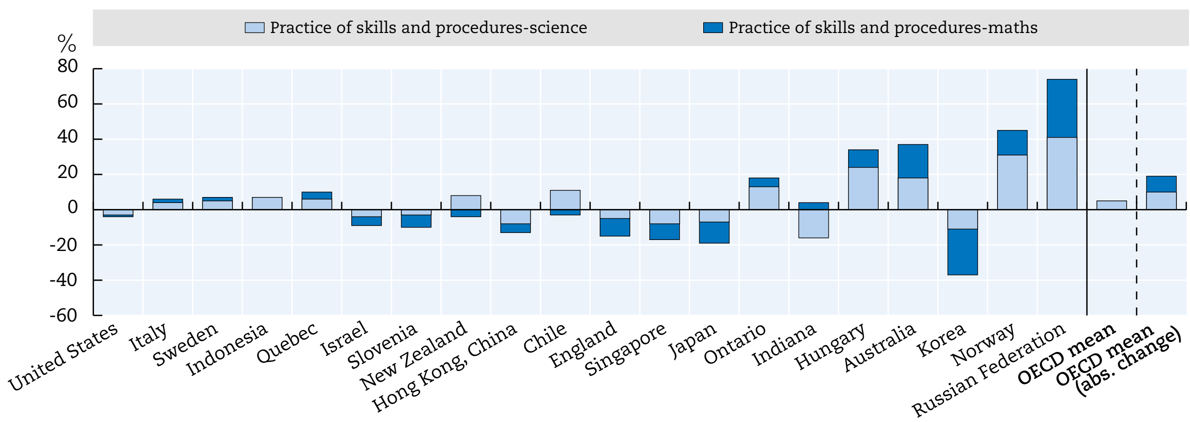
Box 11.5 **Data source details for Figures 11.13 to 11.14**

PIRLS (2001 and 2006) surveys asked 4th grade teachers: "Are computers available for use by your class?" with answer options "Yes/No". Conditional on answering "yes" to this question teachers are asked "How often do you have students do the following computer activities? c) Read stories or other texts on the computer, e) Use the computer to write stories or other texts" with answer options "Every or almost every day; Once or twice a week; Once or twice a month; Never or almost never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

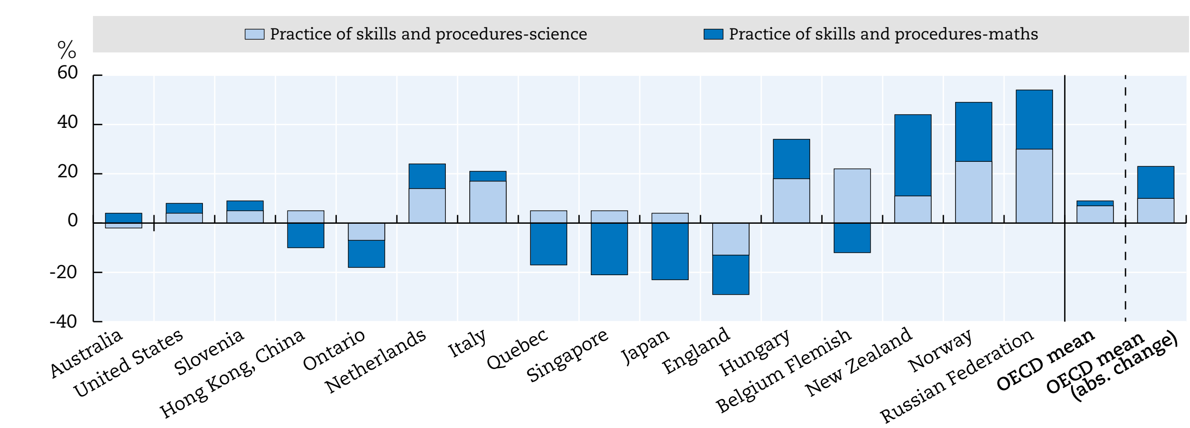
Innovation – or significant change – in the use of computers during lessons varied across countries and pedagogical purposes. Change in the OECD area was unequal across disciplines, where use of computers touched primarily mathematics or science depending on the pedagogical purposes, and levels. Notably the Russian Federation is the only country exhibiting consistent increases across pedagogical purposes, disciplines and levels between 2003 and 2011.

Figure 11.15 **Change in the use of computers to practice skills and procedures in 8th grade**



StatLink http://dx.doi.org/10.1787/888933084950

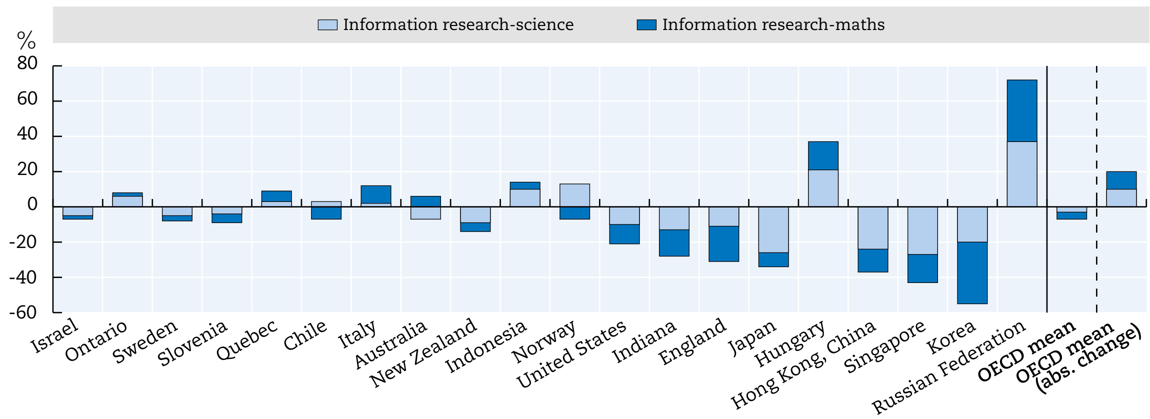
Figure 11.16 **Change in the use of computers to practice skills and procedures in 4th grade**



StatLink http://dx.doi.org/10.1787/888933084969

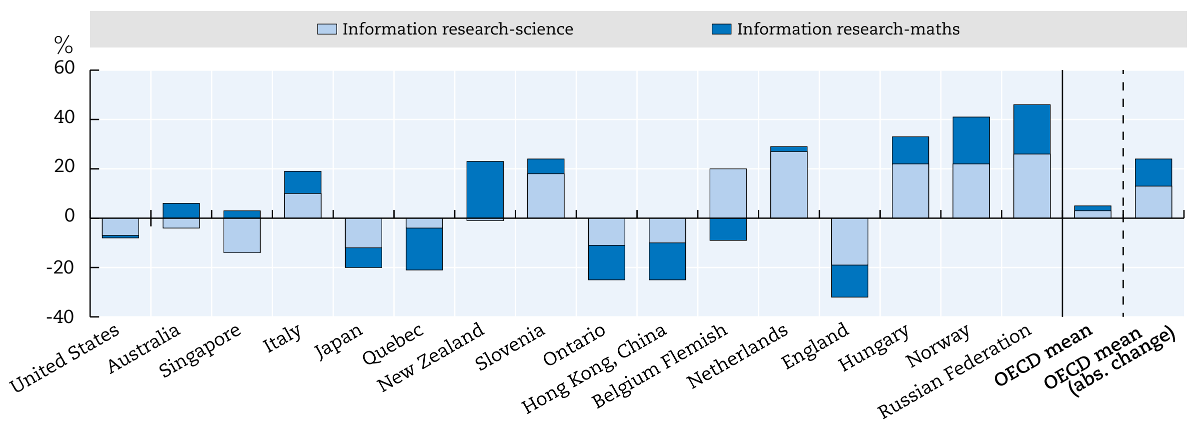
Notes: For details, please see Figures 11.1, 11.2, 11.3 and 11.4.

Figure 11.17 **Change in the use of computers to look up ideas and information in 8th grade**



StatLink http://dx.doi.org/10.1787/888933084988

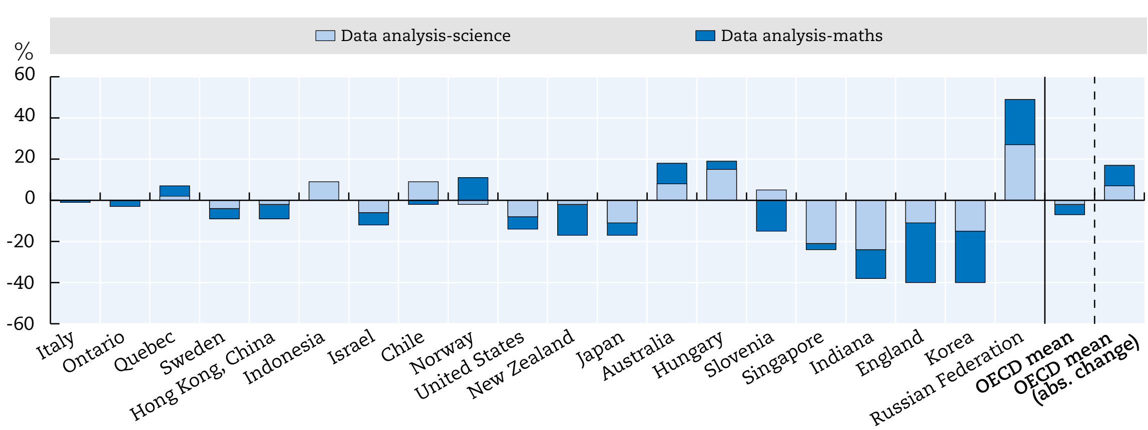
Figure 11.18 **Change in the use of computers to look up ideas and information in 4th grade**



StatLink http://dx.doi.org/10.1787/888933085007

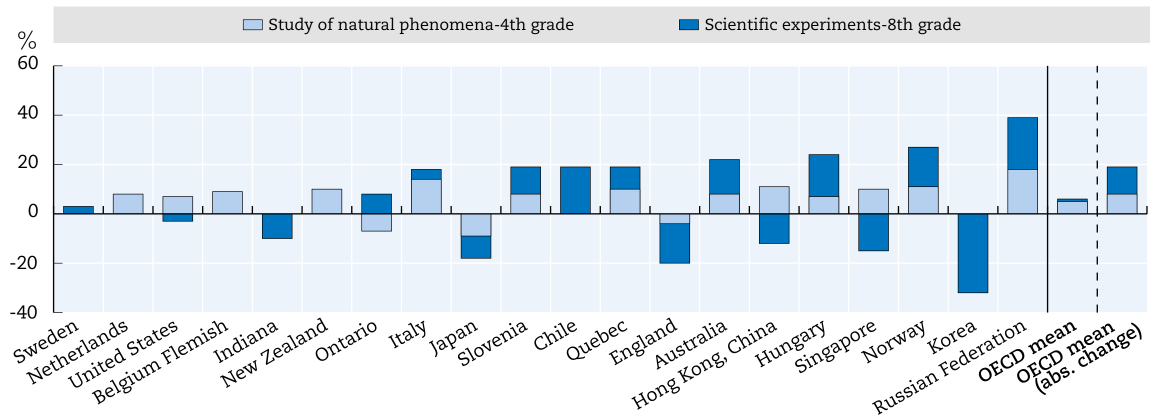
Notes: OECD average includes all OECD education systems. For details, please see Figures 11.5, 11.6, 11.7 and 11.8.

Figure 11.19 **Change in the use of computers to analyse data in 8th grade**



StatLink http://dx.doi.org/10.1787/888933085026

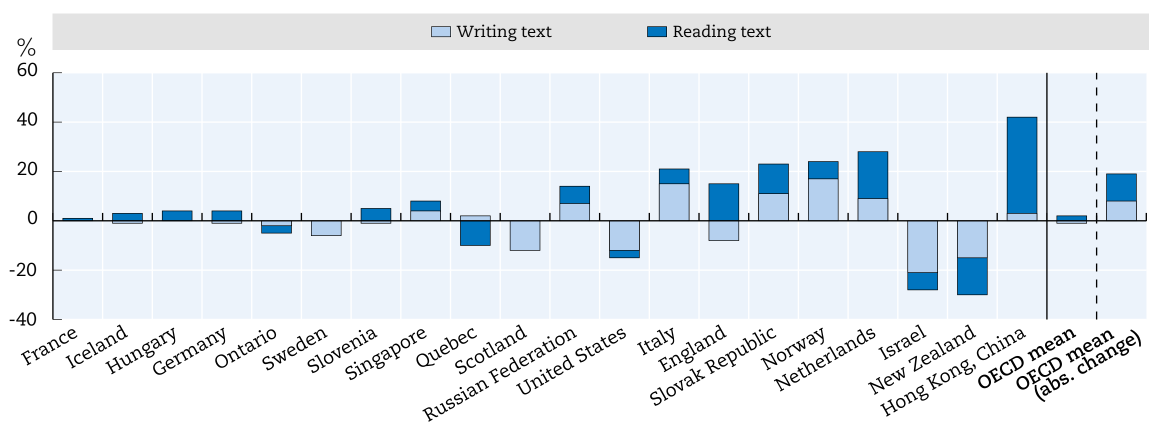
Figure 11.20 **Change in the use of computers to study and conduct scientific experiments**



StatLink http://dx.doi.org/10.1787/888933085045

Notes: OECD average includes all OECD education systems. For details, please see Figures, 11.9, 11.10 ,11.11 and 11.12.

Figure 11.21 **Change in the use of computers to read or write text in 4th grade**



StatLink http://dx.doi.org/10.1787/888933085064

Notes : For details, please see Figures 11.13 and 11.14.

Note on Israel

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.

Table 11.1 Effect sizes for changes in the use of computers in classrooms

	To practice skills and procedures				To lookup information				To analyse data		To conduct scientific experiments		To read/ write text	
	8th grade		4th grade		8th grade		4th grade		8th grade				4th grade	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	8th grade	4th grade	Read text	Write text
	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-11	01-06	01-06
Australia	0.38	0.37	0.09	-0.03	0.13	-0.14	0.13	-0.08	0.21	0.16	0.29	0.16	m	m
Belgium Flemish	m	m	-0.25	0.45	m	m	-0.20	0.43	m	m	m	0.23	m	m
Ontario	0.12	0.30	-0.21	-0.14	0.04	0.11	-0.29	-0.22	-0.06	0.01	0.18	-0.16	-0.09	-0.04
Quebec	0.12	0.14	-0.38	0.11	0.23	0.07	-0.43	-0.08	0.23	0.04	0.27	0.26	-0.28	0.07
Chile	-0.07	0.22	m	m	-0.15	0.07	m	m	-0.05	0.18	0.40	m	m	m
France	m	m	m	m	m	m	m	m	m	m	m	m	0.03	0.00
Germany	m	m	m	m	m	m	m	m	m	m	m	m	0.12	-0.02
Hungary	0.25	0.59	0.43	0.47	0.40	0.45	0.36	0.54	0.10	0.36	0.48	0.21	0.23	0.03
Iceland	m	m	m	m	m	m	m	m	m	m	m	m	0.08	-0.02
Israel	-0.12	-0.09	m	m	-0.05	-0.09	m	m	-0.13	-0.12	-0.08	m	-0.21	m
Italy	0.05	0.11	0.09	0.48	0.26	0.05	0.27	0.23	-0.03	-0.01	0.12	0.47	0.20	0.39
Japan	-0.53	-0.27	-0.59	0.11	-0.30	-0.60	-0.25	-0.24	-0.20	-0.33	-0.39	-0.18	m	m
Korea	-0.54	-0.22	m	m	-0.72	-0.40	m	m	-0.53	-0.30	-0.71	m	m	m
Netherlands	m	m	0.14	0.35	m	m	0.05	0.56	m	m	m	0.25	0.56	0.22
New Zealand	-0.09	0.21	0.73	0.23	-0.12	-0.18	0.46	-0.01	-0.35	-0.04	-0.01	0.20	-0.34	-0.29
Norway	0.28	0.66	0.49	0.60	-0.15	0.28	0.44	0.44	0.23	-0.03	0.37	0.31	0.25	0.43
Slovak Republic	m	m	m	m	m	m	m	m	m	m	m	m	0.50	0.51
Slovenia	-0.16	-0.07	0.08	0.13	-0.13	-0.08	0.15	0.40	-0.38	0.11	0.30	0.21	0.23	-0.05
Sweden	0.04	0.13	m	m	-0.08	-0.10	m	m	-0.13	-0.08	0.08	m	0.00	-0.12
England	-0.20	-0.12	-0.34	-0.25	-0.41	-0.22	-0.27	-0.43	-0.59	-0.22	-0.34	-0.07	0.33	-0.17
Scotland	m	m	m	m	m	m	m	m	m	m	m	m	0.01	-0.27
United States	-0.03	-0.05	0.07	0.08	-0.26	-0.20	-0.02	-0.15	-0.13	-0.16	-0.05	0.14	-0.08	-0.27
Indiana	0.08	-0.31	m	m	-0.37	-0.28	m	m	-0.34	-0.49	-0.20	m	m	m
OECD (average)	-0.03	0.11	0.05	0.18	-0.08	-0.07	0.05	0.08	-0.11	-0.04	0.04	0.15	0.09	-0.01
OECD (average absolute)	0.22	0.24	0.30	0.25	0.24	0.22	0.26	0.28	0.23	0.15	0.28	0.22	0.21	0.20
Hong Kong, China	-0.15	-0.19	-0.22	0.10	-0.32	-0.51	-0.34	-0.20	-0.19	-0.04	-0.26	0.24	1.06	0.23
Indonesia	0.00	0.22	m	m	0.18	0.30	m	m	0.01	0.27	0.33	m	m	m
Russian Federation	0.83	1.01	0.73	0.96	0.92	0.88	0.67	0.85	0.62	0.73	0.65	0.72	0.31	0.41
Singapore	-0.18	-0.16	-0.43	0.11	-0.34	-0.56	0.07	-0.29	-0.07	-0.45	-0.31	0.22	0.09	0.14
South Africa	-0.06	0.09	m	m	-0.03	0.03	m	m	-0.01	0.04	0.06	m	m	m

StatLink http://dx.doi.org/10.1787/888933085083

Notes: OECD average includes all OECD education systems for which data is available for all years concerned

= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)

= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)

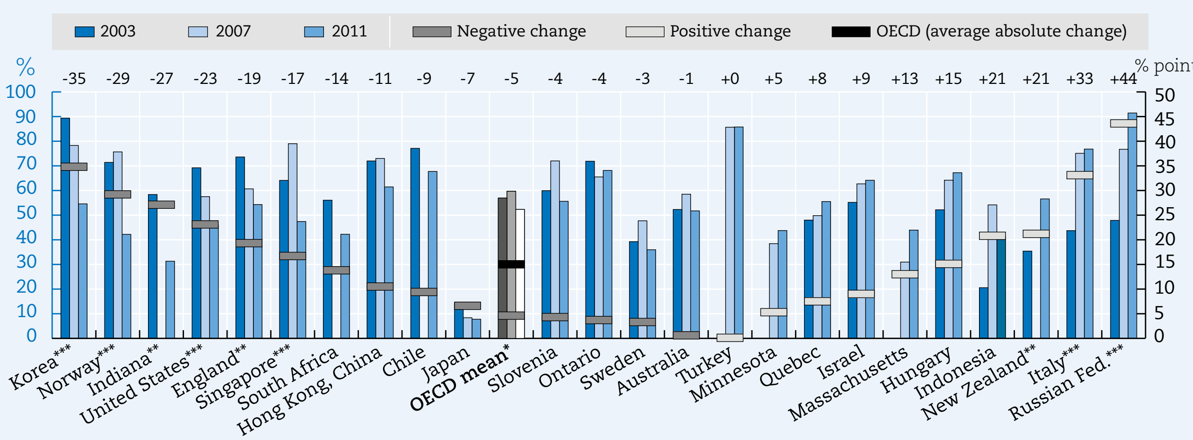
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011) and PIRLS (2001 and 2006)

Box 11.6. Conditional probabilities approach (1/2)

So far in this section, innovation in computer use has been identified by a change in computer use per se, to give a clear idea about the combination of changes in classroom practices and computer availability between 2003 and 2011. However, TIMSS and PIRLS answers on computer use can also be analysed using the conditional probability approach where the percentages are calculated over the subset of those answering yes to the question: "Do the students in this class have computer(s) available to use during their mathematics/science lessons?". The Figures presented below employ this approach; they describe the effective change in use among those classrooms that had a computer available during lessons. This method controls for the change in availability of computers and therefore provides a clearer picture of the extent of any change in use. By comparing the results of these analyses with those above, it is possible to see whether changes relate primarily to a change in the percentage of classrooms with access to a computer, or changes in the proportion of classrooms making specific use of the computer.

Computer use to look up ideas and information in 8th grade mathematics in classrooms with computers.

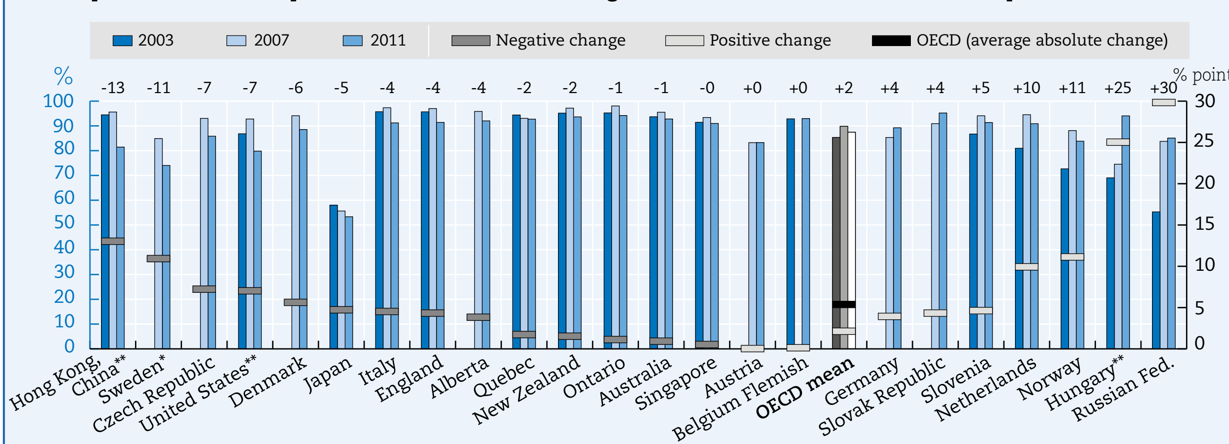


StatLink http://dx.doi.org/10.1787/888933085102

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Computer use to look up ideas and information in 4th grade science in classrooms with computers



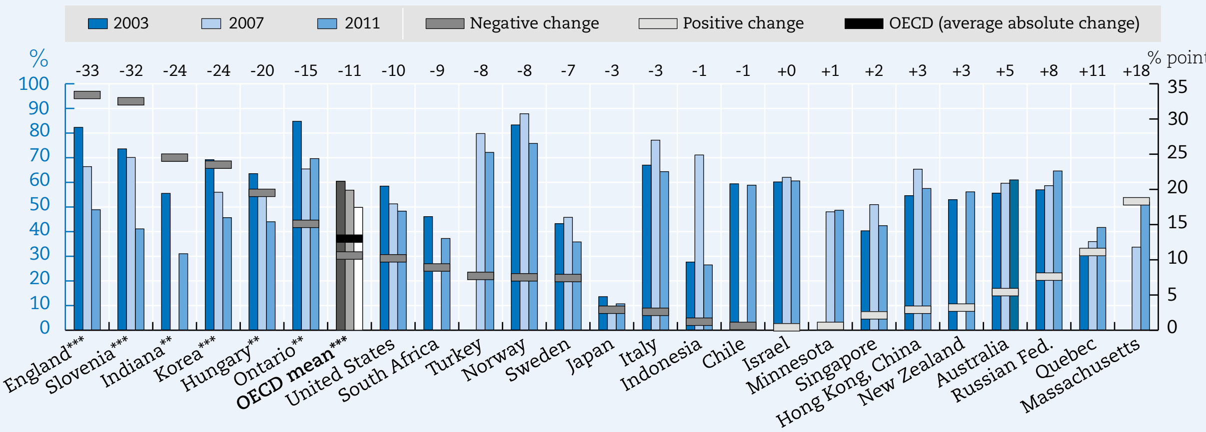
StatLink http://dx.doi.org/10.1787/888933085121

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 11.6. Conditional probabilities approach (2/2)

Computer use to analyse data in 8th grade mathematics in classrooms with computers

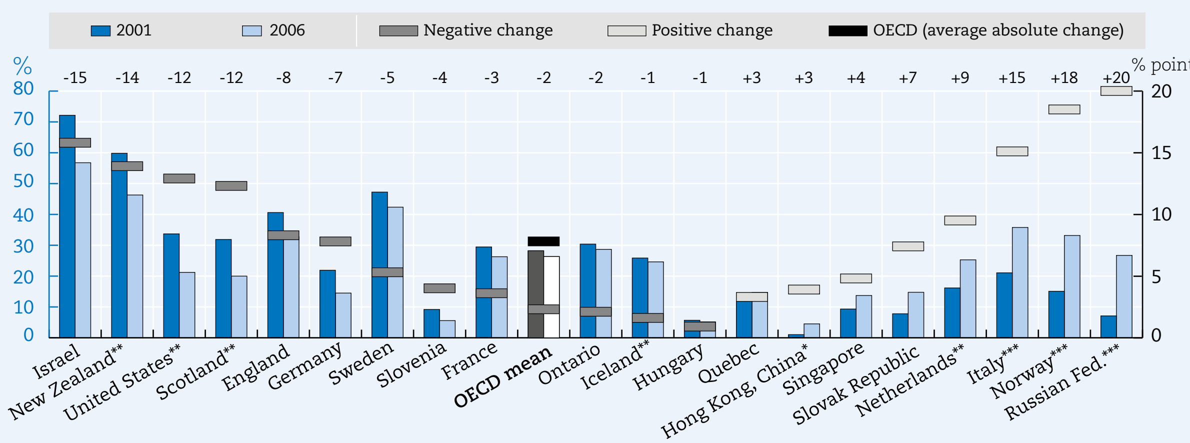


StatLink http://dx.doi.org/10.1787/888933085140

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Computer use to write text in 4th grade reading in classrooms with computers



StatLink http://dx.doi.org/10.1787/888933085159

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PIRLS (2001 and 2006)

CHAPTER 12

Innovation in the provision of special education in schools

Innovation in schools can take the form of providing special education opportunities for students. Schools may choose to offer remedial education to students who need additional support to catch up or keep up with the required skill level of their grade. Schools may also innovate by offering enrichment education for students who have specific interest in a certain discipline and would flourish with extra challenges. The aim of innovation with regard to increasing the use of special education could be, for example, to reduce the inequality in terms of student outcomes and avoid grade repetition, while giving talented students the opportunity to reach their full learning potential. A reduction in the use of remedial education may reflect an innovation such as a move to whole class activities.

Remedial education

General findings

Much innovation has taken place in the form of providing secondary education mathematics and science students with more or less remedial education (Figure 12.1 and Figure 12.2). Between 1999 and 2007, the average absolute change within the OECD area regarding remedial education provision was 17% points for 8th grade mathematics and 16% points for 8th grade science. In mathematics, the increases were the most prominent in Korea (54% points), England (33% points), Turkey (27% points), Quebec (24% points) and Japan (21% points). The decrease was notable in Ontario (19% points). Regarding science, the largest increases took place in Quebec (47% points) and England (37% points). All these changes in individual education systems corresponded to large or medium effect sizes. In contrast,the OECD average and average absolute changes in maths, and average absolute changes in science, presented small effect sizes. Overall, the provision of remedial mathematics increased with at least small effect sizes in eight education systems and decreased in three others. The percentage of 8th grade students attending schools that offered remedial science decreased in seven education systems, while it increased in six others with at least small effect sizes.

Compared to secondary schools, innovation concerning remedial education provision has been less apparent in primary school mathematics, science and reading – although within a shorter period of time (Figure 12.3 to Figure 12.5). For both 4th grade science and mathematics remedial education, the average absolute change for the OECD area was only 5% each between 2003 and 2007. As to having a remedial reading specialist always available in 4th grade classrooms, the average absolute change was 4% points between 2001 and 2006. In mathematics, the increase was prominent in the Russian Federation (26% points) – with a medium effect size. In general, the percentage of 4th grade students attending schools that provided remedial mathematics increased with at least small effect sizes in two education systems and decreased in one system. For science, four education systems experienced increases with small effects, while two others saw decreases. With small effect sizes, two education systems saw decreases and two others increases in the percentage of students whose teachers reported that a reading specialist is always available in their classroom to work with students with reading difficulties.

Country specificities

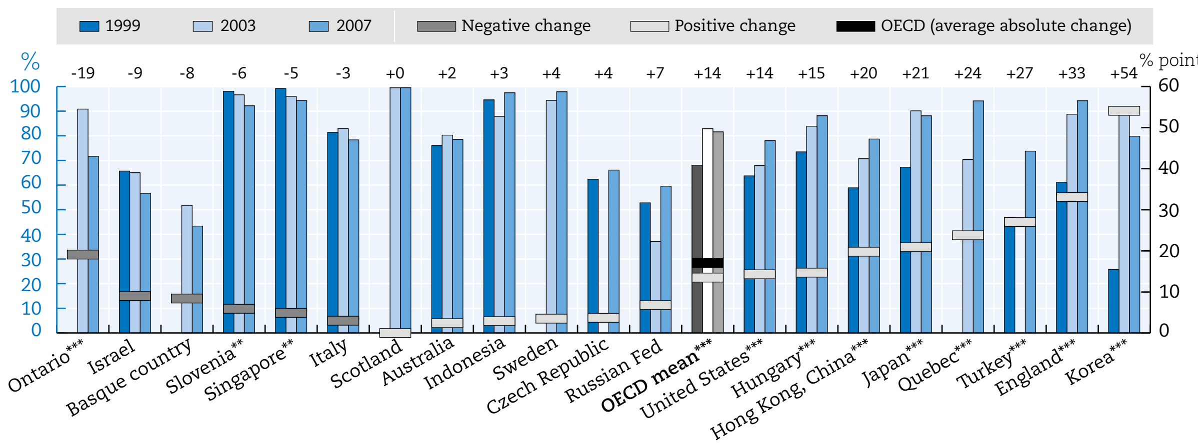
The provision of remedial education for students increased simultaneously in several levels or disciplines in Quebec, England, Israel and the Russian Federation. With at least small effect sizes, Quebec, for example, experienced increases in the percentage of students attending schools that provided remedial mathematics and science both at 8th and 4th grades within the period 2003 to 2007.

By contrast, remedial education provision decreased in a comprehensive manner in Ontario. The provision of both remedial mathematics and science education decreased both at 4th and 8th grades in the Ontario education system from 2003 to 2007 with at least small effects.

Direction of innovation concerning remedial education has not been consistent across education levels and disciplines, as illustrated by the cases of Hong Kong and Singapore. For example in Singapore, remedial mathematics and science in the 8th grade decreased from 1999 to 2007, but increased in science 4th grade within the same period.

Figure 12.1 **Remedial mathematics provision in 8th grade**

Percentage of students in schools that offer remedial mathematics and change over time



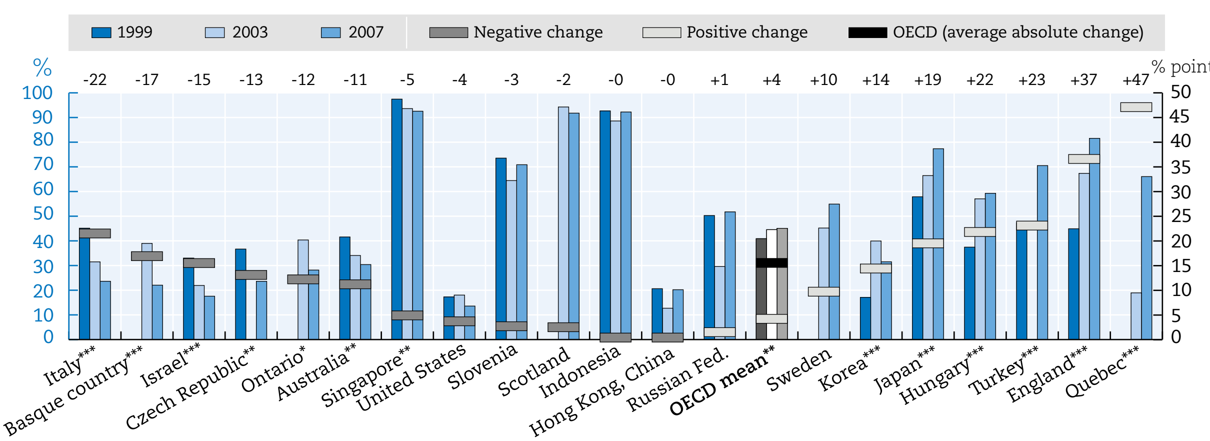
StatLink http://dx.doi.org/10.1787/888933085178

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2003 and 2007 instead of 1999 and 2007 for Canada (Ontario and Quebec), Scotland,Spain (Basque country) and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (1999, 2003 and 2007)

Figure 12.2 **Remedial science provision in 8th grade**

Percentage of students in schools that offer remedial science and change over time



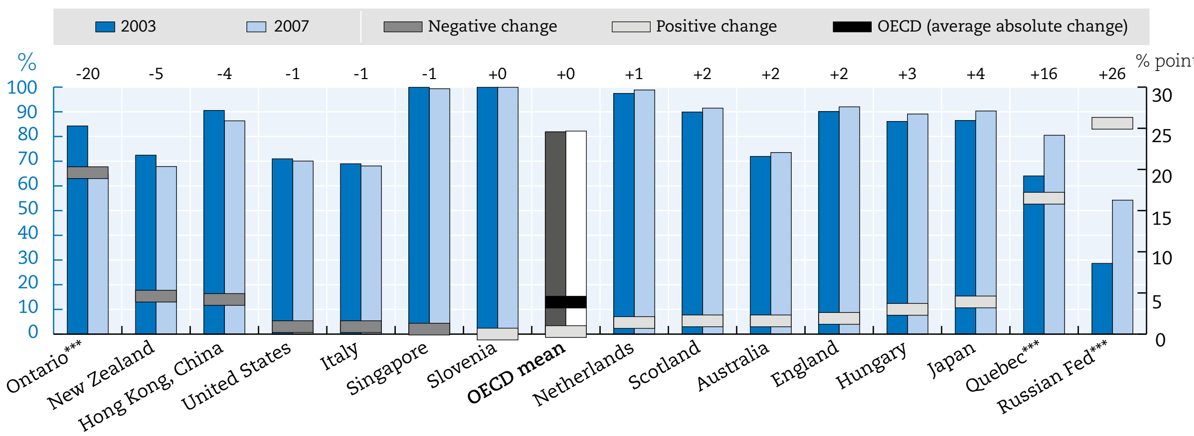
StatLink http://dx.doi.org/10.1787/888933085197

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2003 and 2007 instead of 1999 and 2007 for Canada (Ontario and Quebec), Scotland,Spain (Basque country) and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (1999, 2003 and 2007)

Figure 12.3 **Remedial mathematics provision in 4th grade**

Percentage of students in schools that offer remedial mathematics and change over time



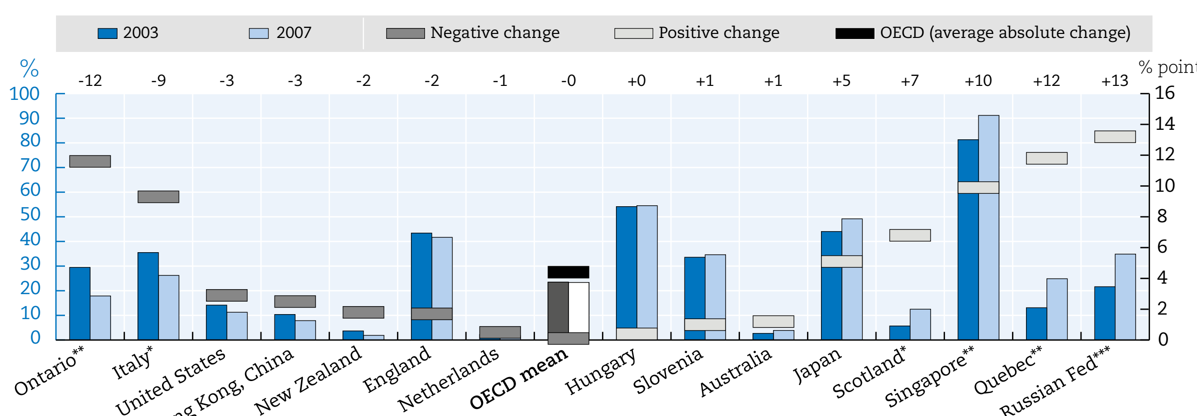
StatLink http://dx.doi.org/10.1787/888933085216

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 12.4 **Remedial science provision in 4th grade**

Percentage of students in schools that offer remedial science and change over time



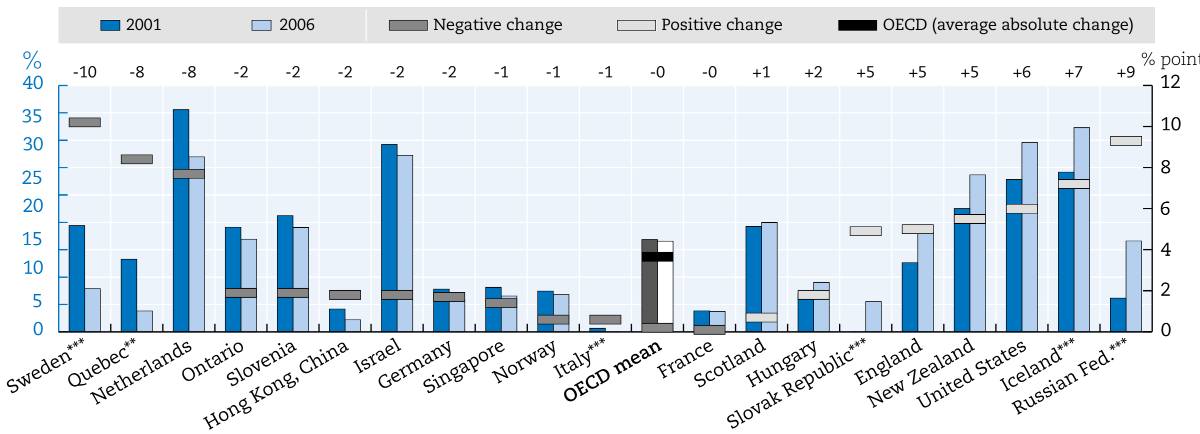
StatLink http://dx.doi.org/10.1787/888933085235

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 12.5 **Availability of specialists to work with 4th grade students with reading difficulties**

Percentage of students in schools with reading specialists always available in classrooms to work with students with reading difficulties and change over time



StatLink http://dx.doi.org/10.1787/888933085254

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PIRLS (2001 and 2006)

Box 12.1 **Data source details for Figures 12.1 to 12.5**

TIMSS (1999, 2003 and 2007) surveys asked school principals and department heads "Does your school do any of the following for students in the <eighth-grade> / <fourth-grade>? […] Offer remedial mathematics […] science" with answer options "Yes/No". PIRLS (2001 and 2006) survey asked teachers "Are the following resources available to you to deal with students who have difficulty with reading? […] A <reading specialist> is available to work in my classroom with those students", with response options "Always; Sometimes; Never". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Enrichment education

General findings

Innovation is apparent through several decreases and some increases in the provision of enrichment education in secondary education mathematics and science (Figure 12.6 and Figure 12.7). Within the period 1999 to 2007 the average absolute change in the OECD area was 16% points for 8th grade mathematics and 15% points for 8th grade science enrichment. The largest decreases in enrichment education for 8th grade science took place in the Russian Federation (50% points), Israel (30% points) and Hong Kong (25% points), while England (34% points) and Japan (30% points) saw the greatest increases. As for mathematics, the decreases were notable in the Russian Federation (43% points) and Ontario (26% points) and the increases in Korea (41% points), Japan (37% points) and England (31% points). Changes in individual education systems presented large to medium effect sizes, whereas, in the case of the OECD average and average absolute, effect sizes were small for 8th grade mathematics and average absolute effect sizes were small for 8th grade science. The percentage of students attending schools that offer enrichment education in mathematics decreased in seven education systems and increased in six others, with at least small effect sizes. The provision of enrichment education in science decreased in eight education systems, while increasing in four others with at least small effect sizes.

Within a shorter time period, innovation with regard to enrichment education in primary school mathematics, science and reading has meant increased or decreased provision in some systems (Figure 12.8 to Figure 12.10). Between 2003 and 2007, the average absolute change for the OECD area regarding 4th grade enrichment education was 8% points for mathematics and 7% points for science. As to the provision of informal reading initiatives in the 4th grade, the average absolute change for the OECD area was 4% points between 2001 and 2006. The increase in mathematics was prominent in Japan (26% points) and the decrease notable in Ontario (25% points) – as illustrated by medium effect sizes. Overall, the percentage of 4th grade students attending schools that provide mathematics enrichment classes increased with medium to small effect sizes in three education systems and decreased in one system. For science, three education systems experienced increases with small effect sizes, while two others saw decreases. In addition, five education systems saw increases in the percentage of 4th grade students whose schools have informal initiatives such as book clubs to encourage students to read,with small effect sizes.

Country specificities

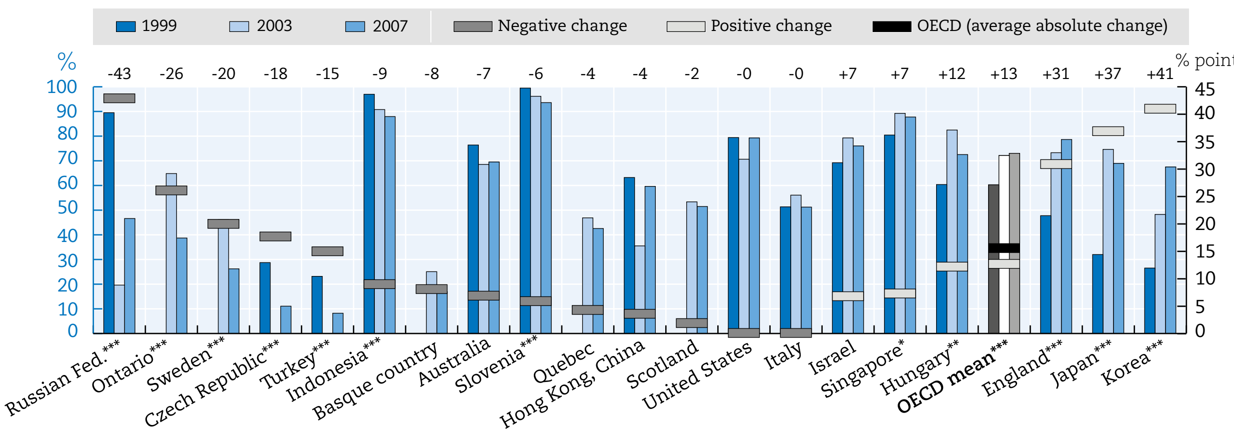
Japan and England stand out as education systems where innovation took the form of increased enrichment education provision in several education levels or disciplines simultaneously. For example, with at least small effect sizes, England saw increases in the percentage of students attending schools that provided enrichment classes in 8th grade mathematics and science as well as in 4th grade science during the period 1999 to 2007.

However, enrichment education provision decreased across several disciplines or education levels in Turkey, Ontario and Indonesia. For example, enrichment education in both mathematics and science in the 8th grade decreased in Indonesia between 1999 and 2007 with small effects.

The cases of Slovenia, the Russian Federation and Hong Kong illustrate that innovation is not always consistent across disciplines and levels of education. For example, although 8th grade mathematics and science enrichment education provision decreased in the Russian Federation from 1999 to 2007 with large effect sizes, it increased in 4th grade enrichment mathematics with small effect sizes. The provision of informal reading initiatives also increased in Russian primary schools between 2001 and 2006.

Figure 12.6 Enrichment mathematics provision in 8th grade

Percentage of students in schools that offer enrichment mathematics and change over time



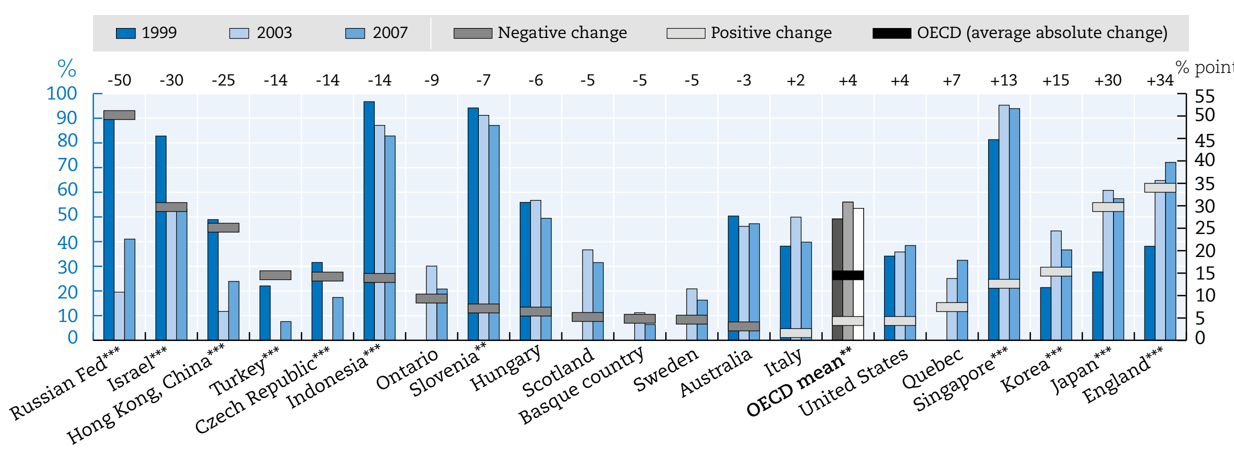
StatLink http://dx.doi.org/10.1787/888933085273

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2003 and 2007 instead of 1999 and 2007 for Canada (Ontario and Quebec), Scotland,Spain (Basque country) and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (1999, 2003 and 2007)

Figure 12.7 Enrichment science provision in 8th grade

Percentage of students in schools that offer enrichment science and change over time



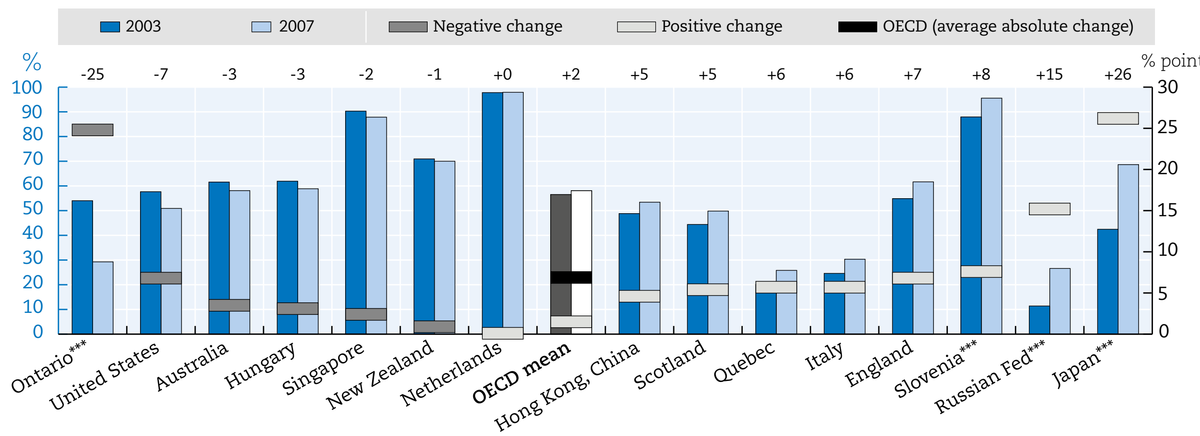
StatLink http://dx.doi.org/10.1787/888933085292

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2003 and 2007 instead of 1999 and 2007 for Canada (Ontario and Quebec), Scotland,Spain (Basque country) and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (1999, 2003 and 2007)

Figure 12.8 **Enrichment mathematics provision in 4th grade**

Percentage of students in schools that offer enrichment mathematics and change over time



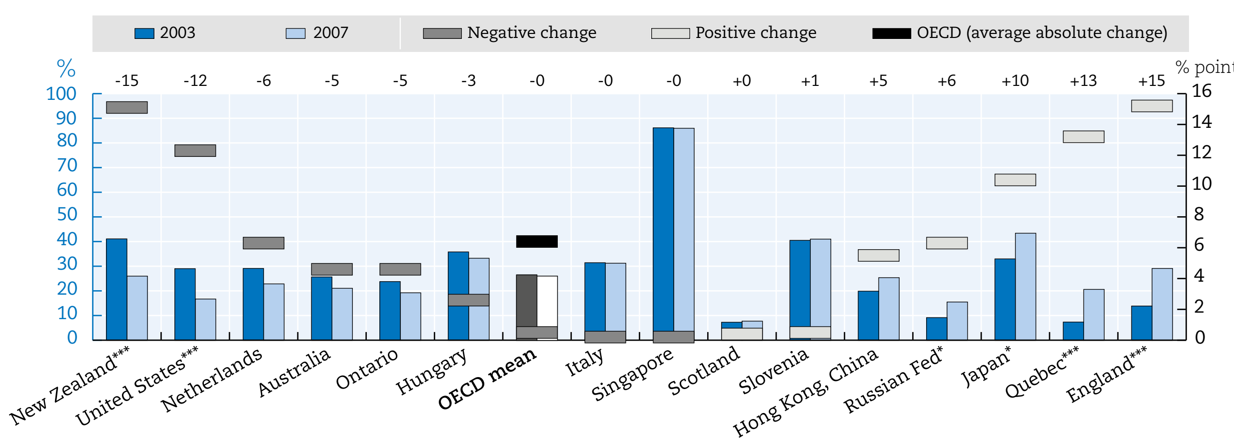
StatLink http://dx.doi.org/10.1787/888933085311

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 12.9 **Enrichment science provision in 4th grade**

Percentage of students in schools that offer enrichment science and change over time



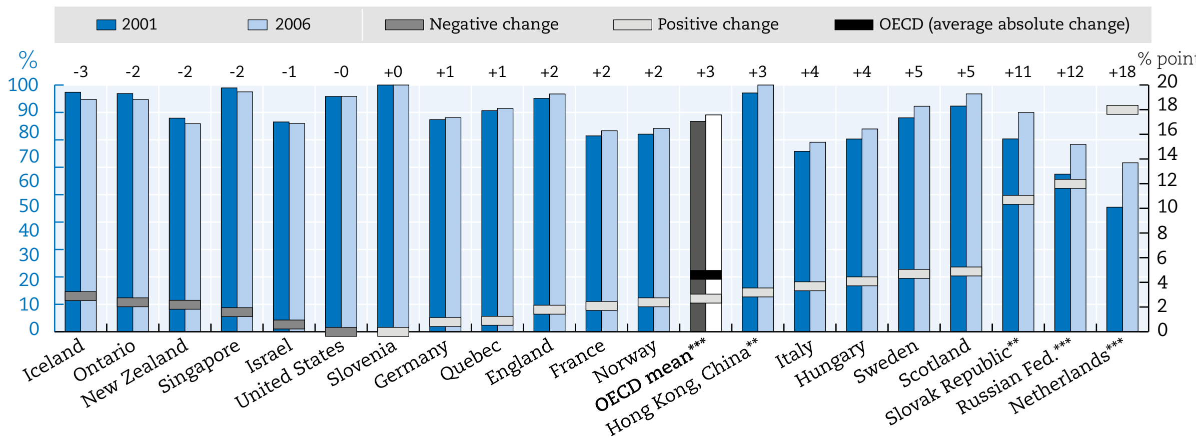
StatLink http://dx.doi.org/10.1787/888933085330

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 12.10 **Provision of informal initiatives to encourage 4th grade students to read**

Percentage of students in schools that offer informal initiatives to encourage students to read and change over time



StatLink http://dx.doi.org/10.1787/888933085349

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PIRLS (2001 and 2006)

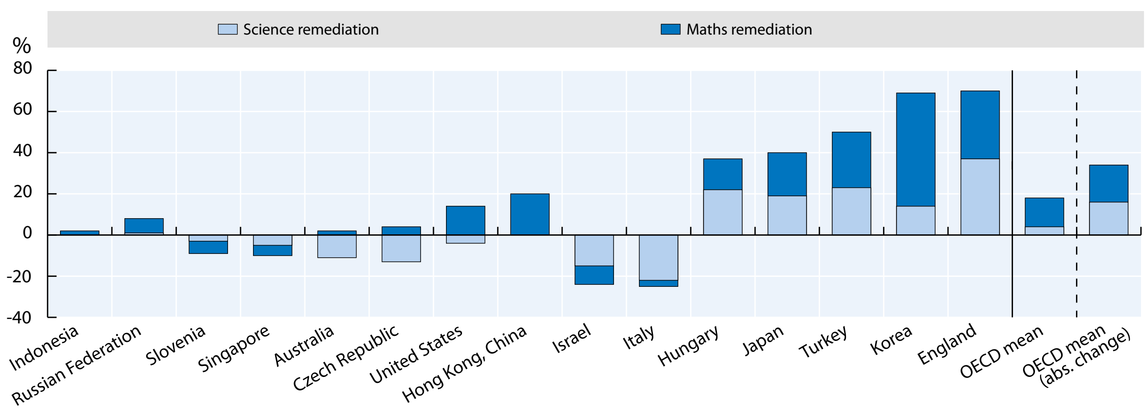
Box 12.2 **Data source details for Figures 12.6 to 12.10**

TIMSS (1999, 2003 and 2007) surveys asked school principals and department heads "Does your school do any of the following for students in the <eighth-grade> / <fourth-grade>? […] Offer enrichment mathematics […] science" with answer options "Yes/No". PIRLS (2001 and 2006) survey asked principals "Does your school have the following? […] Informal initiatives to encourage students to read (for example, book clubs, independent reading contests, school-wide recreational reading periods)" with answer options "Yes/No" The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

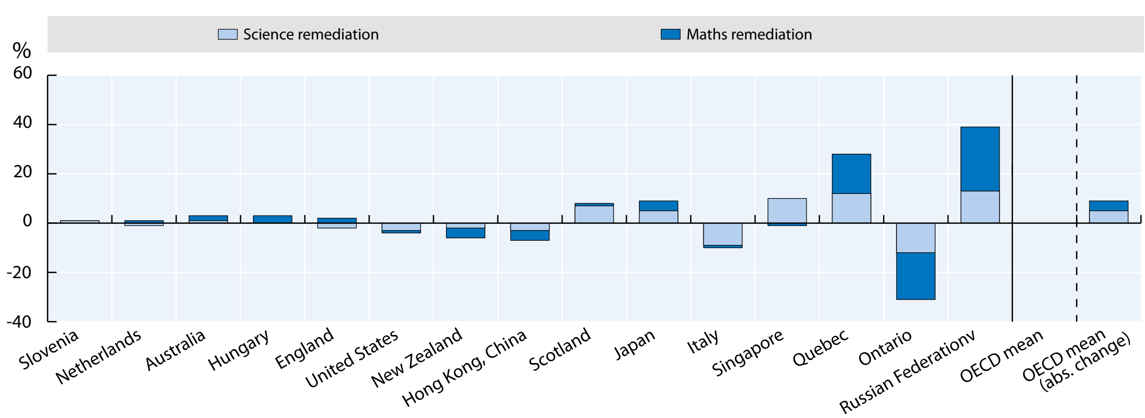
Innovation – or significant change – regarding special education provision has meant both more and less provision in secondary and primary education. Change in the OECD area was balanced across disciplines and unbalanced across levels. Its direction can only be determined in the case of secondary education, where it translated into a significant increase in remedial and enrichment education offerings between 1999 and 2007.

Figure 12.11 **Change in the provision of remedial education in 8th grade**



StatLink http://dx.doi.org/10.1787/888933085368

Figure 12.12 **Change in the provision of remedial education in 4th grade**



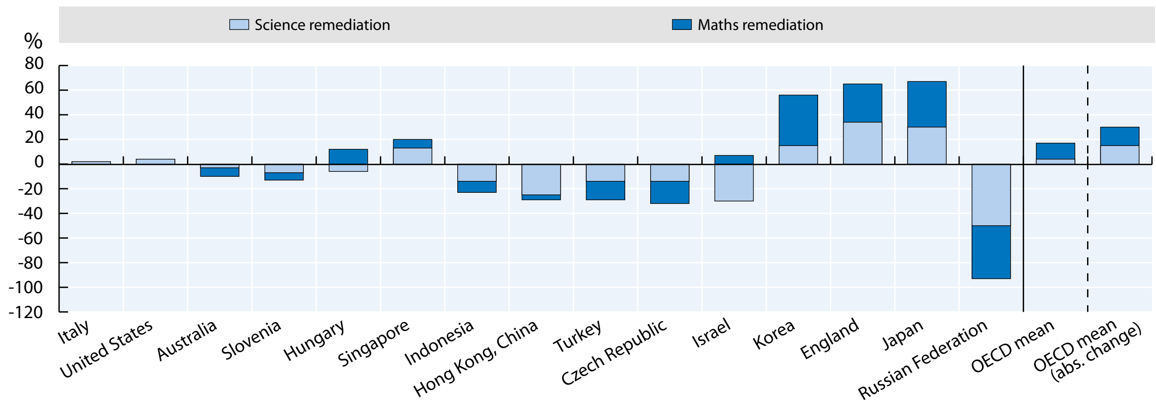
Notes: For details, please see Figures 12.1,12. 2,12.3 and 12.4.

StatLink http://dx.doi.org/10.1787/888933085387

Note on Israel

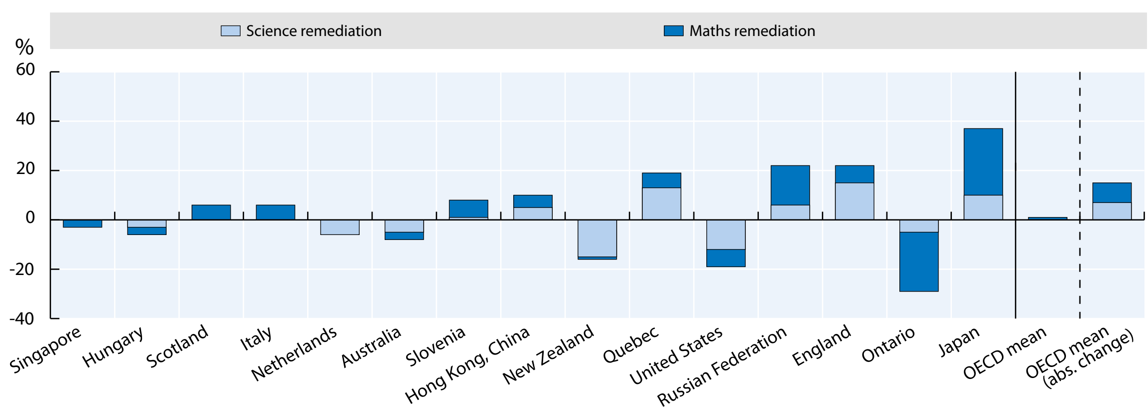
The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

Figure 12.13 **Change in the provision of enrichment education in 8th grade**



StatLink http://dx.doi.org/10.1787/888933085406

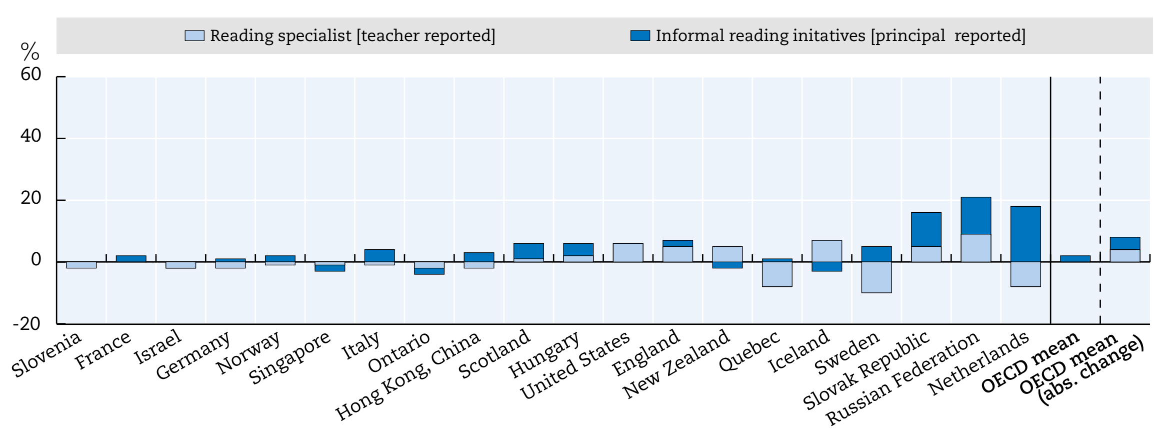
Figure 12.14 **Change in the provision of enrichment education in 4th grade**



StatLink http://dx.doi.org/10.1787/888933085425

Notes: OECD average includes all OECD education systems. For details, please see Figures 12.5, 12.6, 12.7 and 12.8.

Figure 12.15 **Change in the provision of special education in 4th grade reading**



StatLink http://dx.doi.org/10.1787/888933085444

Notes: OECD average includes all OECD education systems. For details, please see Figures 12.5 and 12.10.

Table 12.1 Effect sizes for changes in the provision of special education

	Change in remedial education					Change in enrichment education				
	8th grade		4th grade			8th grade		4th grade		
	Remedial mathematics	Remedial science	Remedial mathematics	Remedial science	Remedial reading specialist	Enrichment mathematics	Enrichment science	Enrichment mathematics	Enrichment science	Informal reading initiatives
	99-07	99-07	03-07	03-07	01-06	99-07	99-07	03-07	03-07	01-06
Australia	0,06	-0,23	0,04	0,07	m	-0,16	-0,06	-0,07	-0,11	m
Ontario	m	m	-0,46	-0,27	-0,05	m	m	-0,51	-0,11	-0,12
Quebec	m	m	0,37	0,30	-0,33	m	m	0,13	0,39	0,03
Czech Republic	0,08	-0,29	m	m	m	-0,45	-0,33	m	m	m
France	m	m	m	m	-0,01	m	m	m	m	0,05
Germany	m	m	m	m	-0,07	m	m	m	m	0,02
Hungary	0,38	0,44	0,09	0,01	0,07	0,26	-0,13	-0,06	-0,05	0,10
Iceland	m	m	m	m	0,16	m	m	m	m	-0,14
Israel	-0,19	-0,36	m	m	-0,04	0,15	-0,65	m	m	-0,02
Italy	-0,08	-0,46	-0,02	-0,20	-0,15	0,00	0,03	0,13	0,00	0,09
Japan	0,51	0,42	0,12	0,10	m	0,76	0,61	0,53	0,21	m
Korea	1,15	0,34	m	m	m	0,85	0,34	m	m	m
Netherlands	m	m	0,11	-0,04	-0,16	m	m	0,01	-0,14	0,37
New Zealand	m	m	-0,10	-0,11	0,13	m	m	-0,02	-0,32	-0,06
Norway	m	m	m	m	-0,02	m	m	m	m	0,06
Slovak Republic	m	m	m	m	0,45	m	m	m	m	0,29
Slovenia	-0,29	-0,06	0,00	0,02	-0,05	-0,37	-0,25	0,29	0,01	0,00
Sweden	m	m	m	m	-0,32	m	m	m	m	0,15
Turkey	0,56	0,47	m	m	m	-0,42	-0,42	m	m	m
England	0,86	0,78	0,07	-0,04	0,14	0,65	0,70	0,14	0,38	0,09
Scotland	m	m	0,05	0,24	0,02	m	m	0,11	0,02	0,21
United States	0,32	-0,10	-0,02	-0,09	0,13	0,00	0,09	-0,14	-0,30	0,00
OECD (average)	0,30	0,09	0,02	0,00	-0,01	0,24	0,08	0,04	-0,04	0,07
OECD (average absolute)	0,42	0,36	0,12	0,12	0,14	0,36	0,32	0,18	0,17	0,11
Hong Kong, China	0,43	-0,01	-0,13	-0,09	-0,11	-0,07	-0,53	0,09	0,13	0,36
Indonesia	0,15	-0,02	m	m	m	-0,36	-0,49	m	m	m
Russian Federation	0,14	0,03	0,53	0,30	0,32	-0,98	-1,15	0,39	0,19	0,26
Singapore	-0,30	-0,23	-0,15	0,29	-0,06	0,20	0,39	-0,08	-0,01	-0,12

StatLink http://dx.doi.org/10.1787/888933085463

Notes: OECD average includes all OECD education systems for which data is available for all years concerned

= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (1999, 2003 and 2007) and PIRLS (2001 and 2006)

CHAPTER 13

Innovation in the extent of teacher collaboration in schools

Innovation in schools can take the form of increased or reduced collaboration among teachers in different ways. Teachers may collaborate with their colleagues by sharing knowledge or by preparing instructional materials together, or they could work independently to develop materials that are highly tailored to their specific class. The aim of innovation with regard to teacher collaboration could be, for example, to foster the diffusion of particularly effective practices and to favour collaborative learning environments for teachers. Additionally, teachers could learn about new practices by observing what happens in their colleagues' classrooms. Alternatively, change may occur to reduce the potential stress of being observed, or the time commitment required to observe colleagues.

Instructional collaboration

General findings

Innovation in primary and secondary schools regarding instructional collaboration has meant increased and decreased discussion among teachers on different ways of teaching a particular concept (Figure 13.1 to Figure 13.3). Between 2003 and 2011 the OECD average absolute change regarding frequency of peer discussions of this type was 12% points for 8th grade mathematics, 10% points for 8th grade science and 5% points for 4th grade. Teachers in 8th grade mathematics discussed more frequently especially in Israel (24% points), Slovenia (21% points), England (17% points), United States (14% points) and Chile (13% points). On the contrary, discussion became less frequent in the Russian Federation (21% points), Sweden (19% points), Hong Kong (14% points), Norway (12% points) and South Africa (10% points). In 8th grade science Israel (34% points) presented the largest increase in the frequency of discussions, whereas the decrease was noteworthy especially in the Russian Federation (27% points). Primary education teachers discussed significantly more often in Singapore (14% points), while the opposite was true in the Netherlands (15% points) and the Russian Federation (14% points). These changes had from medium to small effect sizes, whereas the OECD average absolute change in teacher peer discussions presented a small effect size in 8th grade mathematics. Overall, teacher discussions in mathematics increased in six education systems and decreased in six with at least a small effect size, whereas collaboration among science teachers increased in two and decreased in five education systems. In primary education, teachers increased their collaboration in one education system and decreased in three, with at least small effect size.

Innovation in instructional collaboration manifested also through more or less cooperation in planning and preparing instructional materials (Figure 13.4 to Figure 13.6). Between 2003 and 2011, OECD average absolute change amounted to 12% points in science and 10% points in mathematics 8th grade, whereas it was 8% points for teachers in 4th grade. Eighth grade science teachers increased their cooperation especially in Israel (24% points), whereas noteworthy decreases were observed in the Russian Federation (35% points) and Hungary (34% points). Cooperation increased among 8th grade mathematics teachers most notably in Israel (24% points), whereas decreases were remarkable in Indonesia (33% points) and the Russian Federation (29% points). With regard to 4th grade, collaboration in preparing instructional materials especially decreased in the Slovak Republic (30% points). These changes were characterised by medium effect sizes. OECD average absolute effect sizes were small for joint preparation of materials at 8th grade in both maths and science. Overall, teacher collaboration in preparing instructional materials increased in three and decreased in nine education systems for 8th grade science. Similarly, it increased in two education systems and decreased in eight in 8th grade mathematics it with at least small effect size. In primary education, collaboration in preparing instructional materials increased in two education systems and decreased in six.

Country specificities

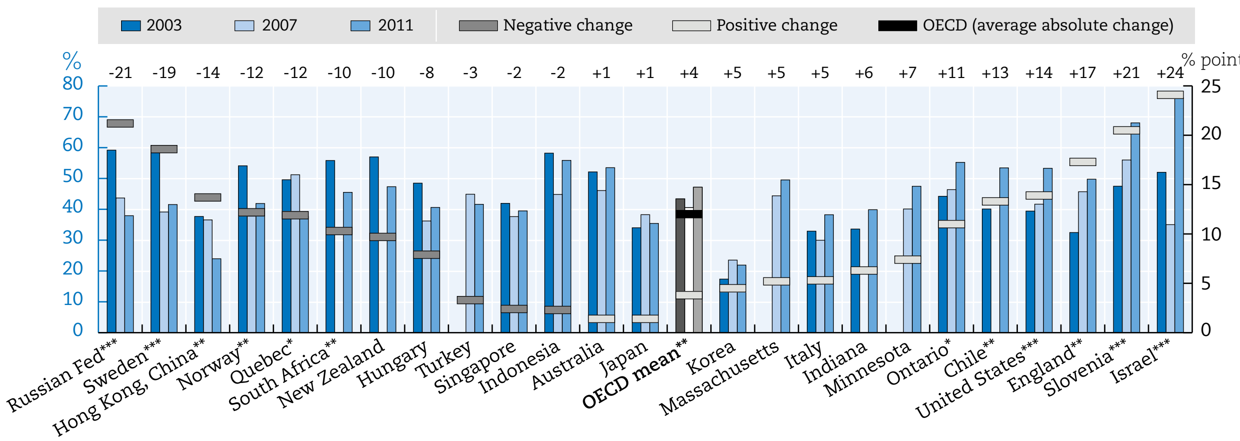
Teacher collaboration practices increased across disciplines in Israel and United States. With at least small effect sizes, teachers in these countries increased both peer discussions and joint preparation of materials in 8th grade mathematics and science, between 2003 and 2011.

In contrast, teacher collaboration decreased substantially across disciplines in the Russian Federation and Sweden. In these countries teachers in 8th grade mathematics and science decreased the levels of peer discussions and joint preparation, with at least small effect sizes.

Direction of innovation regarding teacher collaboration has not been consistent among practices in Norway. Norwegian teachers increased joint preparation with small effect size in 8th grade mathematics and decreased peer discussions in 8th grade science between 2003 and 2011.

Figure 13.1 **Peer discussions amongst 8th grade mathematics teachers**

Percentage of students who have a teacher who discusses with other teachers how to teach a particular topic once a week or more and change over time



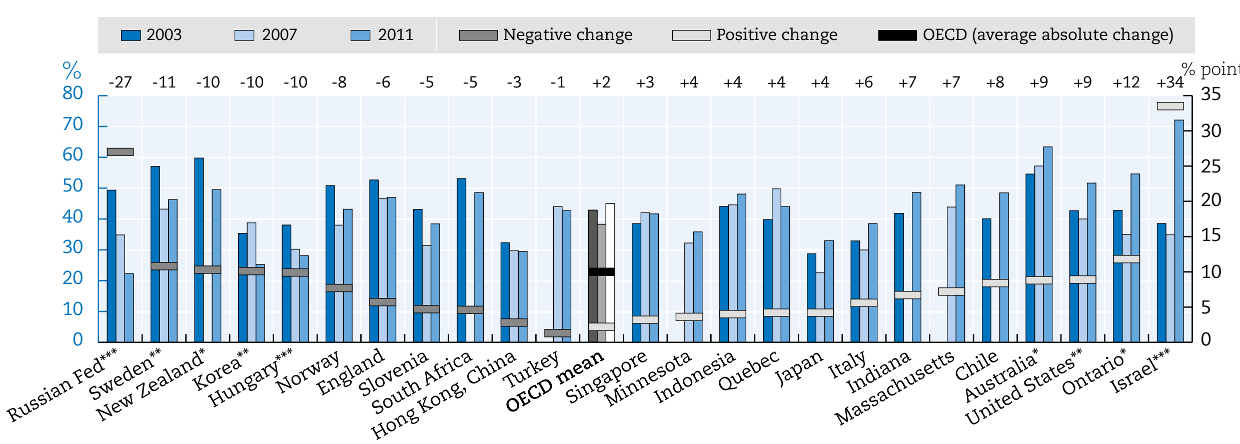
StatLink http://dx.doi.org/10.1787/888933085482

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 13.2 **Peer discussions amongst 8th grade science teachers**

Percentage of students who have a teacher who discusses with other teachers how to teach a particular topic once a week or more and change over time



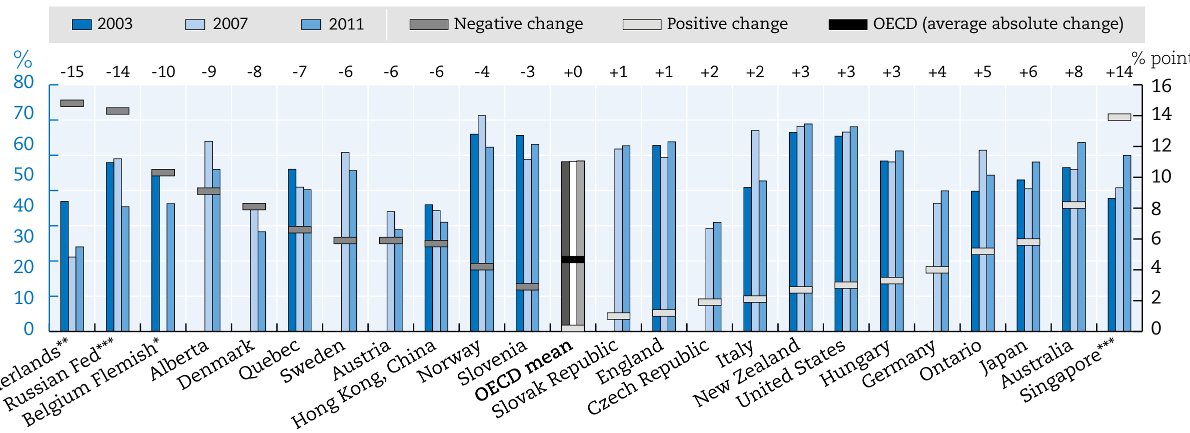
StatLink http://dx.doi.org/10.1787/888933085501

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 13.3 **Peer discussions amongst 4th grade teachers**

Percentage of students who have a teacher who discusses with other teachers how to teach a particular topic once a week or more and change over time



StatLink http://dx.doi.org/10.1787/888933085520

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden . OECD average includes all OECD education systems for which data is available for all years concerned.

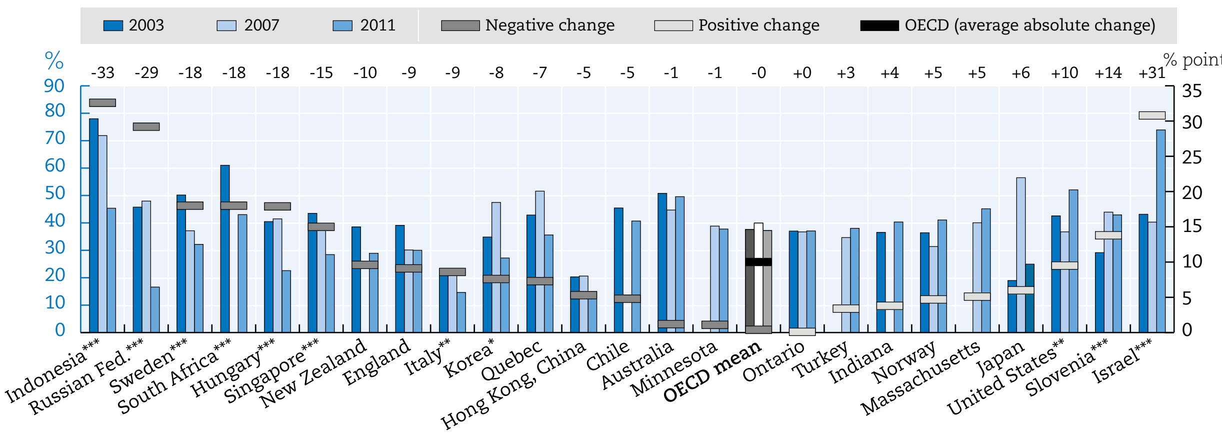
Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 13.1 **Data source details for Figures 13.1 to 13.6**

TIMSS (2003, 2007 and 2011) surveys asked teachers "How often do you have the following types of interactions with other teachers? […] Discuss how to teach a particular topic […] Collaborate in planning and preparing instructional materials […] Visit another classroom to learn more about teaching.", with response options "Never or almost never; 2 or 3 times per month; 1–3 times per week; Daily or almost daily". Same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Figure 13.4 Teacher collaboration in preparing instructional materials in 8th grade mathematics

Percentage of students who have a teacher who collaborates in planning and preparing instructional materials with other teachers once a week or more and change over time



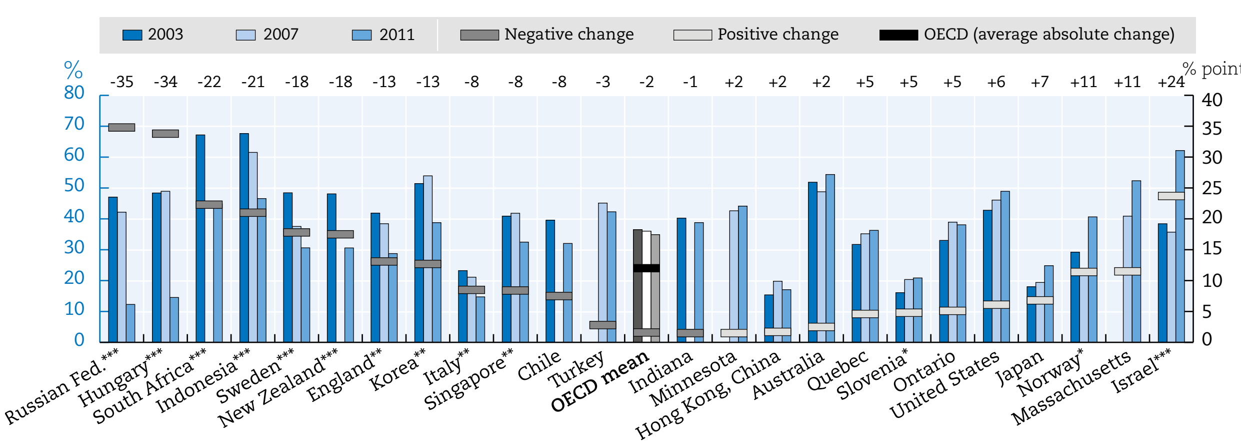
StatLink http://dx.doi.org/10.1787/888933085539

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 13.5 Teacher collaboration in preparing instructional materials in 8th grade science

Percentage of students who have a teacher who collaborates in planning and preparing instructional materials with other teachers once a week or more and change over time



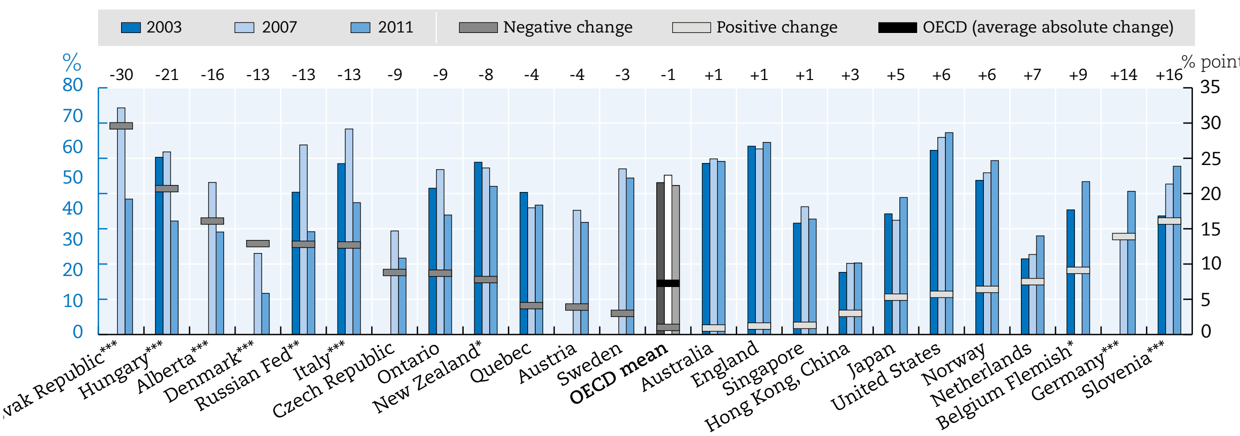
StatLink http://dx.doi.org/10.1787/888933085558

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 13.6 **Teacher collaboration in preparing instructional materials in 4th grade**

Percentage of students who have a teacher who collaborates in planning and preparing instructional materials with other teachers once a week or more and change over time



StatLink http://dx.doi.org/10.1787/888933085577

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Classroom observations

General findings

Innovation in teacher collaboration practices included some change to the proportion of teachers making regular visits to other classrooms to learn teaching practices in secondary education (Figure 13.7 and Figure 13.8). Between 2003 and 2011, the OECD average absolute change was 4% points concerning teachers' visits to other classrooms in 8th grade science and 3% points in 8th grade mathematics. Regarding science, increases in classroom visits occurred in Indonesia (10% points), Ontario (10% points), Hong Kong (8% points), Slovenia (6% points) and Israel (5% points). On the other hand, a decrease was remarkable only in Norway (11% points). In mathematics the increases were noteworthy mostly in Slovenia (11% points) and Ontario (9% points), decreases instead were more pronounced in countries such as Indonesia (13% points) and Norway (8% points). The effect sizes of all these education system changes were small. Overall, teachers' visits to other science classrooms increased in six education systems with small effect sizes and decreased in one with medium effect size. Teachers' visits in mathematics classrooms increased in three education systems and decreased in another three with at least small effect size.

In comparison with secondary education, primary education teachers increased regular visits to their colleagues to learn more about teaching practices (Figure 13.9). The OECD average absolute change in the period between 2003 and 2011 was 8% points concerning classroom observations of other teachers work in 4th grade, although it should be noted that OECD average change and absolute change are heavily driven by changes in Slovenia. The largest increases were observed in Slovenia (59% points), Denmark (11% points), England (8% points) and Singapore (5% points); on the contrary Norway (11% points) showed the largest decrease in teachers' visits to other colleagues in 4th grade. With the exception of Slovenia showing a large effect size, all changes within these education systems and the OECD average absolute presented small effect sizes. Altogether, with a small effect size, increases in classroom observation practices were significant in four education systems, whereas decreases were significant in one.

Country specificities

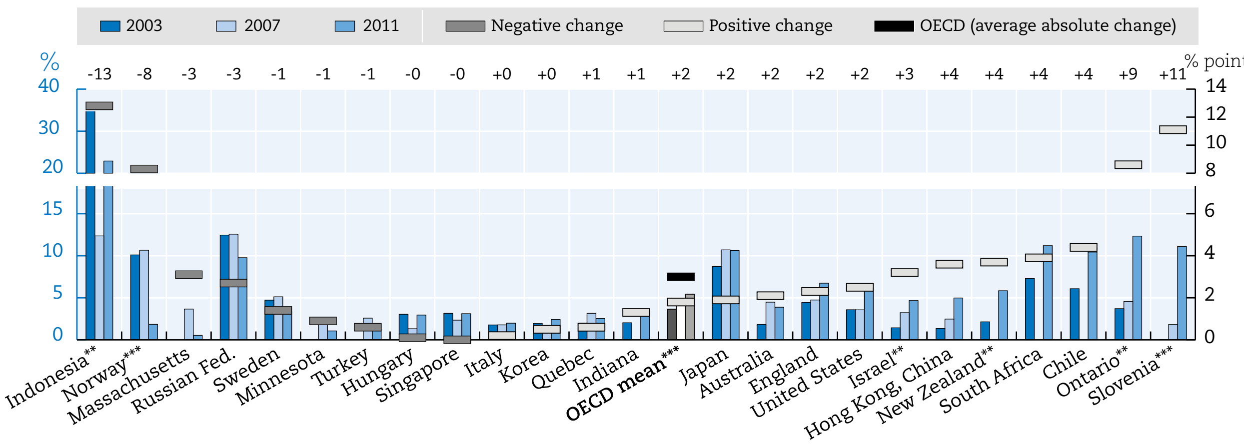
Classroom observation practices in the form of teachers' visits to other colleagues' classrooms increased simultaneously across disciplines and levels in Slovenia and across disciplines in Ontario. Between 2003 and 2011 teachers' visits to other classrooms increased in 8th grade science and mathematics in Slovenia and Ontario with at least small effect size. In Slovenia there was also a significant increase at 4th grade, with a large effect size.

On the contrary, Norway was the only country which experienced reductions across disciplines and levels with regard to classroom observation practices. Norwegian teachers reduced the frequency of their visits to other colleagues both in secondary science and mathematics and in primary education.

The direction of change concerning classroom observation practices has not been consistent in Indonesia across disciplines in secondary education. Indonesian teachers increased the frequency of their visits to other colleagues in 8th grade science between 2003 and 2011 and decreased in 8th grade mathematics.

Figure 13.7 **Classroom observations in 8th grade mathematics**

Percentage of students who have a teacher who visits another classroom to learn more about teaching once a week or more and change over time



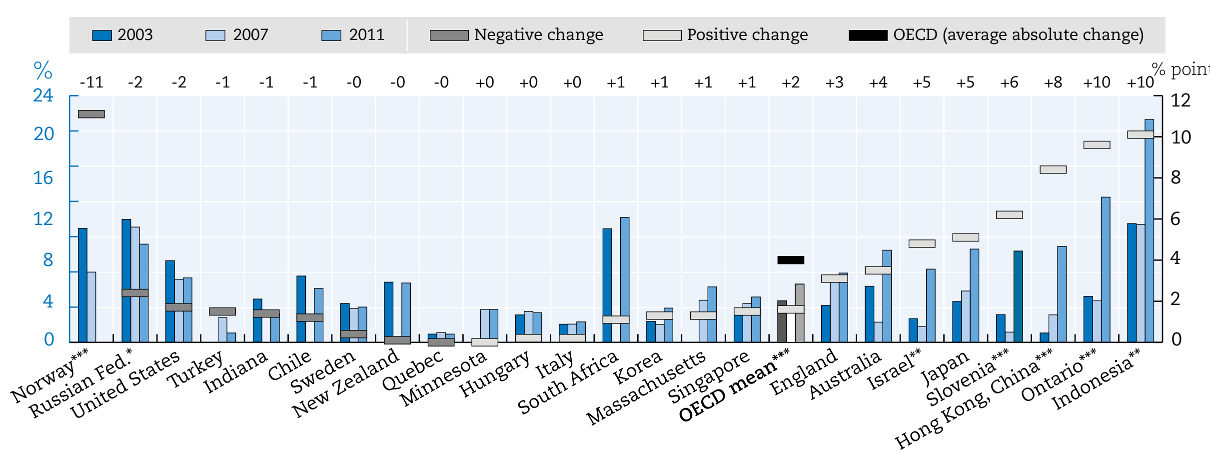
StatLink http://dx.doi.org/10.1787/888933085596

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 13.8 **Classroom observations in 8th grade science**

Percentage of students who have a teacher who visits another classroom to learn more about teaching once a week or more and change over time



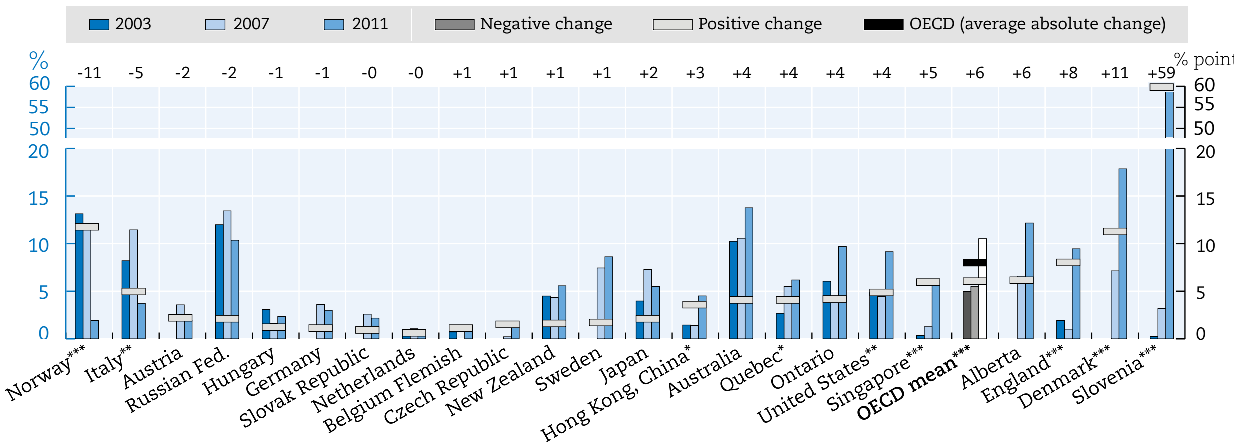
StatLink http://dx.doi.org/10.1787/888933085615

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 13.9 **Classroom observations in 4th grade**

Percentage of students who have a teacher who visits another classroom to learn more about teaching once a week or more and change over time



StatLink http://dx.doi.org/10.1787/888933085634

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

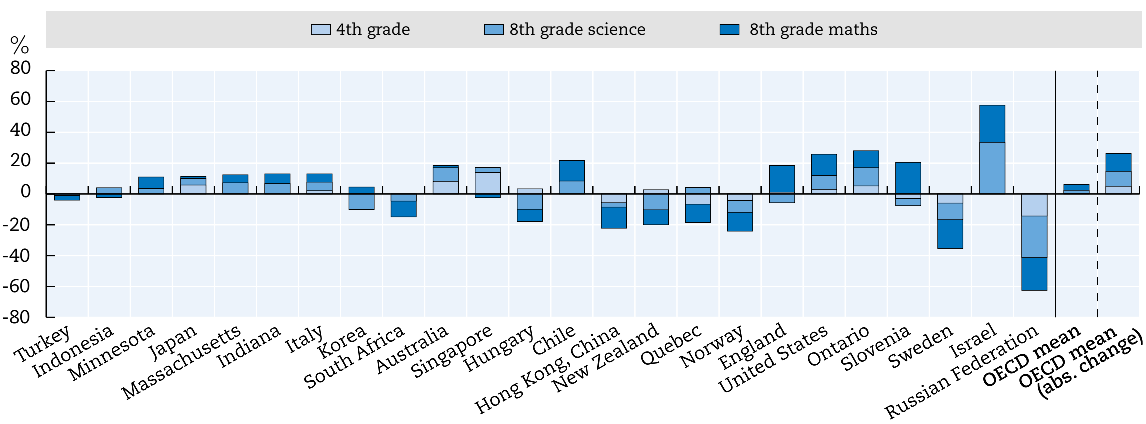
Box 13.2 **Data source details for Figures 13.7 to 13.9**

TIMSS (2003, 2007 and 2011) surveys asked teachers "How often do you have the following types of interactions with other teachers? […] Visit another classroom to learn more about teaching.", with response options "Never or almost never", "2 or 3 times per month", "1–3 times per week" and "Daily or almost daily". Same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

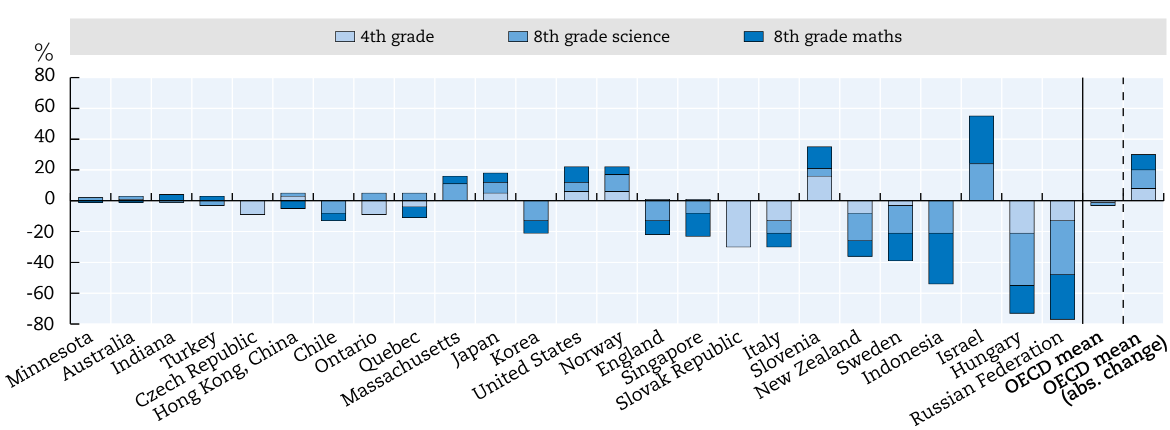
Innovation – or significant change – regarding teacher collaboration has meant more and fewer peer discussions, joint material preparation and classroom observations among teachers in secondary and primary education. While there has been clear change in the OECD area, direction of innovation has not been consistent across education systems and therefore little can be said on the overall trajectory of change between 2003 and 2011 for OECD countries.

Figure 13.10 **Change in the frequency of teachers' peer discussions**



StatLink http://dx.doi.org/10.1787/888933085653

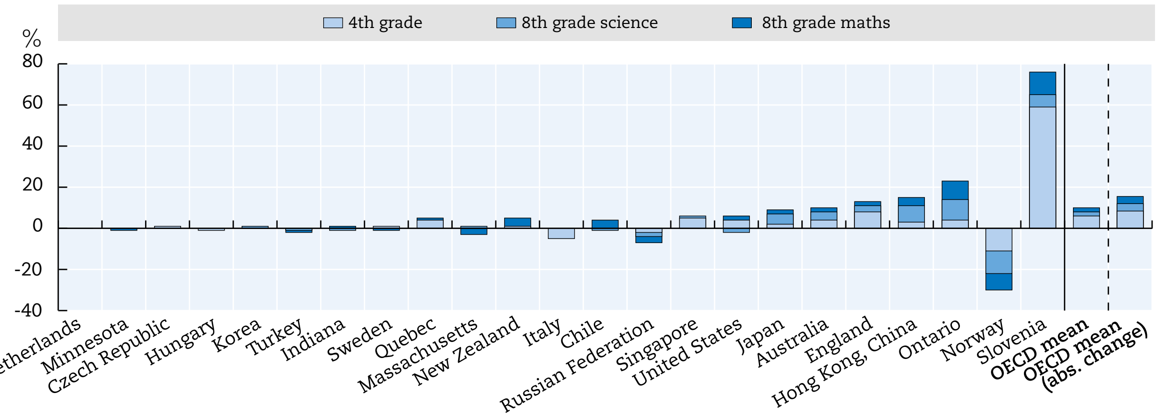
Figure 13.11 **Change in the frequency of teacher collaboration in preparing instructional materials**



StatLink http://dx.doi.org/10.1787/888933085672

Notes: For details please see Figure 13.1, 13.2, 13.3, 13.4, 13.5 and 13.6

Figure 13.12 **Change in the frequency of classroom observations**



Notes: For details please see Figure 13.7, 13.8 and 13.9

StatLink http://dx.doi.org/10.1787/888933085691

Note on Israel

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.

Table 13.1 Effect sizes for changes in teacher collaboration practices

	Change in instructional collaboration						Change in classroom observations		
	8th grade				4th grade		8th grade		4th grade
	Teachers peer discussions		Joint preparation of materials		Teachers peer discussions	Joint preparation of materials	Visits of other teachers classrooms		Visits of other teachers classrooms
	Maths	Science	Maths	Science	All	All	Maths	Science	All
	03-11	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**
Australia	0,03	0,18	-0,02	0,05	0,17	0,01	0,13	0,14	0,11
Belgium Flemish	m	m	m	m	-0,21	0,18	m	m	0,06
Ontario	0,22	0,24	0,00	0,11	0,10	-0,18	0,33	0,34	0,14
Quebec	-0,24	0,09	-0,15	0,10	-0,13	-0,08	0,04	0,00	0,18
Chile	0,27	0,17	-0,10	-0,16	m	m	0,16	-0,05	m
Hungary	-0,16	-0,21	-0,39	-0,76	0,07	-0,42	-0,01	0,01	-0,05
Israel	0,51	0,69	0,64	0,48	m	m	0,20	0,24	m
Italy	0,11	0,12	-0,22	-0,22	0,04	-0,25	0,02	0,02	-0,19
Japan	0,03	0,09	0,14	0,17	0,12	0,11	0,06	0,21	0,07
Korea	0,11	-0,22	-0,17	-0,26	m	m	0,03	0,08	m
Netherlands	m	m	m	m	-0,31	0,17	m	m	-0,01
New Zealand	-0,19	-0,21	-0,20	-0,36	0,06	-0,16	0,19	0,00	0,05
Norway	-0,25	-0,15	0,10	0,24	-0,09	0,13	-0,37	-0,68	-0,47
Slovenia	0,42	-0,10	0,29	0,12	-0,06	0,32	0,66	0,28	1,65
Sweden	-0,37	-0,22	-0,37	-0,37	m	m	-0,07	-0,02	m
England	0,35	-0,11	-0,19	-0,28	0,02	0,03	0,10	0,14	0,35
United States	0,28	0,18	0,19	0,12	0,06	0,12	0,12	-0,07	0,17
Indiana	0,13	0,14	0,08	-0,03	m	m	0,08	-0,08	m
OECD (average)	0,08	0,04	-0,01	-0,04	0,00	-0,02	0,09	0,05	0,17
OECD (average absolute)	0,24	0,20	0,22	0,25	0,10	0,16	0,16	0,17	0,29
Hong Kong, China	-0,30	-0,06	-0,14	0,05	-0,12	0,07	0,22	0,43	0,19
Indonesia	-0,05	0,08	-0,69	-0,43	m	m	-0,28	0,27	m
Russian Federation	-0,43	-0,57	-0,65	-0,80	-0,29	-0,26	-0,09	-0,08	-0,05
Singapore	-0,05	0,06	-0,32	-0,17	0,28	0,03	0,00	0,08	0,37
South Africa	-0,21	-0,09	-0,36	-0,45	m	m	0,14	0,03	m

StatLink http://dx.doi.org/10.1787/888933085710

Notes: OECD average includes all OECD education systems for which data is available for all years concerned

= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011

CHAPTER 14

Innovation in feedback mechanisms in schools

Innovation in schools can take the form of a change in the use of benchmarking, monitoring and feedback activities. Student assessment and achievement data may be used for comparing a school's performance against national benchmarks, against other schools or for monitoring its progress over time to better understand its strengths and weaknesses. Feedback received from assessments can be used for further instructional and curriculum improvement. The aim of innovation with regard to increasing the use of benchmarking, monitoring and feedback activities could be, for example, to improve teaching quality through increased feedback. A decrease may result from the desire to decrease between-school competition or limit the burden of data collection by reducing these activities.

Progress benchmarking and monitoring

General Findings

Much of the innovation in progress monitoring has resulted in less use of student assessments for between-school comparisons and more for comparison with district or national benchmarks across schools teaching 15-year-olds (Figure 14.1 and Figure 14.2). The average absolute change within the OECD area concerning use of assessments for school comparisons was 23% points between 2003 and 2009 whereas it amounted to 15% points for comparison with district or national performance from 2000 to 2009. Hong Kong (68% points), Spain (45% points), Italy (45% points), Iceland (42% points), Poland (40% points), Portugal (39% points) and Hungary (34% points) showed prominent reductions in the use of student assessments for comparison between schools. Increase was noteworthy only in Denmark (19% points). As for comparison with district or national benchmarks, Luxembourg (54% points), Canada (29% points), Portugal (28% points), Denmark (27% points), Switzerland (24% points), United States (23% points) and Germany (21% points) experienced the largest increases. Illustrating the magnitude of change, all increases in these individual education systems were characterised by at least medium effect sizes, whereas the decreases had large effect sizes. OECD average and average absolute effect sizes were small to medium for between-school comparisons and the average absolute effect size was small for comparison with district or national benchmarks. Overall, with at least small effect sizes, assessment use for between-school comparisons decreased in 24 education systems and increased in one. Comparisons with district and national benchmarks increased in 16 systems and decreased in two.

Innovation has also occurred in the form of increased monitoring over time and tracking of the achievement of 15-year-old students by schools and administrations (Figure 14.3 and Figure 14.4). On average absolute level, change between 2000 and 2009 within the OECD area was 12% points regarding the use of student assessments for monitoring school progress over time. It amounted to 7% points between 2006 and 2009 for tracking of achievement data by an administrative authority and to 3% points for parental perception on schools monitoring student progress. In particular, Luxembourg (40% points), Belgium (34% points), Greece (34% points), the United States (24% points) and the Russian Federation (14% points) increased assessment use for monitoring school progress. Decreases in tracking achievement data were prominent in the Netherlands (25% points) and Germany (25% points). Changes in individual systems corresponded to medium to large effect sizes, while the OECD average effect size was small for monitoring school progress as well as for parental perception. There was no notable change for administrative tracking of achievement data on average for the OECD. Overall, with at least small effect sizes, 14 education systems increased the use of student assessment to monitor schools' progress overtime, whereas the opposite was true for three systems. Administrative achievement data tracking increased in eight education systems and decreased in three others with at least small effect sizes.

Country specificities

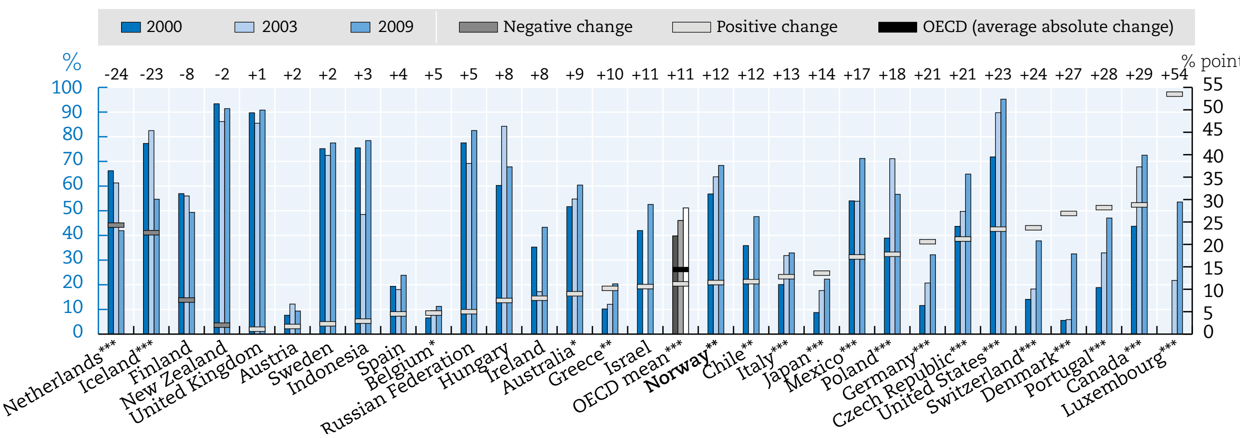
Denmark stands out as the only country where innovation took the form of increased use of assessment data. With at least small effects, assessment use for comparisons between schools and with national benchmarks as well as for monitoring and tracking increased from 2000, 2003 or 2006 to 2009.

In the Netherlands, innovation took the form of decreased monitoring. With at least small effect sizes, assessment use for between-school comparisons and/or district or national performance decreased from 2000 or 2003 to 2009. Also administrative tracking of data decreased from 2006 to 2009.

The cases of Germany and Mexico illustrate that innovation can mean increases in one type of monitoring and decreases in other. In these two countries assessment use for comparison with district or national performance and progress monitoring increased with at least small effects between 2000 and 2009, while use for between-school comparisons decreased from 2003 to 2009.

Figure 14.1 **Use of student assessments for district or national benchmarking**

Percentage of 15-year old students in schools where assessments are used for comparing school to district or national performance and change over time



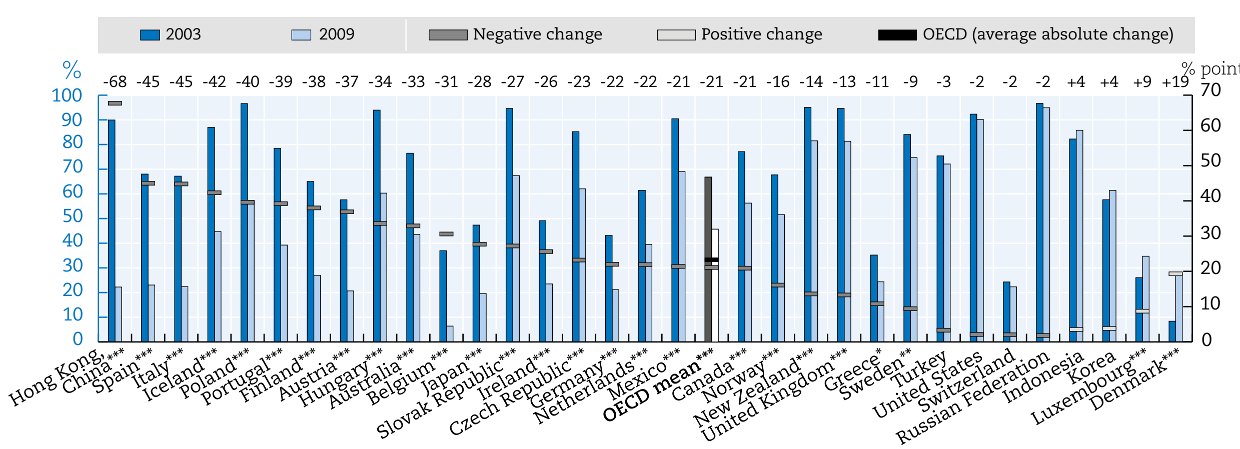
StatLink http://dx.doi.org/10.1787/888933085729

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PISA (2000, 2003 and 2009)

Figure 14.2 **Use of student assessments for between-school comparisons**

Percentage of 15-year old students in schools where assessments are used to compare the school with other schools and change over time



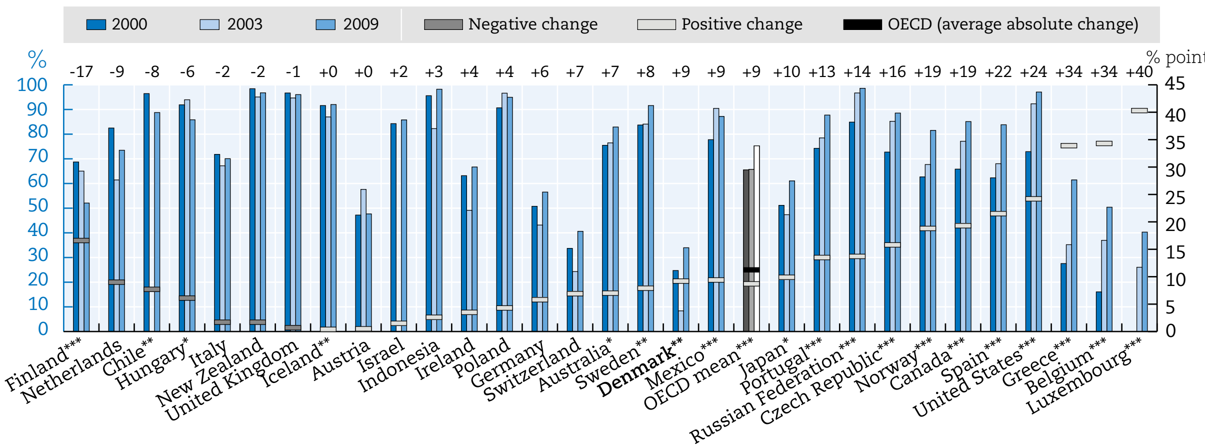
StatLink http://dx.doi.org/10.1787/888933085748

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2003 and 2009)

Figure 14.3 **Use of student assessments for monitoring progress over time**

Percentage of 15-year old students in schools where assessments are used for monitoring progress from year to year and change over time



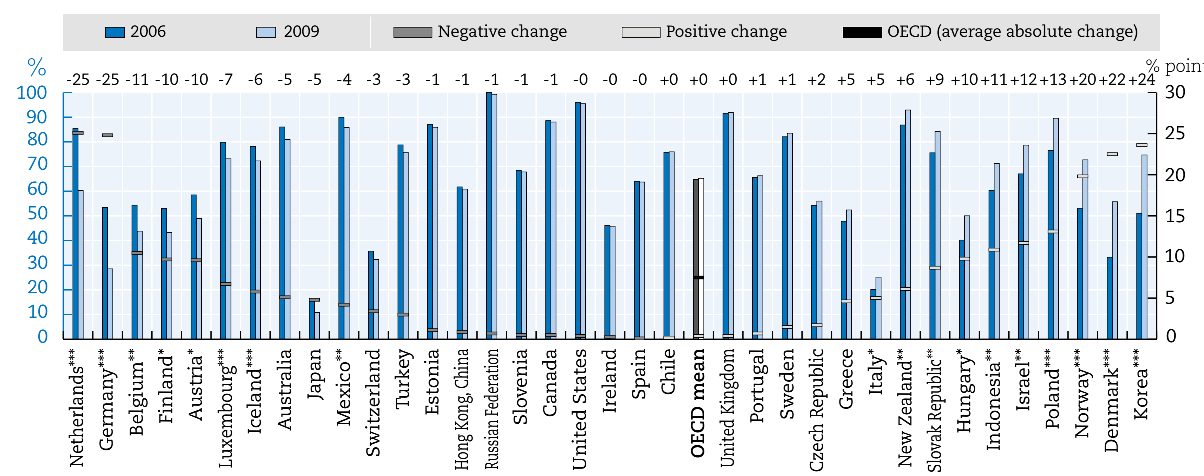
StatLink http://dx.doi.org/10.1787/888933085767

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on PISA (2000, 2003 and 2009)

Figure 14.4 **Administrative tracking of school achievement data**

Percentage of 15-year old students in schools where achievement data is tracked over time by an administrative authority and change over time



StatLink http://dx.doi.org/10.1787/888933085786

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2006 and 2009)

Box 14.1 **Data source details for Figures 14.1 to 14.4**

PISA (2000, 2003 and/or 2009) surveys asked principals "In your school, are assessments of students in <national modal grade for 15-year-olds> used for the following purposes […]To compare the school to <district or national> performance […] To compare the school with other schools […] To monitor the school's progress from year to year" with answer options "Yes/No". PISA (2006 and 2009) asked ''In your school, are achievement data used in any of the following <accountability procedures> […] tracked over time by an administrative authority?" with answer options "Yes/No".

Curriculum and instruction development

General findings

Innovation in the form of increased use of assessment data for instructional and curriculum improvement has taken place in many education systems in schools with 15-year-old students (Figure 14.5). Between 2003 and 2009, the average absolute change within the OECD area for using student assessments to identify improvement aspects for instruction and curriculum amounted to 8% points. The most noteworthy increases took place in Denmark (38% points) and Indonesia (22% points). Hungary (27%) experienced the largest decrease in using assessments to identify points for instructional and curriculum improvement. Change in these individual countries was associated with large to medium effect sizes. In general, the percentage of 15-year-olds in schools where assessments were used to identify points for instructional and curriculum improvement increased with at least small effect sizes in six education systems, while decreasing in only one.

Overall, little innovation has taken place regarding time investment for pedagogical and curriculum development at the primary school level (Figure 14.6). The average absolute change within OECD area regarding the time principals in the 4th grade schools devoted to curriculum and pedagogical development was 3% points between 2001 and 2006. Hungary (10% points) stands out as the only country where principals notably reduced the time devoted to curriculum and instruction development and it is the only country where the change presents a small effect size.

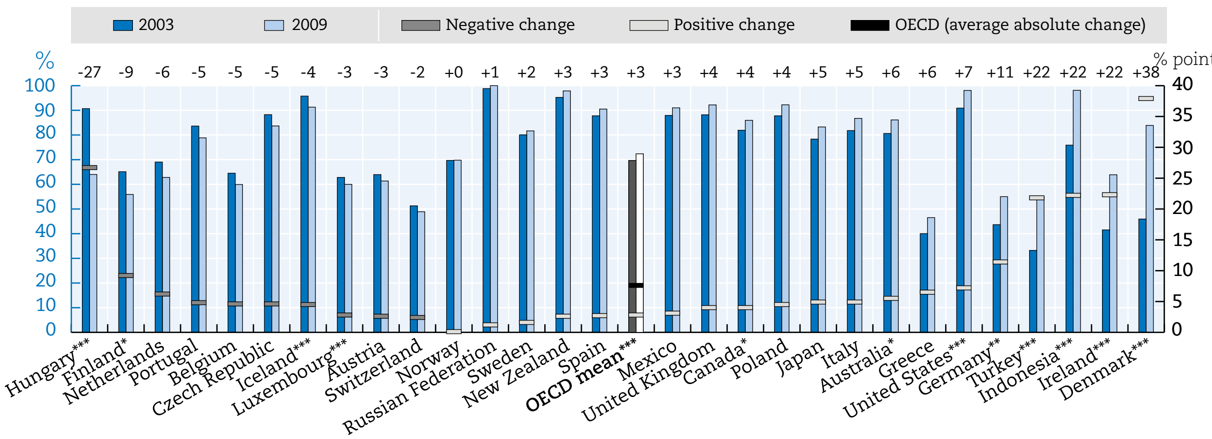
Country specificities

Innovation in Denmark has taken the form of an increase in the use of student assessments for instructional and curriculum improvement. Within the period 2003 to 2009, the share of 15-year-olds attending Danish schools where student assessments were used to identify points for instructional and curriculum improvement increased with a large effect size.

In contrast, innovation took the form of a clear decrease in (data based) curriculum and instruction development in Hungary. In Hungary, the use of student assessments for instructional and curriculum improvement in the schools of 15-year-olds decreased with medium effect size from 2003 to 2009. In addition, the time principals dedicated to curriculum and pedagogy development fell with small effect size between 2001 and 2006.

Figure 14.5 **Use of student assessments for instructional or curriculum improvement**

Percentage of 15-year old students in schools where assessments are used to identify instructional or curriculum improvement and change over time



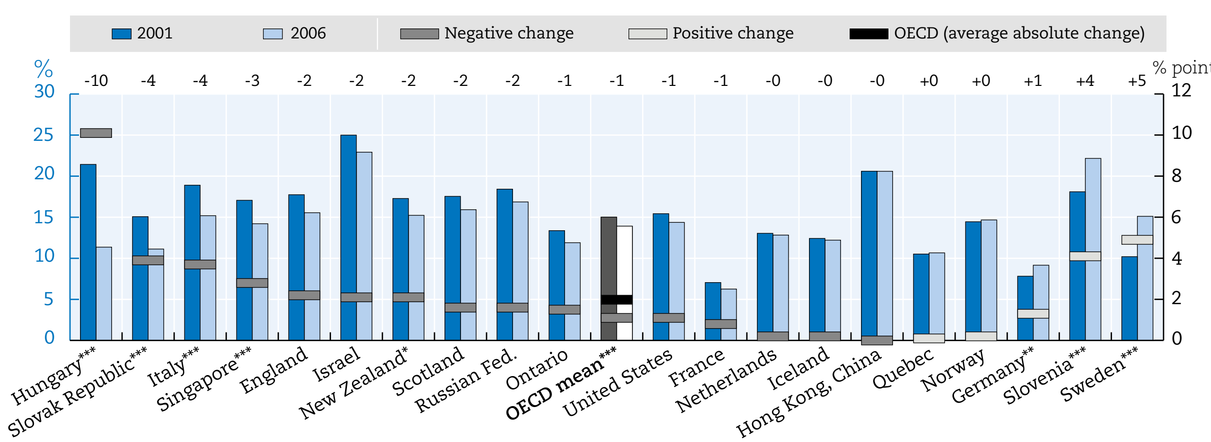
StatLink http://dx.doi.org/10.1787/888933085805

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Sources: Authors' calculations based on PISA (2003 and 2009)

Figure 14.6 **Principals' time devoted to curriculum and pedagogy development at the 4th grade**

Percentage of principals' time devoted to developing curriculum and pedagogy in their school and change over time



StatLink http://dx.doi.org/10.1787/888933085824

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Sources: Authors' calculations based on PIRLS (2001 and 2006)

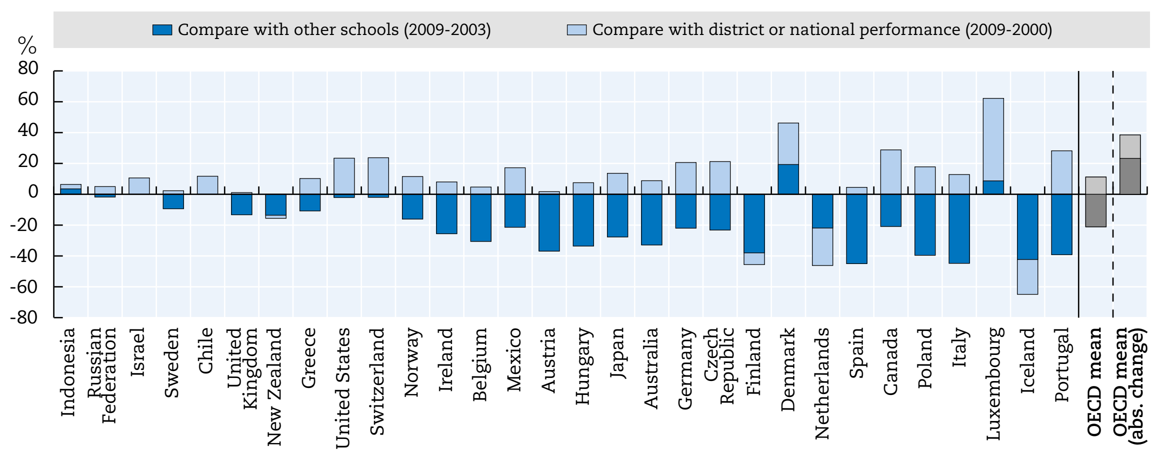
Box 14.2 **Data source details for Figures 14.5 and 14.6**

PISA (2003 and 2009) surveys asked school principals "In your school, are assessments of students in <national modal grade for 15-year-olds> used for the following purposes: [...] To Identify aspects of instruction or the curriculum that could be improved" with answer options "Yes/No". PIRLS (2001 and 2006) surveys asked principals and department heads ''As principal of this school, approximately what percentage of your time is devoted to the following activities? [...] Developing curriculum and pedagogy for your school", with answers expressed in percentages. The same data restrictions as in International PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

Innovation regarding benchmarking, monitoring and feedback practices has meant more or less use of student assessment in secondary schools for external comparison and internal evaluation purposes. Innovation took the form of an increase in performance monitoring for comparison with national benchmarks between 2000 and 2009 and a decrease for comparison among schools among OECD countries between 2003 and 2009. On the contrary, in general, the use of assessment for curriculum and instruction development has exhibited little change between 2003 and 2009.

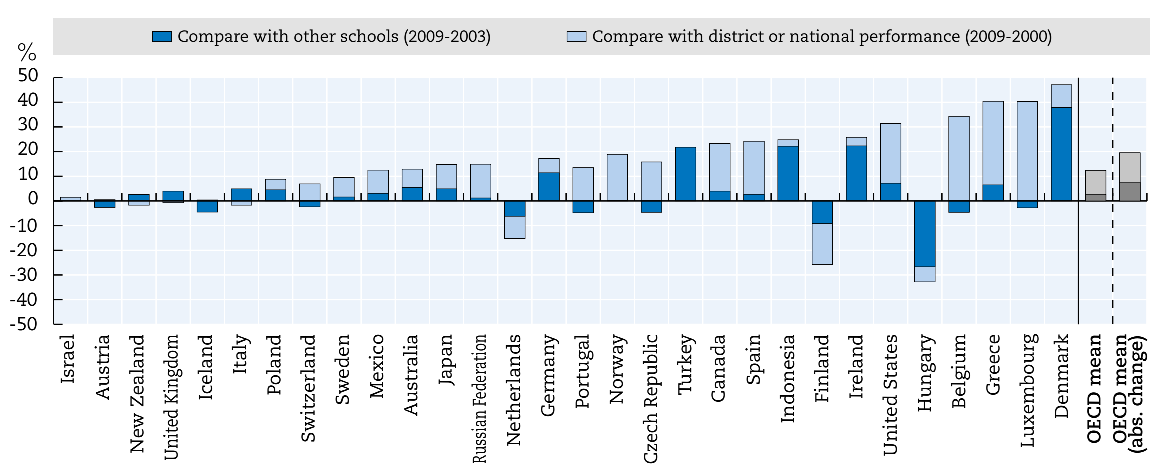
Figure 14.7 **Change in the use of student assessments for external comparison**



StatLink http://dx.doi.org/10.1787/888933085843

Notes : For details please see Figures 14.1 and 14.2

Figure 14.8 **Change in the use of student assessments to monitor progress and to improve curriculum in secondary education**



StatLink http://dx.doi.org/10.1787/888933085862

Notes : For details please see Figures 14.3 and 14.6

Note on Israel

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.

Table 14.1 **Effect sizes for changes in benchmarking, monitoring and feedback in school education**

	Change in progress monitoring				Change in curriculum and instruction development	
	Use of assessment data			Use of achievement data	Use of assessment data	
	Comparison with district/national performance	Comparison with other schools	Monitoring school progress	Tracked over time by admin authority	Instructional or curriculum improvement	Principal time devoted to curriculum development
	00-09	**03-09**	**00-09**	**06-09**	**03-09**	**01-06**
Australia	0,18	-0,69	0,18	-0,14	0,15	m
Austria	0,06	-0,78	0,01	-0,19	-0,05	m
Belgium	0,17	-0,80	0,75	-0,21	-0,09	m
Canada	0,59	-0,45	0,46	-0,02	0,11	m
Chile	0,24	m	-0,30	0,00	m	m
Czech Republic	0,43	-0,54	0,41	0,04	-0,13	m
Denmark	0,74	0,52	0,20	0,46	0,83	m
Estonia	m	m	m	-0,03	m	m
Finland	-0,15	-0,78	-0,34	-0,19	-0,19	m
France	m	m	m	m	m	-0,12
Germany	0,51	-0,48	0,12	-0,51	0,23	0,18
Greece	0,29	-0,24	0,70	0,09	0,13	m
Hungary	0,16	-0,87	-0,19	0,20	-0,67	-0,95
Iceland	-0,48	-0,94	0,01	-0,13	-0,18	-0,03
Ireland	0,16	-0,54	0,07	-0,01	0,45	m
Israel	0,21	m	0,04	0,26	m	-0,20
Italy	0,29	-0,94	-0,04	0,12	0,14	-0,40
Japan	0,38	-0,60	0,20	-0,14	0,13	m
Korea	m	0,08	m	0,50	m	m
Luxembourg	1,64	0,19	1,38	-0,16	-0,06	m
Mexico	0,36	-0,55	0,25	-0,13	0,10	m
Netherlands	-0,49	-0,44	-0,22	-0,58	-0,13	-0,03
New Zealand	-0,07	-0,44	-0,11	0,20	0,15	-0,21
Norway	0,24	-0,33	0,43	0,41	0,00	0,02
Poland	0,36	-1,06	0,17	0,36	0,15	m
Portugal	0,61	-0,82	0,35	0,01	-0,12	m
Slovak Republic	m	-0,75	m	0,22	m	-0,62
Slovenia	m	m	m	-0,01	m	0,42
Spain	0,11	-0,94	0,49	0,00	0,09	m
Sweden	0,05	-0,23	0,24	0,04	0,04	0,62
Switzerland	0,55	-0,05	0,14	-0,07	-0,05	m
Turkey	m	-0,08	m	-0,07	0,44	m
United Kingdom	0,04	-0,43	-0,03	0,02	0,14	m
England	m	m	m	m	m	-0,20
Scotland	m	m	m	m	m	-0,17
United States	0,68	-0,08	0,75	-0,02	0,33	-0,09

Table 14.1 **Effect sizes for changes in benchmarking, monitoring and feedback in school education (continued)**

	Change in progress monitoring				Change in curriculum and instruction development	
	Use of assessment data			Use of achievement data	Use of assessment data	
	Comparison with district/national performance	Comparison with other schools	Monitoring school progress	Tracked over time by admin authority	Instructional or curriculum improvement	Principal time devoted to curriculum development
	00-09	**03-09**	**00-09**	**06-09**	**03-09**	**01-06**
OECD (average)	0,28	-0,48	0,22	0,01	0,07	-0,11
OECD (average absolute)	0,37	0,54	0,31	0,17	0,20	0,26
Hong Kong, China	m	-1,51	m	-0,02	m	0,00
Indonesia	0,07	0,10	0,15	0,23	0,75	m
Russian Federation	0,13	-0,09	0,56	-0,17	0,22	-0,15
Singapore	m	m	m	m	m	-0,28

StatLink http://dx.doi.org/10.1787/888933085881

Notes: OECD average includes all OECD education systems for which data is available for all years concerned

= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on PIRLS (2001 and 2006) and PISA (2000, 2003, 2006 and 2009)

CHAPTER 15

Innovation in evaluation and hiring in schools

Innovation in schools can also include changes in practices such as evaluation, hiring and retention. Teachers may be evaluated externally by inspectors or through internal review by their peers. Schools may also innovate by changing the extent to which they use achievement and assessment data to evaluate teacher and principal performances. Innovation in schools could also concern the use of incentives for recruitment and retention purposes. The aim of innovation with regard to teacher evaluation could be, for example, to improve the quality of teaching and teachers' effectiveness, while an increased use of incentives could be a response to a greater degree of competition among schools, to ensure the presence of talented teachers on the staff.

Use of data for teacher and principal evaluation

General findings

Innovation in evaluation practices also included either increased or decreased use of assessment and achievement data in secondary education (Figure 15.1 and Figure 15.2). Between 2003 and 2009 the OECD average absolute change in the use of assessment data to make judgements about teachers' effectiveness was 7% points; the average absolute change in the use of achievement data between 2006 and 2009 amounted to 6% points. Use of assessment data to judge teachers' effectiveness increased especially in Turkey (38% points). Achievement data were used more widely in countries such as Greece (17% points), Denmark (16% points), Norway and Slovenia (11% points), whereas their use declined in Portugal (21% points), Estonia (13% points), Hungary (9% points) and Czech Republic (9% points). The reported changes in the use of assessment data presented medium effect sizes, while effect size was small for changes in achievement data use (reflecting the shorter time period over which changes were measured). Overall, the use of assessment data to judge teachers' effectiveness increased in eight education systems and decreased in two with at least a small effect size, while achievement data were used more widely to evaluate teachers' performance in five education systems and less in four, with small effect sizes.

Innovation also entailed wider use of achievement data to evaluate principal's performance in the majority of education systems (Figure 15.3). Between 2006 and 2009, OECD average absolute change amounted to 7% regarding this particular practice. The most prominent increase was found in Slovenia (49% points), while other countries such as Norway (17% points), Denmark (15% points), Greece (12% points), New Zealand (11% points) and Iceland (8% points) also showed notable increases. Decreases were noteworthy in the case of Estonia (13% points), Hungary (13% points) and Hong Kong (11% points). These changes presented small effect sizes, with the exception of Slovenia, where the effect size was large. Altogether, principals' performance evaluatios were more likely to incorporate achievement data in 2009 than in 2006 in six education systems and less in three, with at least small effect size.

Country specificities

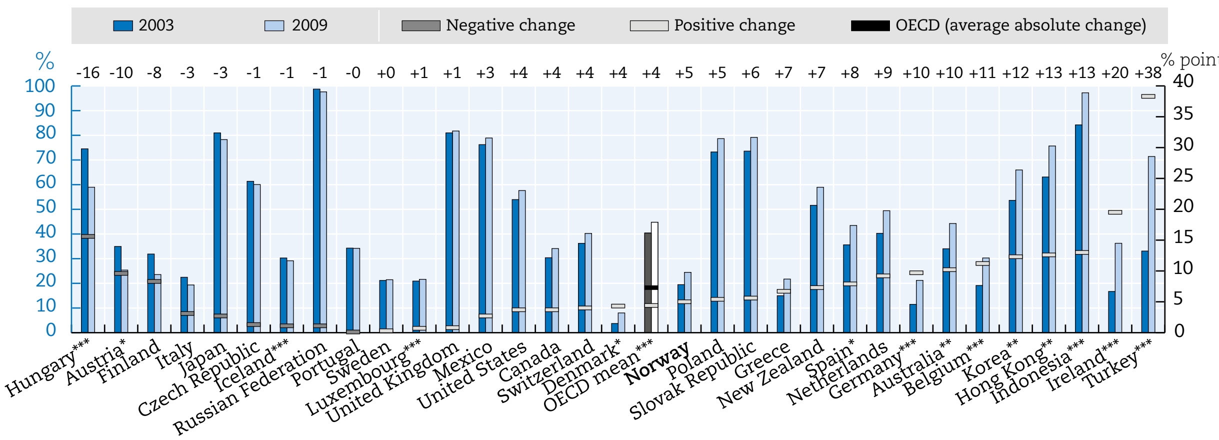
Slovenia, Norway, Denmark and Greece are countries where innovation was exemplified in additional use of achievement data for evaluation purposes. In these countries, achievement data were used more widely to evaluate both teachers' and principals' performance between 2006 and 2009, with at least small effect sizes.

In contrast, use of achievement and assessment data for evaluation purposes particularly decreased in Hungary. Hungarian schools made less use of assessment and achievement data to evaluate the performance and effectiveness of teachers and principals in the time span between 2003 and 2009, with small effect sizes.

The direction of innovation regarding use of data for evaluation has not been consistent among instruments and targets in Hong Kong. Schools in Hong Kong increased the use of student assessment data to judge teachers' effectiveness between 2003 and 2009 and reduced the use of achievement data to evaluate principals' performance, with small effect sizes.

Figure 15.1 Use of assessment data to make judgments about teachers' effectiveness

Percentage of 15-year old students in schools where assessment data are used to make judgments about teachers' effectiveness and change over time



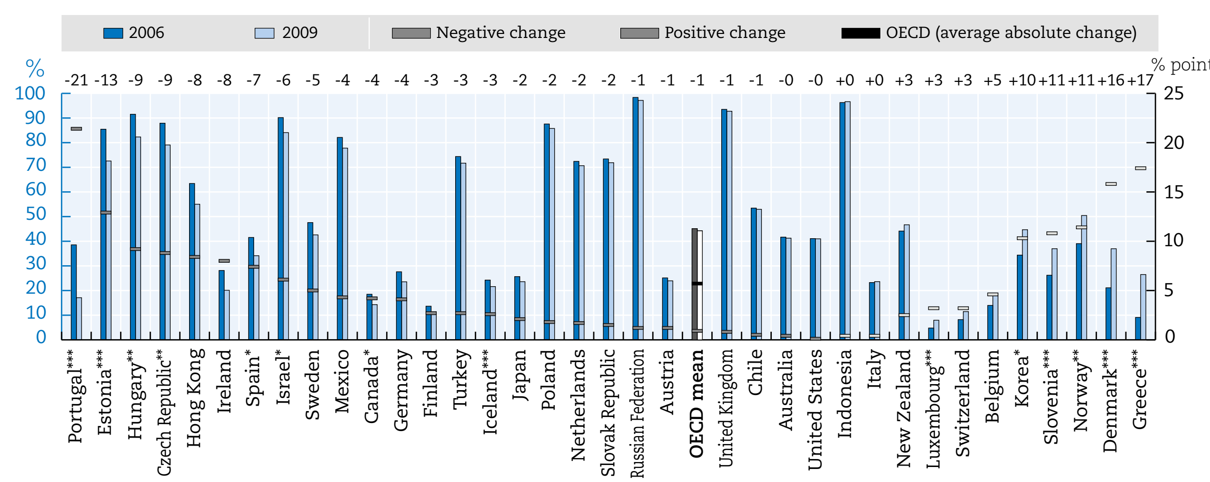
StatLink http://dx.doi.org/10.1787/888933085900

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2003 and 2009)

Figure 15.2 Use of achievement data for evaluating teachers' performance

Percentage of 15-year old students in schools where achievement data are used for evaluating teachers' performance and change over time



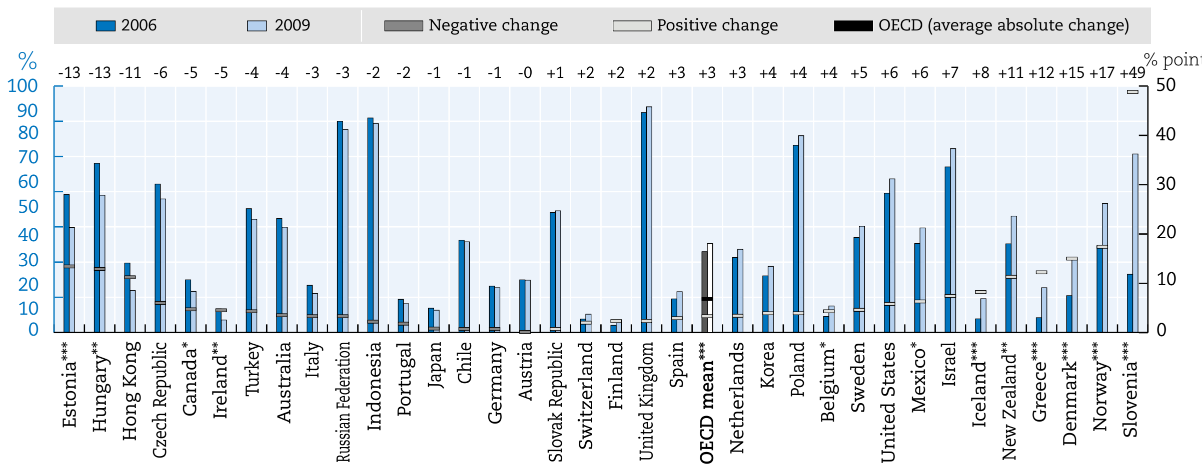
StatLink http://dx.doi.org/10.1787/888933085919

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2006 and 2009)

Figure 15.3 **Use of achievement data for the evaluation of principal's performance**

Percentage of 15-year old students in schools where achievement data are used for evaluating the principal's performance and change over time



StatLink http://dx.doi.org/10.1787/888933085938

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2006 and 2009)

Box 15.1 **Data source details for Figures 15.1 to 15.3**

PISA (2003 and 2009) surveys asked school principals "In your school, are assessments of students in <national modal grade for 15-year-olds> used for the following purposes […] To make judgments about teachers' effectiveness" with answer options "Yes/No". PISA (2006 and 2009) asked ''In your school, are achievement data used in any of the following <accountability procedures>? […] Achievement data are used in evaluation of teachers' performance […] Achievement data are used in evaluation of principal's performance with answer options "Yes/No".

External evaluation

General findings

In secondary education, innovation in the evaluation of teachers translated into more observations of teachers' practices by inspectors or other persons external to the school, across the vast majority of OECD countries (Figure 15.4 and Figure 15.5). Between 2003 and 2011 the OECD average absolute change regarding performance evaluation through inspectors' external observations was 11% points for 8^{th} grade mathematics and 10% points for 8^{th} grade science. In 8^{th} grade mathematics the increase was most prominent in Israel (33% points), South Africa (31% points), Chile (23% points) and Ontario (15% points). Similarly in 8^{th} grade science, education systems with the largest increases were South Africa (34% points), Israel (26% points) and Ontario (12% points). These changes exhibit medium effect sizes, whereas the OECD average and average absolute changes showed small effect sizes both for 8^{th} grade mathematics and science. Altogether, teacher observation by inspectors or other persons external to the school increased in 13 education systems and decreased in one, with at least a small effect size in 8^{th} grade mathematics classes. In the case of 8^{th} grade science classes, external observation increased in 14 education systems and decreased in one, with at least small effect sizes.

Similarly, innovation in external evaluation in primary education is illustrated through more frequent observations of teachers' practices by inspectors or other persons external to the school (Figure 15.6). The OECD average absolute change in teacher evaluation via external observation between 2003 and 2011 amounted to 13% points in 4^{th} grade classes. Education systems where external observation of teachers' practices increased the most were New Zealand (26% points), Hong Kong (26% points), Norway (26% points), Singapore (24% points) and Ontario (16% points). These changes were characterised by medium effect sizes, while the OECD average and average absolute presented small effect sizes. Overall, 4^{th} grade teacher evaluation through external observations by inspectors or other persons external to the school increased in 12 education systems with at least a small effect size, whereas the opposite was true only in the case of one education system.

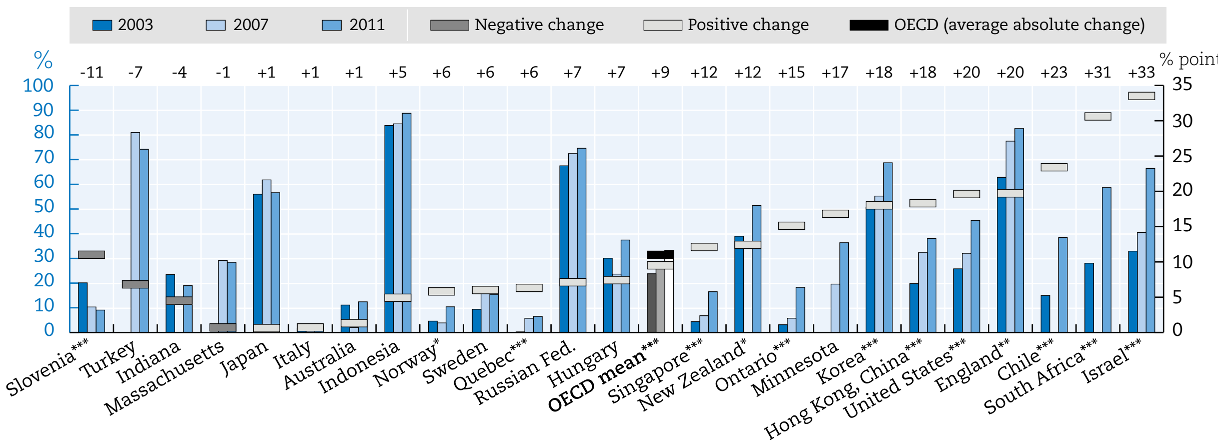
Country specificities

Teachers' evaluation via inspectors or external observation increased simultaneously across disciplines and levels in Hong Kong and Ontario. Increases in external evaluation were substantial in Ontario, showing medium effect size across levels, whereas in the case of Hong Kong, this was true only for teachers in 4^{th} grade in the period from 2003 to 2011.

By contrast, Slovenia was the only country showing a simultaneous decrease across disciplines and levels with regard to evaluation through inspectors or external observations, with small effect sizes between 2003 and 2011, both for 8^{th} grade and 4^{th} grade teachers.

Figure 15.4 Evaluation of teachers' practices by inspector observation in 8th grade mathematics

Percentage of students in schools in which observations by inspectors or other persons external to the school are used to evaluate the practice of teachers and change over time



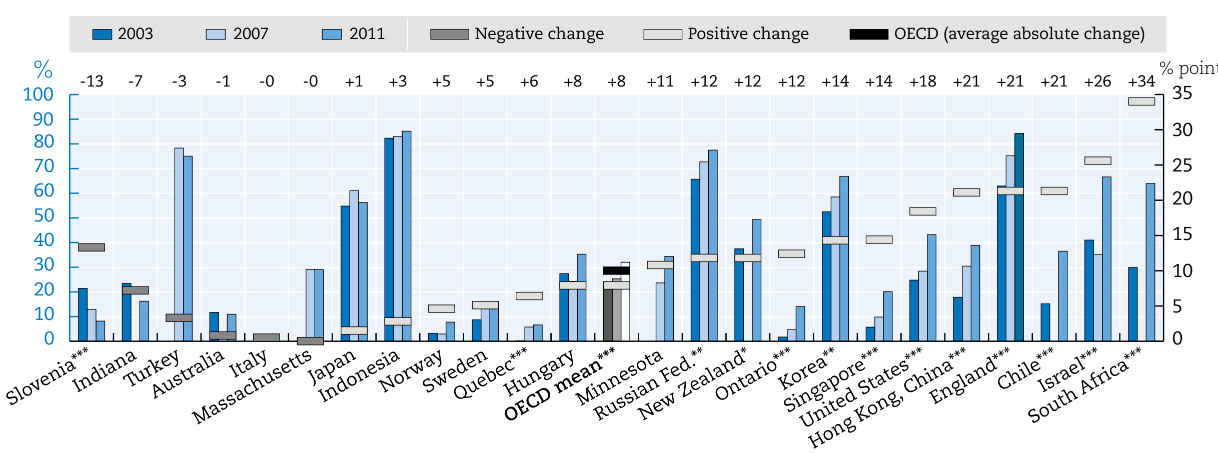
StatLink http://dx.doi.org/10.1787/888933085957

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 15.5 Evaluation of teachers' practices by inspector's observation in 8th grade science

Percentage of students in schools in which observations by inspectors or other persons external to the school are used to evaluate the practice of teachers and change over time



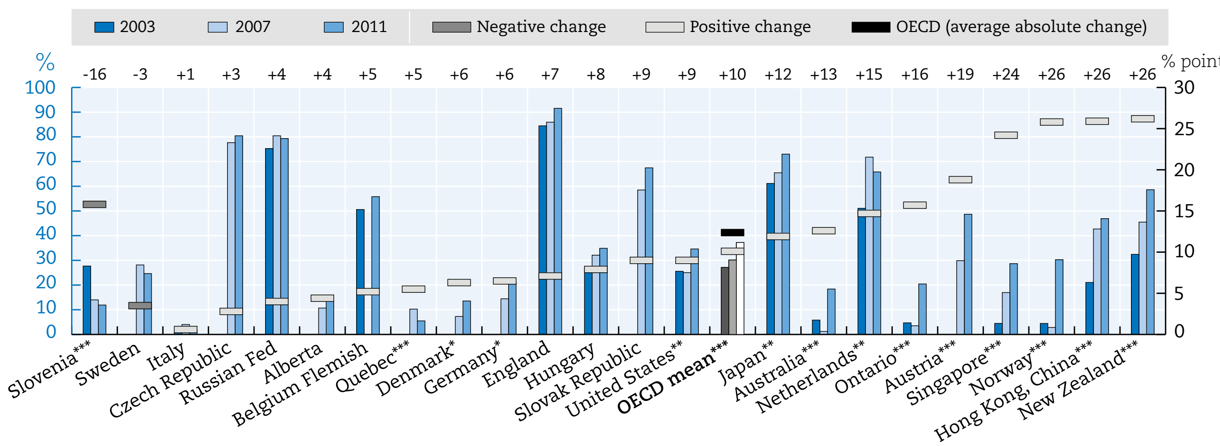
StatLink http://dx.doi.org/10.1787/888933085976

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 15.6 **Evaluation of teachers' practices by inspector's observation in 4th grade**

Percentage of students in schools in which observations by inspectors or other persons external to the school are used to evaluate the practice of teachers and change over time



StatLink http://dx.doi.org/10.1787/888933085995

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 15.2 **Data source details for Figures 15.4 to 15.6**

TIMSS and PIRLS (2003, 2007 and 2011) surveys asked principals and heads of schools: "In your school, are any of the following used to evaluate the practice of <eighth-grade> mathematics/science teachers? […] Observations by inspectors or other persons external to the school", with response options "Yes/No". The same question was asked to 4th grade school principals and heads of schools. The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Peer evaluation

General findings

Innovation in peer evaluation practices typically took the form of more use of teacher peer review in secondary education (Figure 15.7 and Figure 15.8). Between 2003 and 2011, OECD average absolute change regarding peer review activities was 12% points for 8th grade science teachers and 11% points for 8th grade mathematics teachers. South Africa (34% points), Hong Kong (27% points), Korea (22% points) and New Zealand (21%) were the education systems showing the largest increases in the use of peer review among 8th grade science teachers, while Norway (17% points) had the most prominent decease in this respect. Similarly, the use of peer reviews for evaluating mathematics teachers also increased especially in South Africa (36% points), Hong Kong (26% points) and Korea (22% points), whereas the decrease was particularly marked in the case of Indonesia (13% points). These education system changes showed medium effect sizes except in the case of Korea where the effect size was large. The OECD average absolute change in teacher peer review use presented small effect sizes both for 8th grade mathematics and science teachers. Altogether, use of teacher peer review as a tool for evaluation increased in 11 education systems and decreased in five in both 8th grade science and mathematics, with at least small effect sizes.

At the primary school level, innovation in the form of greater adoption of teacher peer review for evaluation was also widespread (Figure 15.9). The OECD average absolute change in the period between 2003 and 2011 amounted to 12% points for teachers in 4th grade. The largest increase was observed in Austria (34% points), while in the case of Flemish teachers (24% points), use of peer reviews significantly diminished in comparison with other countries. These changes had medium effect sizes, whereas the OECD average absolute effect size was small. Overall, with at least small effect sizes, use of teacher peer reviews as an evaluation tool increased in 11 education systems and decreased in four.

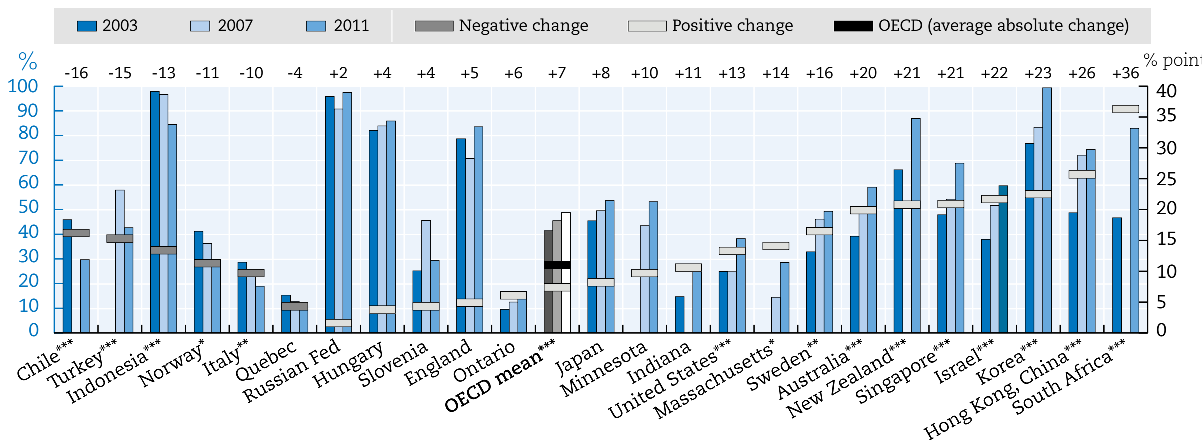
Country specificities

Teacher evaluations through peer review increased simultaneously across disciplines and levels in Hong Kong and New Zealand. Between 2003 and 2011 teacher peer reviews aimed at evaluating other colleagues' practices increased in these education systems in 8th grade mathematics and science and in 4th grade, with at least small effect size. Similarly, more 8th grade Korean schools conducted evaluations through peer reviews across disciplines between 2003 and 2011, with large effect size.

The cases of Norway and Italy, on the contrary, illustrate that innovation can also take the form of a reduction across disciplines and levels in the adoption of teacher peer reviews as a tool for evaluation. In these countries, use of peer reviews decreased consistently in 8th grade science, mathematics and 4th grade between 2003 and 2011, with at least small effect sizes.

Figure 15.7 **Peer review evaluation of teachers' practices in 8th grade mathematics**

Percentage of students in schools in which peer review is used to evaluate the practice of teachers and change over time



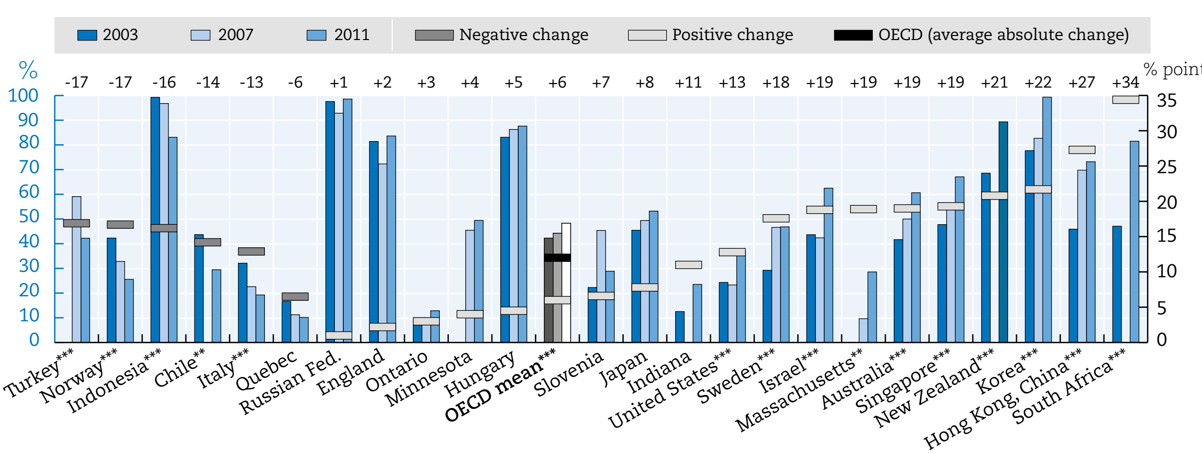
StatLink http://dx.doi.org/10.1787/888933086014

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 15.8 **Peer review evaluation of teachers' practices in 8th grade science**

Percentage of students in schools in which peer review is used to evaluate the practice of teachers and change over time



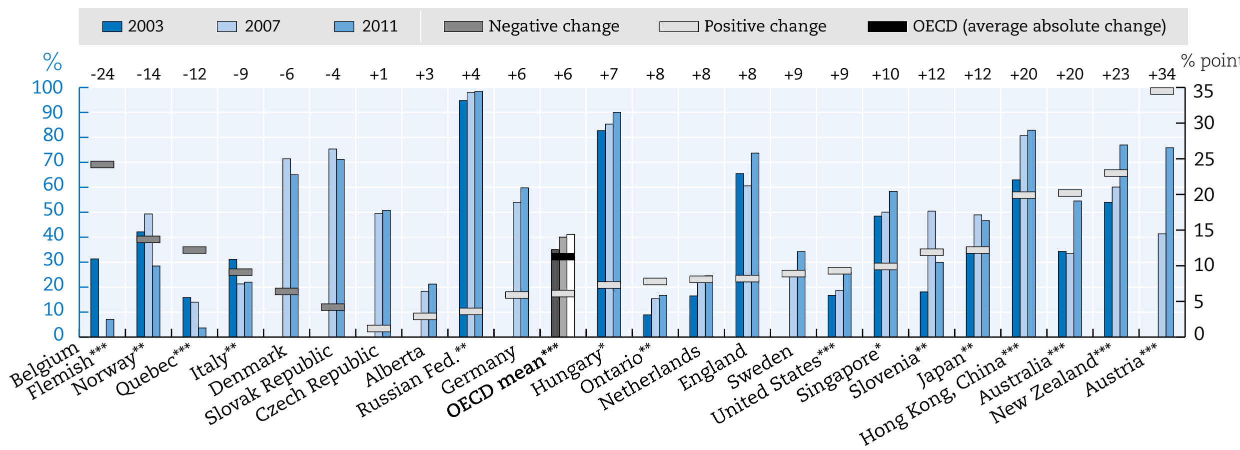
StatLink http://dx.doi.org/10.1787/888933086033

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 15.9 **Peer review evaluation of teachers' practices in 4th grade**

Percentage of students in schools in which peer review is used to evaluate the practice of teachers and change over time



StatLink http://dx.doi.org/10.1787/888933086052

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Austria, Canada (Alberta), Czech Republic, Denmark, Germany, Slovak Republic and Sweden. OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Box 15.3 **Data source details for Figures 15.7 to 15.9**

TIMSS and PIRLS (2003, 2007 and 2011) surveys asked principals and heads of schools: "In your school, are any of the following used to evaluate the practice of <eighth-grade> mathematics/science teachers? […]Teacher peer review", with response options "Yes/No". The same question was asked to 4th grade school principals and heads of schools. The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Incentive use for recruitment and retention of teachers

General findings

Innovation in teacher recruitment and retention in secondary education took the form of increases and decreases in the use of different types of incentives (Figure 15.10 and Figure 15.11). The OECD average absolute change regarding incentives use between 2003 and 2011 amounted to 6% points and 5% points for teachers in 8th grade mathematics and science respectively. Use of pay, housing or signing bonus incentives particularly increased in Singapore (40% points), the Russian Federation (28% points), Israel (18% points) and Japan (13% points) for teachers in 8th grade mathematics. Similarly, Singapore (40% points), the Russian Federation (30% points) and Israel (16% points) were the countries that increased the use of incentives to recruit and retain 8th grade science teachers. These changes registered from large to medium effect sizes, while the OECD average absolute changes had small effect sizes. Overall, the use of incentives for recruiting and retaining teachers increased in 11 education systems and decreased in four in the case of 8th grade mathematics teachers, with at least small effect size . Incentive use for recruiting and retention of 8th grade science teachers increased in ten education systems and decreased in five, with at least small effect sizes.

In comparison with secondary education, change in the use of incentives for recruiting and retaining teachers in primary education was less pronounced (Figure 15.12). In this respect, the OECD average absolute change in the period between 2003 and 2007 amounted to 3% points for 4th grade teachers. The largest increases in the use of incentives to recruit and retain teachers in 4th grade were observed in the Russian Federation (11% points), Hungary (9% points), and Singapore (7% points). In addition to statistical significance these changes presented small effect sizes. Altogether, with a small effect size, increases in the use of incentives were significant in eight education systems.

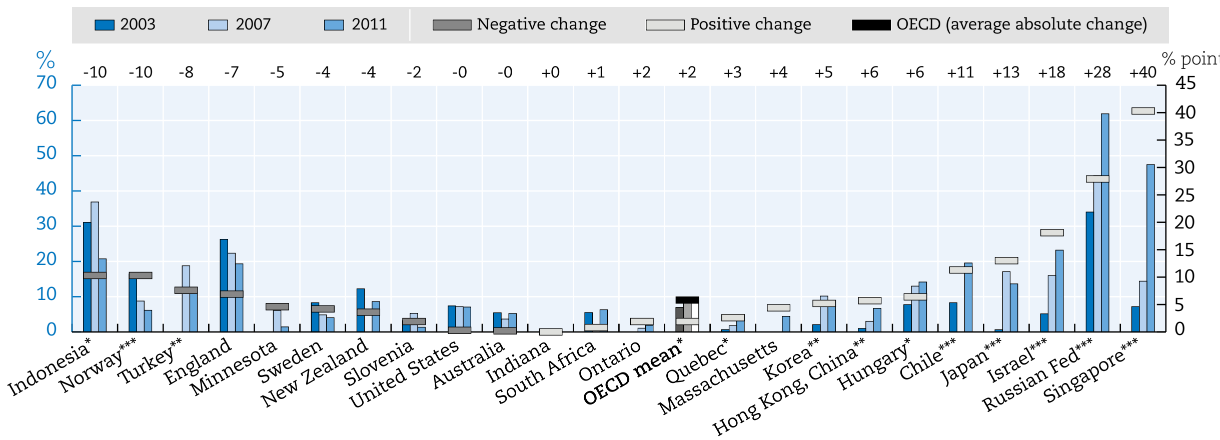
Country specificities

Incentive use for teacher recruitment and retention increased simultaneously across disciplines and levels in the Russian Federation, Singapore and Hungary. Between 2003 and 2011 incentives to recruit and retain teachers in 8th grade and 4th grade were used significantly more in these countries, with at least small effect size.

On the contrary, use of incentives to recruit and retain teachers significantly decreased across disciplines in Indonesia, Norway and Turkey. Fewer schools in these countries used incentives for 8th grade mathematics and science teacher recruitment and retention between 2003 and 2011, with small effect size.

Figure 15.10 **Use of incentives for teacher recruitment and retention in 8th grade mathematics**

Percentage of students in schools which currently use any incentives to recruit or retain teachers and change over time



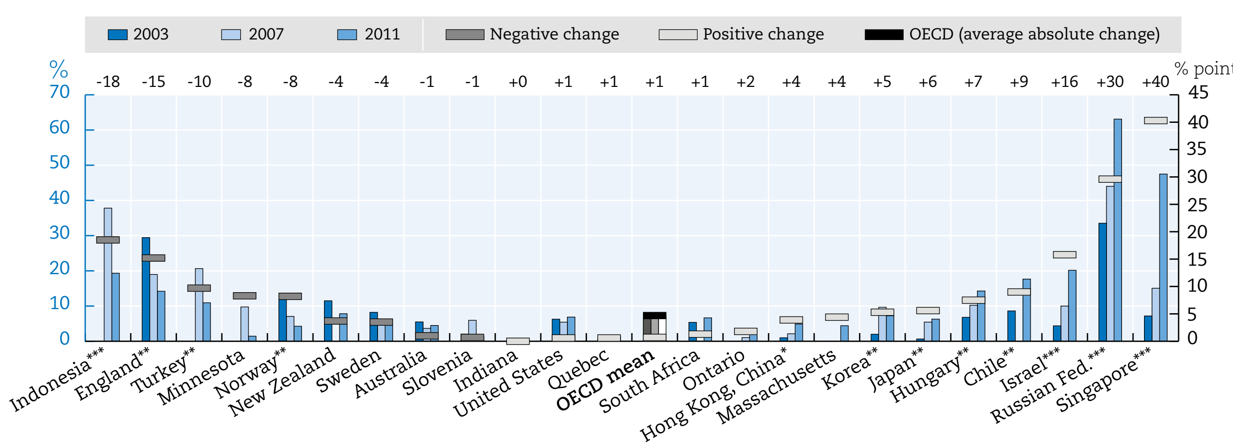
StatLink http://dx.doi.org/10.1787/888933086071

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 15.11 **Use of incentives for teacher recruitment and retention in 8th grade science**

Percentage of students in schools which currently use any incentives to recruit or retain teachers and change over time



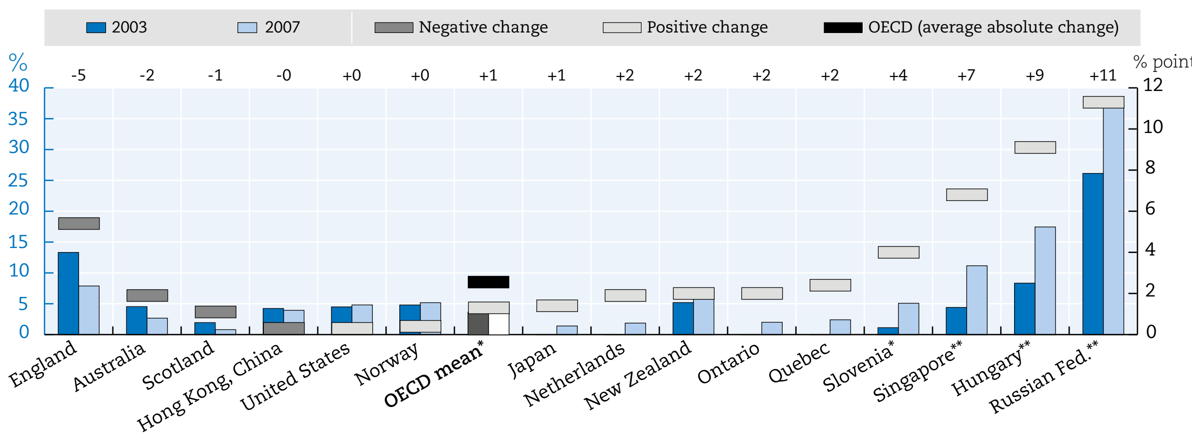
StatLink http://dx.doi.org/10.1787/888933086090

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level; Change between 2007 and 2011 instead of 2003 and 2011 for Turkey and United States (Massachusetts and Minnesota). OECD average includes all OECD education systems for which data is available for all years concerned.

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011)

Figure 15.12 Use of incentives for teacher recruitment and retention in 4th grade

Percentage of students in schools which currently use any incentives to recruit or retain teachers and change over time



StatLink http://dx.doi.org/10.1787/888933086109

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

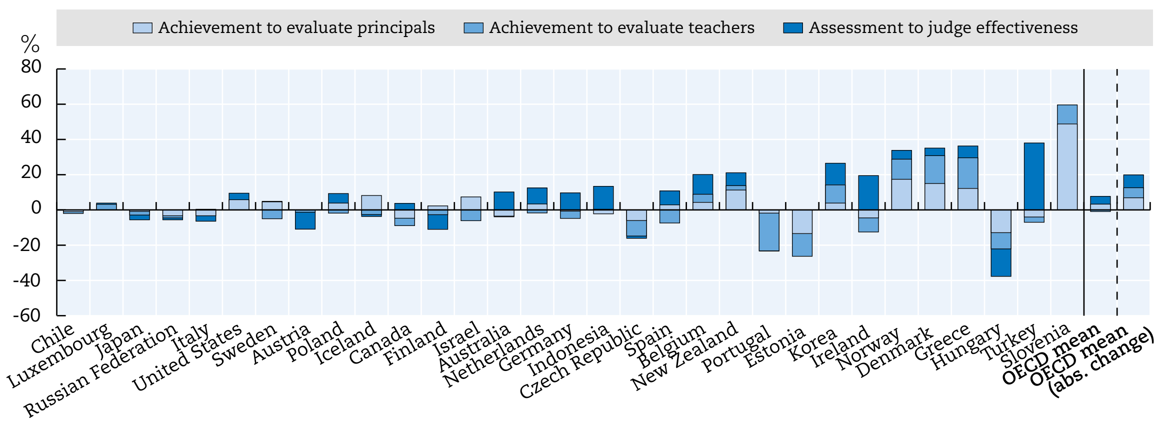
Box 15.4 Data source details for Figures 15.10 to 15.12

TIMSS and PIRLS (2003, 2007 and 2011) surveys asked principals and heads of schools: "Does your school currently use any incentives (e.g. pay, housing, signing bonus, smaller classes) to recruit or retain <eighth-grade> teachers in the following fields? […] Mathematics […] Science […] Others", with response options "Yes/No". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

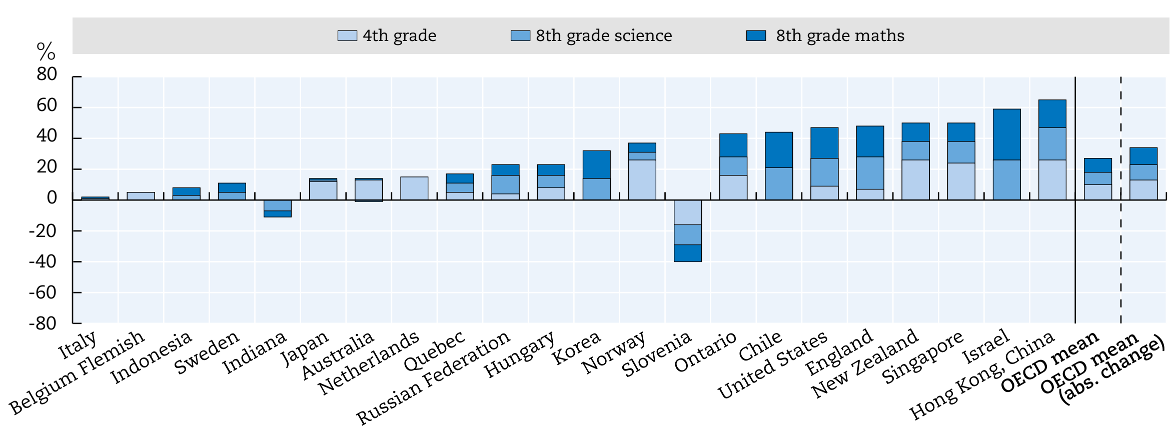
Innovation – or significant change – regarding teacher evaluation has meant more and less use of achievement and assessment data, a greater degree of external evaluation by inspectors in primary and secondary education, as well as a greater use of teacher peer reviews for these purposes between 2003 and 2011. The direction of innovation in recruiting and retaining practices differed across education systems with regard to incentives use, with little overall change concerning OECD average level.

Figure 15.13 **Change in the use of achievement and assessment data for school evaluation**



StatLink http://dx.doi.org/10.1787/888933086128

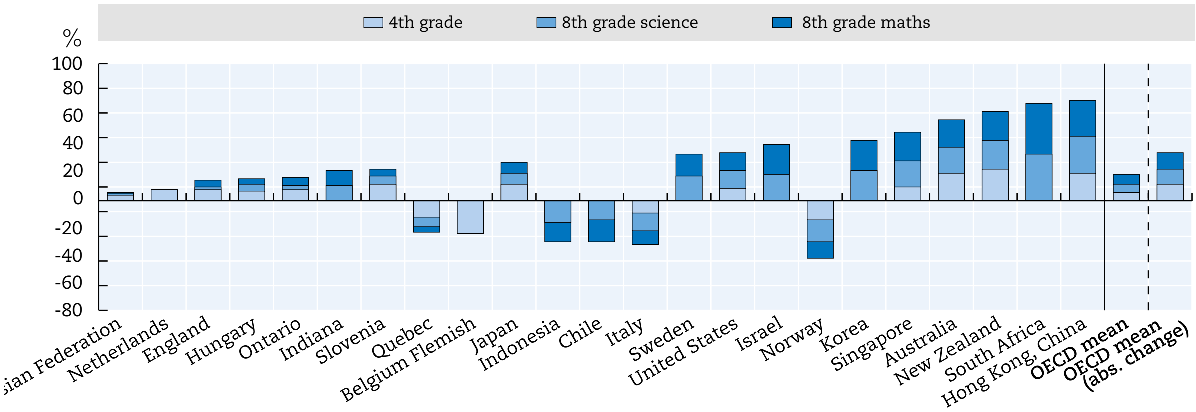
Figure 15.14 **Change in the evaluation of teachers' practices by inspector's observation**



StatLink http://dx.doi.org/10.1787/888933086147

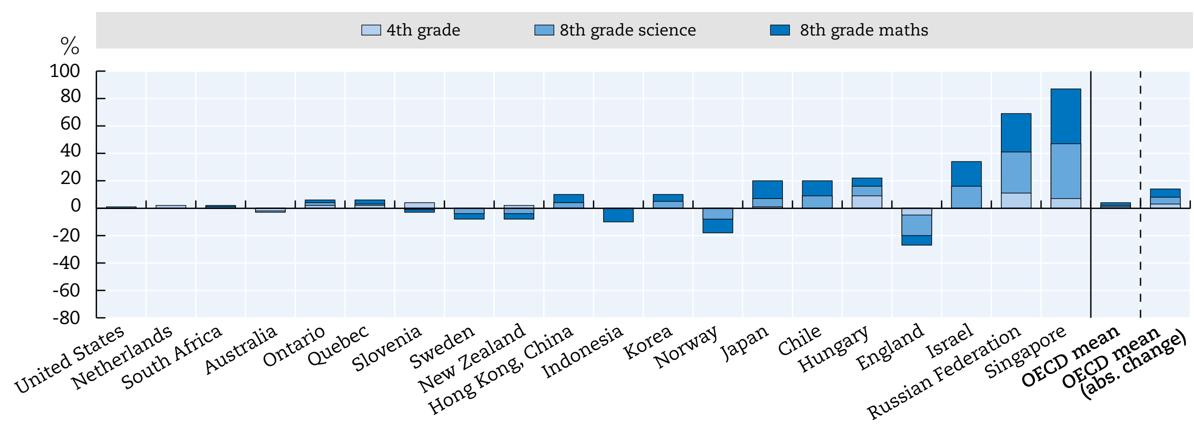
Notes: For details, please see Figures 15.1, 15.2, 15.3, 15.4, 15.5 and 15.6.

Figure 15.15 **Change in peer review evaluation of teachers' practices**



StatLink http://dx.doi.org/10.1787/888933086166

Figure 15.16 **Change in the use of incentives for teachers' recruitment and retention**



StatLink http://dx.doi.org/10.1787/888933086185

Notes: For details, please see Figures 15.7, 15.8, 15.9, 15.10, 15.11 and 15.12

Note on Israel

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.

Table 15.1 **Effect sizes for changes in school evaluation and hiring practices**

	Change in data use for evaluation			Change in external evaluation			Change in peer evaluation			Change in use of incentives		
	Assessment data to judge teachers' effectiveness	Achievement data to evaluate teachers performance	Achievement data to evaluate principal's performance	Change in inspector's observations of teacher practices			Change in peer review evaluation of teachers' practices			Change in use of incentives for teachers' recruitment and retention		
	8^{th} grade			8^{th} grade		4^{th} grade	8^{th} grade	4^{th} grade		8^{th} grade	4^{th} grade	
				maths	science	all	maths	science	all	maths	science	all
	03-09	06-09	06-09	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-11	03-07
Australia	0,21	-0,01	-0,07	0,04	-0,02	0,40	0,40	0,38	0,41	-0,01	-0,05	-0,10
Austria	-0,21	-0,03	0,00	m	m	m	m	m	m	m	m	m
Belgium	0,26	0,12	0,15	m	m	m	m	m	m	m	m	m
Belgium Flemish	m	m	m	m	m	0,10	m	m	-0,65	m	m	m
Canada	0,08	-0,11	-0,12	m	m	m	m	m	m	m	m	m
Ontario	m	m	m	0,53	0,51	0,50	0,19	0,10	0,24	0,24	0,24	0,25
Quebec	m	m	m	0,41	0,43	0,47	-0,13	-0,19	-0,43	0,20	0,06	0,31
Chile	m	-0,01	-0,01	0,54	0,50	m	-0,34	-0,30	m	0,33	0,27	m
Czech Republic	-0,03	-0,24	-0,12	m	m	m	m	m	m	m	m	m
Denmark	0,19	0,35	0,36	m	m	m	m	m	m	m	m	m
Estonia	m	-0,32	-0,27	m	m	m	m	m	m	m	m	m
Finland	-0,19	-0,08	0,12	m	m	m	m	m	m	m	m	m
Germany	0,27	-0,09	-0,02	m	m	m	m	m	m	m	m	m
Greece	0,17	0,47	0,39	m	m	m	m	m	m	m	m	m
Hungary	-0,33	-0,28	-0,27	0,16	0,17	0,17	0,10	0,13	0,21	0,21	0,25	0,28
Iceland	-0,02	-0,06	0,28	m	m	m	m	m	m	m	m	m
Ireland	0,45	-0,19	-0,17	m	m	m	m	m	m	m	m	m
Israel	m	-0,18	0,16	0,68	0,52	m	0,44	0,38	m	0,55	0,51	m
Italy	-0,08	0,01	-0,09	0,05	-0,03	0,05	-0,23	-0,30	-0,21	m	m	m
Japan	-0,07	-0,05	-0,03	0,01	0,03	0,25	0,16	0,16	0,25	0,59	0,35	0,24
Korea	0,25	0,21	0,09	0,37	0,29	m	0,84	0,82	m	0,26	0,26	m
Luxembourg	0,02	0,13	m	m	m	m	m	m	m	m	m	m
Mexico	0,06	-0,11	0,13	m	m	m	m	m	m	m	m	m
Netherlands	0,18	-0,04	0,07	m	m	0,30	m	m	0,20	m	m	0,28
New Zealand	0,15	0,05	0,23	0,25	0,24	0,53	0,50	0,53	0,49	-0,12	-0,13	0,08
Norway	0,12	0,23	0,35	0,22	0,21	0,74	-0,24	-0,36	-0,29	-0,33	-0,31	0,02
Poland	0,13	-0,05	0,09	m	m	m	m	m	m	m	m	m
Portugal	0,00	-0,49	-0,05	m	m	m	m	m	m	m	m	m
Slovak Republic	0,13	-0,03	0,01	m	m	m	m	m	m	m	m	m
Slovenia	m	0,23	1,02	-0,32	-0,38	-0,40	0,10	0,15	0,28	-0,13	-0,05	0,24
Spain	0,16	-0,15	0,08	m	m	m	m	m	m	m	m	m
Sweden	0,01	-0,10	0,09	0,18	0,16	m	0,34	0,36	m	-0,18	-0,14	m
Switzerland	0,08	0,11	0,08	m	m	m	m	m	m	m	m	m
Turkey	0,79	-0,06	-0,09	m	m	m	m	m	m	m	m	m

Table 15.1 **Effect sizes for changes in school evaluation and hiring practices (continued)**

	Change in data use for evaluation			Change in external evaluation			Change in peer evaluation			Change in use of incentives		
	Assessment data to judge teachers' effectiveness	Achievement data to evaluate teachers performance	Achievement data to evaluate principal's performance	Change in inspector's observations of teacher practices			Change in peer review evaluation of teachers' practices			Change in use of incentives for teachers' recruitment and retention		
	8th grade			8th grade		4th grade	8th grade	4th grade		8th grade	4th grade	
				maths	science	all	maths	science	all	maths	science	all
	03-09	**06-09**	**06-09**	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**	**03-11**	**03-07**
United Kingdom	0,02	-0,03	0,08	m	m	m	m	m	m	m	m	m
England	m	m	m	0,45	0,49	0,22	0,12	0,06	0,18	-0,17	-0,37	-0,18
Scotland	m	m	m	m	m	m	m	m	m	m	m	-0,10
United States	0,07	0,00	0,12	0,41	0,39	0,20	0,29	0,28	0,23	-0,01	0,02	0,02
Indiana	m	m	m	-0,11	-0,18	m	0,27	0,29	m	0,00	0,00	m
OECD (average)	0,10	-0,03	0,07	0,25	0,21	0,29	0,18	0,15	0,13	0,10	0,06	0,11
OECD (average absolute)	0,16	0,14	0,16	0,30	0,28	0,35	0,28	0,28	0,28	0,24	0,22	0,17
Hong Kong, China	0,27	-0,17	-0,27	0,41	0,47	0,56	0,54	0,56	0,45	0,32	0,25	-0,01
Indonesia	0,48	0,02	-0,06	0,14	0,08	m	-0,52	-0,68	m	-0,24	m	m
Russian Federation	-0,08	-0,08	-0,09	0,16	0,26	0,10	0,09	0,07	0,21	0,57	0,60	0,24
Singapore	m	m	m	0,41	0,45	0,70	0,43	0,39	0,20	0,98	0,98	0,26
South Africa	m	m	m	0,63	0,70	m	0,79	0,74	m	0,03	0,05	m

StatLink http://dx.doi.org/10.1787/888933086204

Notes: OECD average includes all OECD education systems for which data is available for all years concerned

= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003, 2007 and 2011) andPISA (2003, 2006 and 2009)

CHAPTER 16

Innovation in schools' external relations

Innovation in schools can incorporate changes to external relation practices whether aimed at informing parents on their child's performance or to involve them in certain activities as well as for self-promotion purposes. The aim of innovation with regard to external relations could be, for example, to create a stronger and supportive sense of community between schools, parents and students as well as to promote the schools and extend their outreach to previously under served students.

Informing parents

General findings

In general, innovation in school external relations has not resulted in changes in the use of different methods to inform parents about their child's progress (Figure 16.1 and Figure 16.2). Assessment data were extensively used as tools to inform parents in 2000 and there has been little change between then and 2009. Similarly, parental perception regarding school provision of regular information on students' performance did not change significantly between 2006 and 2009. OECD average absolute change regarding the use of student assessment data to inform parents about their child's progress amounted to 2% points in the period between 2000 and 2009. Likewise, parental perception of regular performance information provision registered the same OECD average absolute change between 2006 and 2009. The United States (21% points) registered the largest increase in the use of assessment data to inform parents about their child's performance. This change was characterised by a medium effect size. Altogether, use of assessment data to inform parents increased in two education systems and decreased in three, with at least a small effect size.

As to the modalities through which parents are informed about their child's performance, innovation is indicated through both increased and decreased provision of information on student comparative performance against different points of reference (Figure 16.3 to Figure 16.5). Between 2006 and 2009, OECD average absolute change regarding provision of information on student performance relative to other students in the school was 10% points, while it amounted to 7% points when information on student performance was presented in comparison with regional or national benchmarks. OECD average absolute change regarding performance information provision comparing group of students to same grade students from another school was 7% points. Decreases were particularly pronounced in terms of information on student performance being presented in comparison with those of others in the same class in the Slovak Republic (33% points) and the Russian Federation (21% points). Indonesia (25% points) exhibited the largest decrease in the use of national or regional benchmarks as a point of reference in student performance comparisons. The Slovak Republic (29% points) showed the largest decrease in performance information provision presented in comparison to same grade but different school students. These changes had from large to medium effect size, while the OECD average absolute change presented small effect sizes when performance information was presented in comparison with those of others in the same class. Overall, other students were more frequently used as a reference for performance comparison in two education systems and less in 18, while regional or national benchmarks were used more frequently in five education systems and less in seven, with at least small effect sizes. Information on performance compared with same grade but different school students was used more frequently in four education systems and less in eight, with at least small effect sizes.

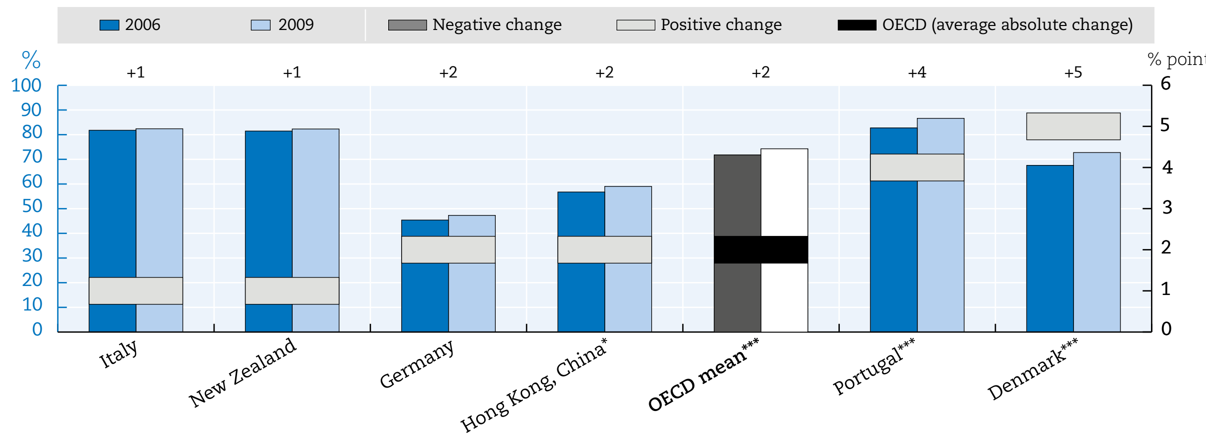
Country specificities

Innovation in providing more information on student performance was particularly pronounced in Portugal. Portuguese schools provided parents with more information about their child's performance relative to students of other schools and in comparison with national or regional benchmarks between 2006 and 2009, with small effect sizes.

In contrast, innovation in the Slovak Republic was characterised by a lower degree of comparative performance information provision to parents. Slovak schools provided less comparative information about student performance in comparison with other classmates or students from other schools between 2006 and 2009, with small effect sizes.

Figure 16.1 Parental perceptions of receiving regular information about their child's progress

Percentage of 15-year old students whose parents agree or strongly agree that they receive regular information about their child's progress and change over time



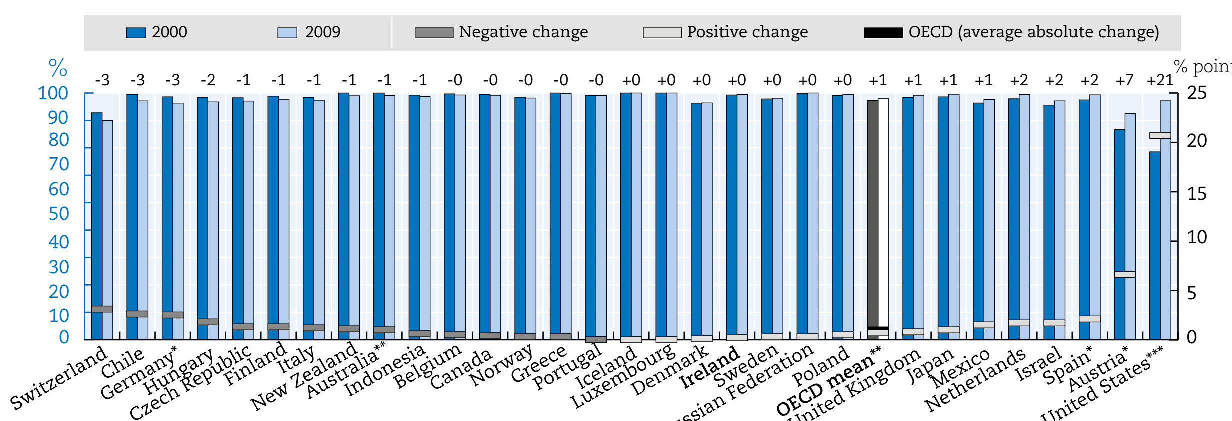
StatLink http://dx.doi.org/10.1787/888933086223

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2006 and 2009)

Figure 16.2 Use of assessment data to inform parents about their child's progress

Percentage of 15-year old students in schools where assessment data are used to inform parents about their child's progress and change over time



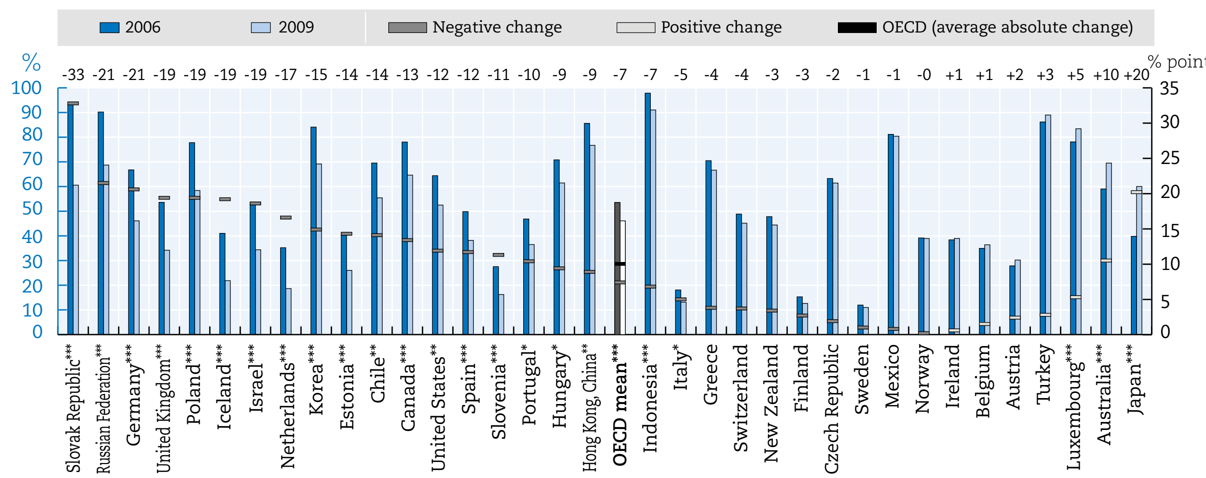
StatLink http://dx.doi.org/10.1787/888933086242

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Source: Authors' calculations based on PISA (2000 and 2009)

Figure 16.3 **Information provided to parents about their child's performance relative to other students in the same school**

Percentage of 15-year old students in schools that provide information to parents on their child's academic performance relative to other students in the school and change over time



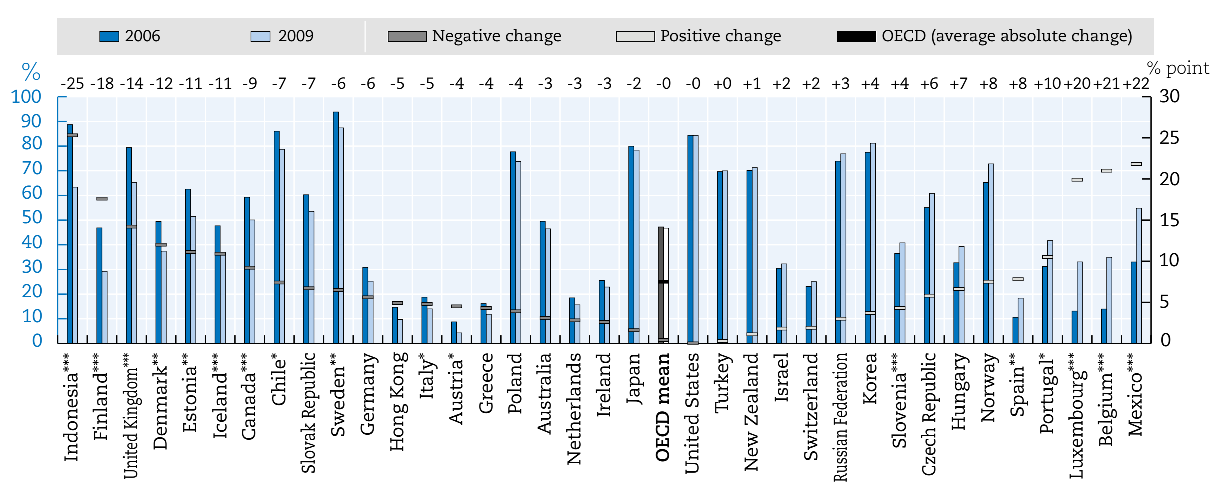
StatLink http://dx.doi.org/10.1787/888933086261

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on PISA (2006 and 2009)

Figure 16.4 **Information provided to parents about their child's performance relative to national or regional benchmarks**

Percentage of 15-year old students in schools that provide information to parents on their child's academic performance relative to national or regional benchmarks and change over time



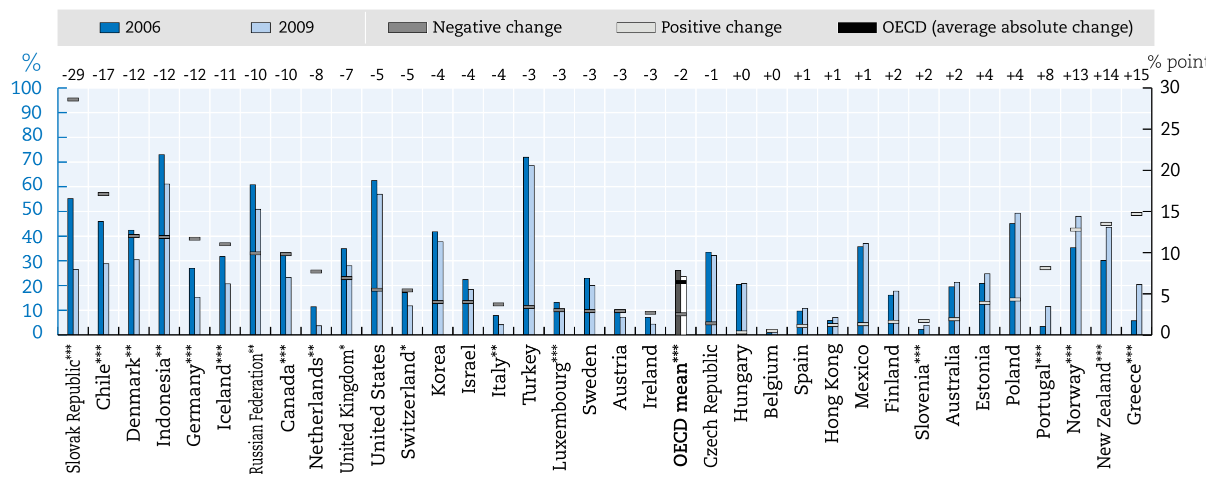
StatLink http://dx.doi.org/10.1787/888933086280

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Source: Authors' calculations based on PISA (2006 and 2009.

Figure 16.5 **Information provided to parents about student group performance relative to students in the same grade in other schools**

Percentage of 15-year old students in schools that provide information to parents on the academic performance of students relative to students in the same grade in other schools and change over time



StatLink http://dx.doi.org/10.1787/888933086299

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Source: Authors' calculations based on PISA (2006 and 2009)

Box 16.1 **Data source details for Chapter 16.1 to 16.5**

PISA (2000, 2003 and/or 2009) surveys asked school principals: "In your school, are assessments of students in <national modal grade for 15-year-olds> used for any of the following purposes? […]To inform parents about their child's progress" with answer options "Yes/No". PISA (2006 and 2009) surveys asked parents: "How much do you agree or disagree with the following statements? […] My child's school provides regular and useful information on my child's progress" with answer options "Strongly Agree; Agree; Disagree; Strongly disagree".

PISA (2006 and 2009) surveys asked school principals: "Does your school provide information to parents of students in <national modal grade for 15-year-olds> on their child's academic performance relative to other students in <national modal grade for 15-year-olds> in your school?", "Does your school provide information to parents of students in <national modal grade for 15-year-olds> on their child's academic performance relative to national or regional <benchmarks>?"'. "Does your school provide information to parents on the academic performance of students in <national modal grade for 15-year-olds> as a group relative to students in the same grade in other schools?". Answer options were "Yes/No".

Parental involvement

General findings

In secondary education, innovation in terms of schools' openness to parental involvement with the school was indicated through both increased and reduced invitations to parents to join school committees and in volunteering in projects, programmes or trips in their child's school (Figure 16.6 and Figure 16.7). Between 2003 and 2007 the OECD average absolute change in the practice of asking parents to serve on school committees was 10% points, while the change in terms of asking parents to volunteer in projects, programmes and trips amounted to 6% points. Invitations for parental participation in 8th grade school committees increased mostly in countries such as the United States (15% points), Hungary (15% points), Indonesia (14% points), Hong Kong (13% points), Korea (10% points), the Russian Federation (9% points) and Australia (7% points). It decreased in Slovenia (22% points), Italy (16% points) and Israel (13% points). Parent volunteering in school projects, programmes or trips increased especially in Singapore (15% points), Australia (13% points), Norway (13% points), United States (7% points) and the Russian Federation (6% points). Decreases were particularly remarkable in the case of Indonesia (18% points) and Italy (11% points). These changes presented small effect size as did the OECD average absolute change in schools asking paretns of 8th grade studetns to serve on committees. Overall, parental involvement in school committees increased in eight education systems and decreased in four, while parent volunteering increased in five education systems and decreased in two, with small effect sizes.

Innovation in parental involvement at the primary school level was also illustrated through increased and decreased invitations to participate in school committees or volunteering in projects, programmes and trips across OECD countries (Figure 16.8 and Figure 16.9). OECD average absolute change regarding parents being asked to serve on 4th grade school committees was 8% points, while it amounted to 4% for parents being asked to volunteer in school projects, programmes and trips between 2003 and 2007. Requests for parental participation in school committees increased particularly in Hungary (14% points), Scotland (10% points), the Russian Federation (8% points) and New Zealand (6% points), while decreases were substantial in Slovenia (19% points) and Italy (12% points). Parents were asked more frequently to volunteer for projects, programmes and trips especially in Norway (7% points), Australia (7% points), and Singapore (3% points), while it was the opposite in Italy (13% points). These changes were characterised by medium effect sizes. Altogether, school requests for parental involvement in committees increased in six education systems and decreased in two with at least small effect sizes, while demand for parental volunteering in projects programmes and trips augmented in four education systems and reduced in one.

Country specificities

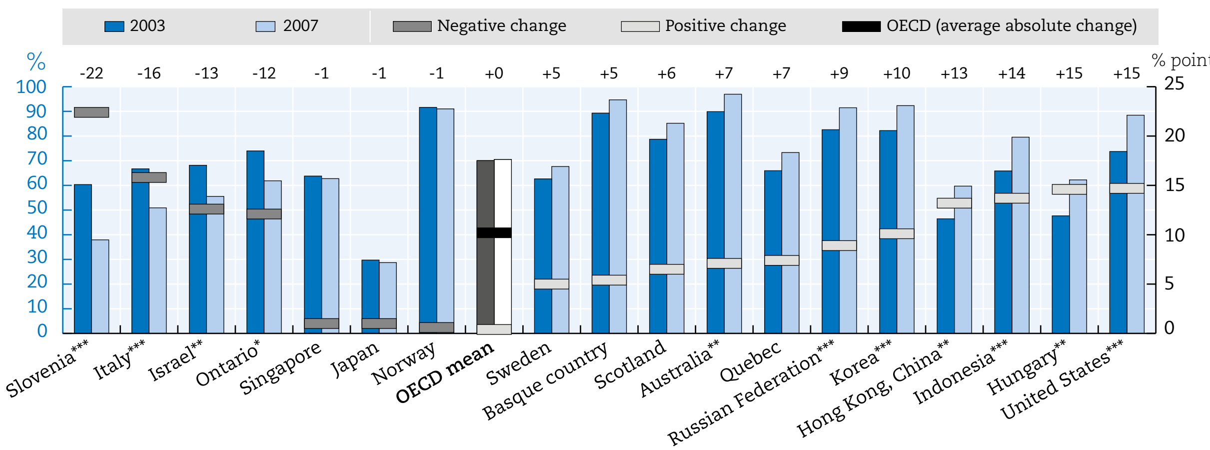
Singapore illustrates the case of an education system where requests for parental involvement increased across levels and practices. Between 2003 and 2007, schools in Singapore asked more parents to serve on school committees both in 8th and 4th grade and to volunteer in projects, programmes and trips in 4th grade, with small effect sizes.

On the contrary, Italy showed simultaneous decreases across practices and levels with regard to requests for parental involvement. Italian schools decreased their invitations for parents to serve on committees as well as to volunteer for projects, programmes and trips in both primary and secondary education between 2003 and 2007.

Indonesia is the only example of a country where secondary schools asked for more parental participation in committees and less volunteering in projects, programmes and trips between 2003 and 2007; both changes were characterised by small effect sizes.

Figure 16.6 **Schools asking parents of 8th grade students to serve on committees**

Percentage of students in schools that ask parents to serve on school committees and change over time



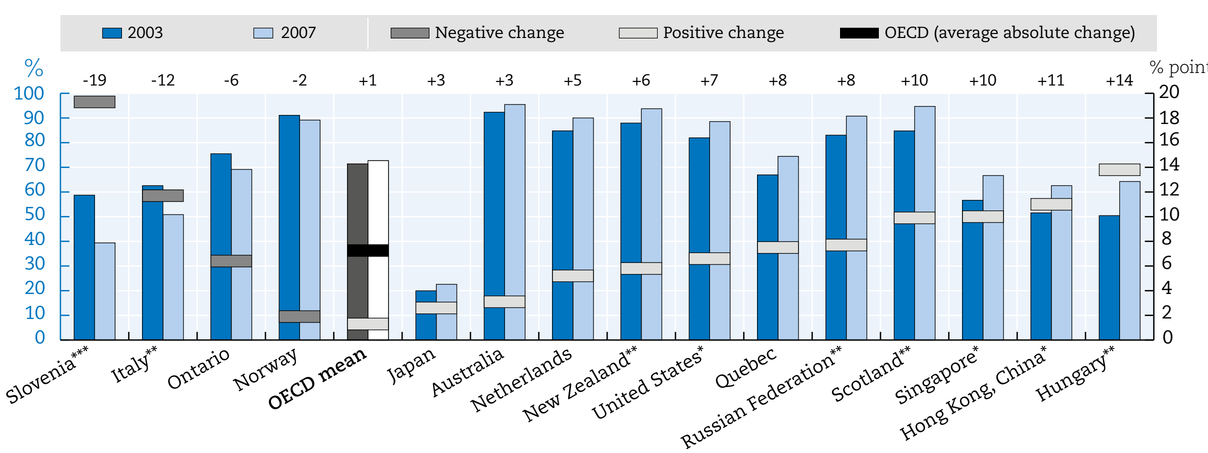
StatLink http://dx.doi.org/10.1787/888933086318

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 16.7 **Schools asking parents of 4th grade students to serve on committees**

Percentage of students in schools that ask parents to serve on school committees and change over time



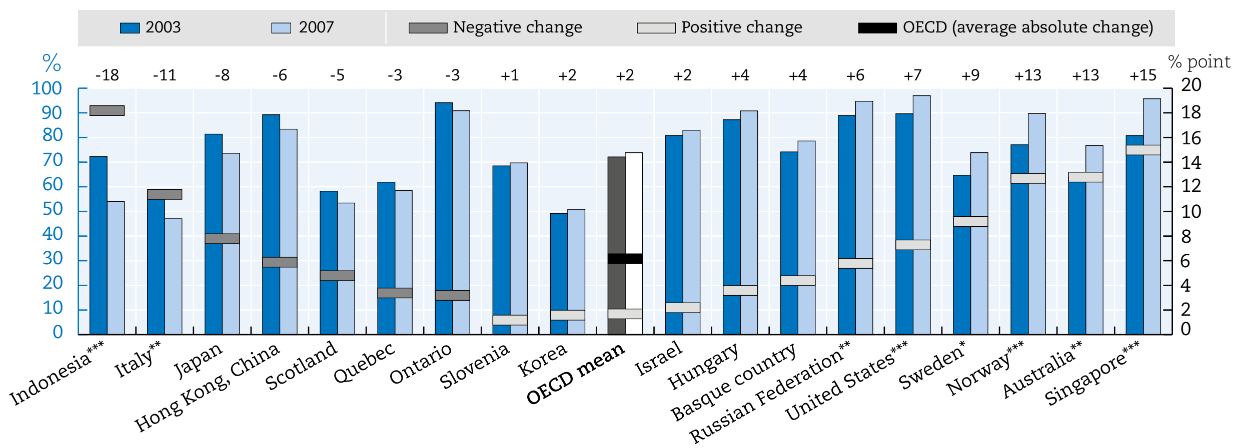
StatLink http://dx.doi.org/10.1787/888933086337

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 16.8 **Schools asking parents of 8th grade students to volunteer for projects**

Percentage of students in schools that ask parents to volunteer for projects, programmes and trips and change over time



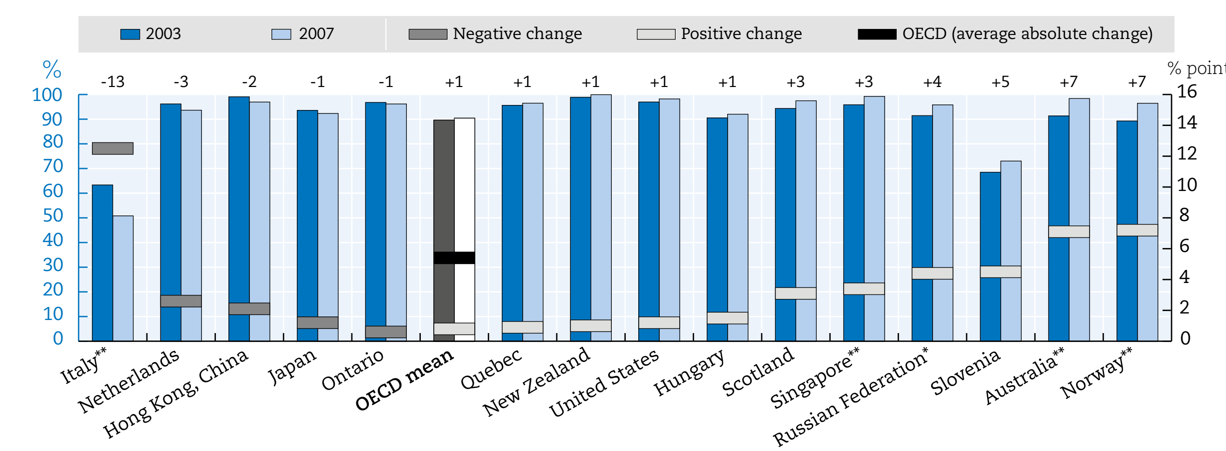
StatLink http://dx.doi.org/10.1787/888933086356

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Source: Authors' calculations based on TIMSS (2003 and 2007)

Figure 16.9 **Schools asking parents of 4th grade students to volunteer for projects**

Percentage of students in schools that ask parents to volunteer for projects, programmes and trips and change over time



StatLink http://dx.doi.org/10.1787/888933086375

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Source: Authors' calculations based on TIMSS (2003 and 2007)

Box 16.2 **Data source details for Chapter 16.6 to 16.9**

TIMSS (2003 and 2007) asked principal and head of schools in 8th and 4th grade "Does your school ask parents to do the following? […] Volunteer for school projects, programs, and trips […] Serve on school committees (e.g., select school personnel, review school finances)" with response options "Yes/No". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Public relations

General findings

Innovation in schools' public relations can be illustrated by more or less self-promotion through achievement data and more or less engagement of the principal in public relations and fundraising among OECD countries (Figure 16.10 and Figure 16.11). The OECD average absolute change between 2006 and 2009 concerning public posting of achievement data amounted to 9% points in secondary education, whilst OECD average absolute change regarding principal engagement in public relation and fundraising was 10% points between 2003 and 2007. Slovak Republic (35% points) and New Zealand (30% points) stood out as countries where the practice of posting achievement data publicly was used more frequently in 2009 than in 2006. In Korea (19% points) and Canada (15% points) principals devoted substantially more time into public relations and fundraising activities, while they spent less time to these ends in Slovenia (19% points), Norway (19% points) and United States (17% points). Changes in the posting of achievement data at country level showed medium effect sizes, while changes related to principals' engagement in public relations and fundraising showed small effect sizes. OECD average absolute change in principals' public relations and fundraising showed a small effect size. Overall, with at least small effect sizes, public posting of achievement data increased in six education systems and decreased in eight. The time spent by principals in fundraising and public relations increased in two education systems, whereas decreases were observed in four, with small effect sizes.

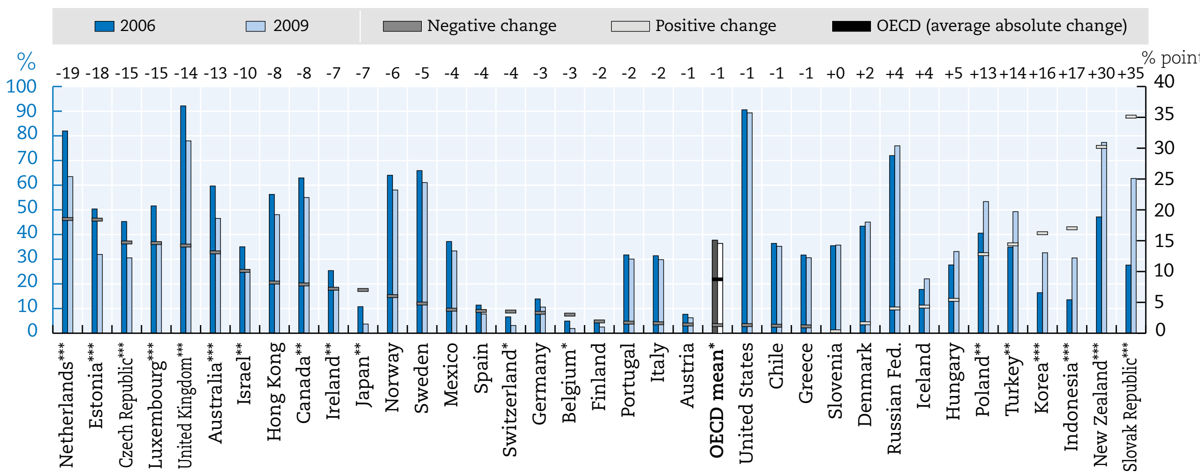
Innovation in primary education school public relation activities has taken the form of modest changes with regard to principal's engagement in community and parent relations (Figure 16.12). The OECD average absolute change between 2001 and 2006 in percentage of 4th grade principal's time devoted to this end was 2% points.

Country specificities

Innovation in Korea translated into schools engaging more in public relation activities in secondary education. More Korean schools posted achievement data publicly in 2009 than 2006, while principals spent more time in fundraising and public relations in 2007 than in 2003. These changes were characterised by small effect sizes.

Figure 16.10 **Publicly posting school achievement data**

Percentage of 15-year old students in schools where achievement data are publicly posted and change over time



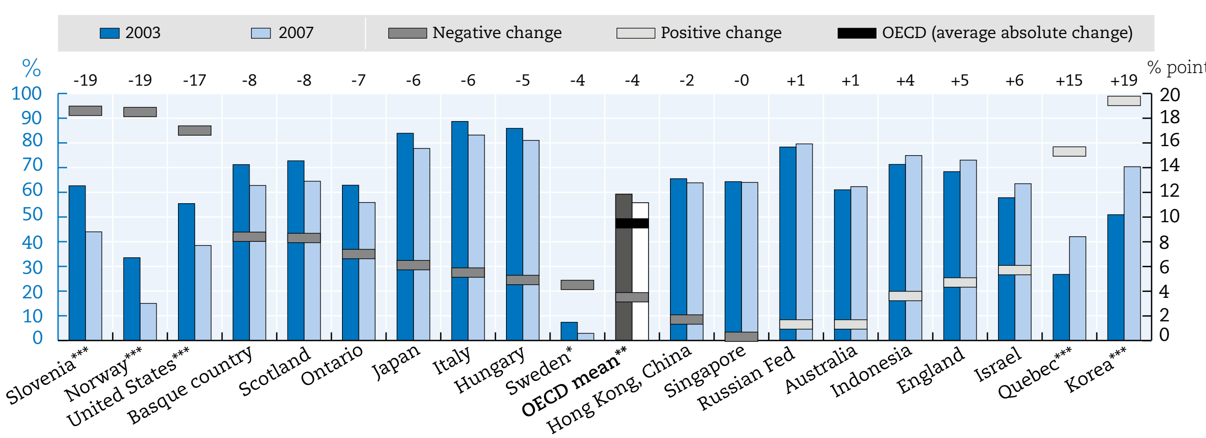
StatLink http://dx.doi.org/10.1787/888933086394

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level

Sources: Authors' calculations based on PISA (2006 and 2009)

Figure 16.11 **Public relations and fundraising by school principals**

Percentage of 15-year olds in schools in which the principal spends 10% or more of his/her time on public relations and fundraising and change over time

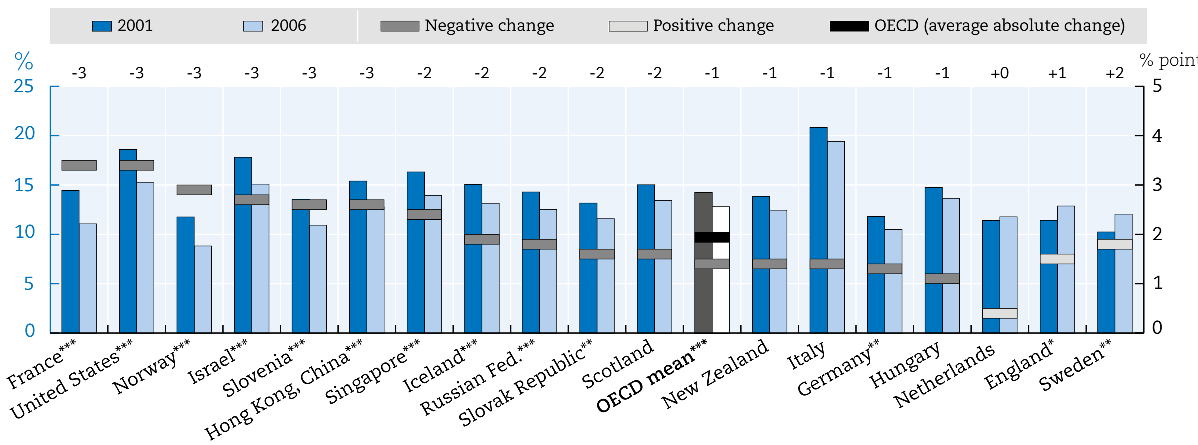


StatLink http://dx.doi.org/10.1787/888933086413

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Sources: Authors' calculations based on TIMSS (2003 and 2007)

Figure 16.12 **Time devoted to community/parent relations by 4th grade principals**



StatLink http://dx.doi.org/10.1787/888933086432

Notes: *** = change significant at the 0.01 level; ** = change significant at the 0.05 level; * = change significant at 0.1 level.

Source: Authors' calculations based on PIRLS (2001 and 2006)

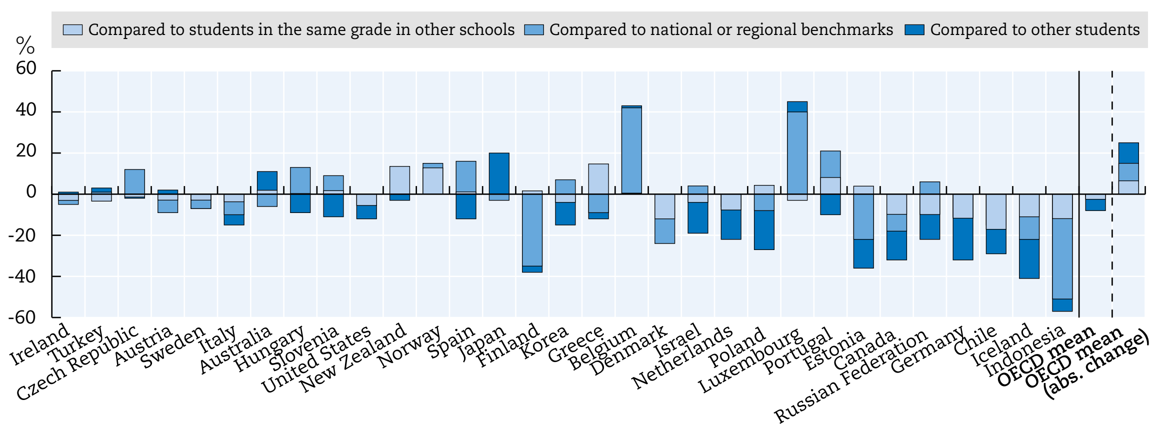
Box 16.3 **Data source details for Chapter 16.10 to 16.12**

PISA (2006 and 2009) surveys asked principals and heads of schools in 8th grade: "In your school, are achievement data used in any of the following <accountability procedures>? […] Achievement data are posted publicly (e.g. in the media)", with response options "Yes/No". TIMSS (2003 and 2007) survey asked principals and head of schools: "By the end of this school year, approximately what percentage of time in your role as principal […] Public relations and fundraising", with answer option expressed in percentages. PIRLS (2001 and 2006) asked principals of 4th grade classes "As principal of this school, approximately what percentage of your time is devoted to the following activities? […]Parent and community relations" with answers expressed in percentages. The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data.

Summary

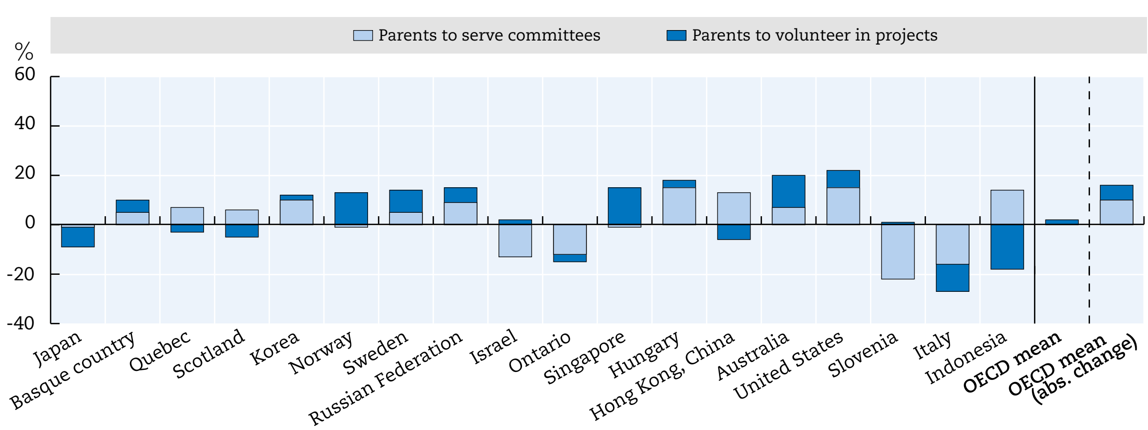
Innovation – or significant change – regarding external relations practices has meant less use of achievement and assessment data for the provision of comparative information on the student's performance between 2006 and 2009. On the other hand, more schools asked for parental involvement in schools between 2003 and 2007. Principal and school engagement in public relations and fundraising activities slightly decreased across OECD countries in the timeframe between 2001 and 2009.

Figure 16.13 **Change in provision of comparative information on student's performance**



StatLink http://dx.doi.org/10.1787/888933086451

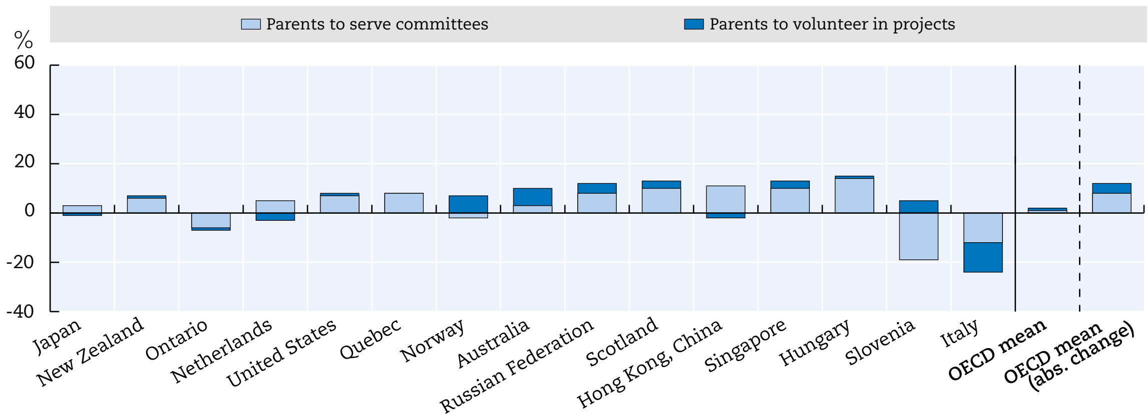
Figure 16.14 **Change in school involvement by parents of 8th grade students**



StatLink http://dx.doi.org/10.1787/888933086470

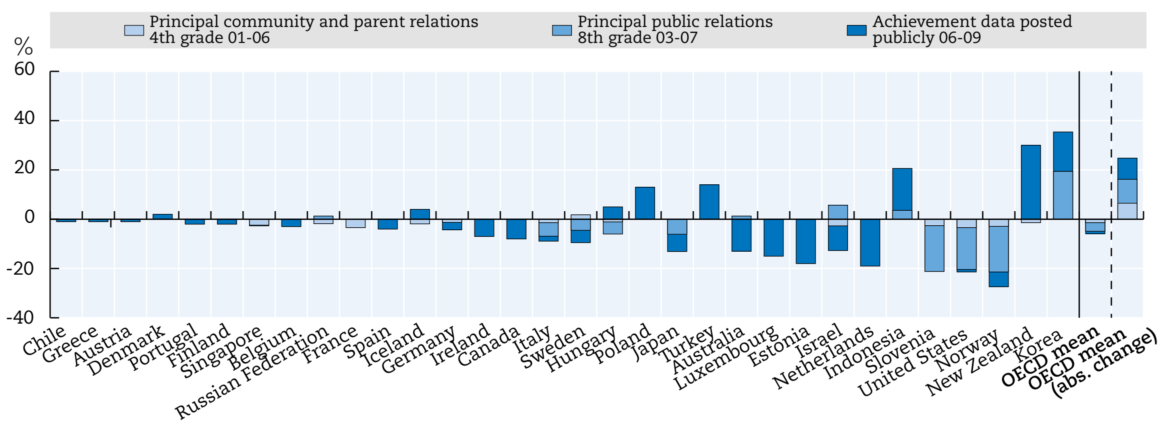
Notes : For details, please see Figures 16.1, 16.2, 16.3, 16.4 and 16.5.

Figure 16.15 **Change in school involvement by parents of 4th grade students**



StatLink http://dx.doi.org/10.1787/888933086489

Figure 16.16 **Change in public relation practices of schools**



StatLink http://dx.doi.org/10.1787/888933086508

Notes : For details, please see Figures 16.6, 16.7, 16.8, 16.9 and 16.10.

Note on Israel

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.

Table 16.1 **Effect sizes for changes in school external relations practices**

	Change in information provision to parents					Change in parents involvement				Change in public relations		
	Parental perceptions on provision of regular information	Achievement data to inform parent on child performance	Students performance relative to other students	Students performance relative to national/regional benchmarks	As a group relative to students in the same grade in other schools	Schools asking parents to serve on school committees		School asking parents to be volunteer for school projects, programs and trips		Achievement data to be posted publicly	Public relations and fund-raising by principals	Principal's time to community/parent relations
	8th grade					8th grade	4th grade	8th grade	4th grade	8th grade		4th grade
	06-09	06-09	06-09	06-09	06-09	03-07	03-07	03-07	03-07	06-09	03-07	01-06
Australia	m	-0.20	0.22	-0.06	0.05	0.30	0.13	0.28	0.35	-0.26	0.03	m
Austria	m	0.21	0.05	-0.18	-0.10	m	m	m	m	-0.06	m	m
Belgium	m	-0.06	0.03	0.50	0.05	m	m	m	m	-0.17	m	m
Canada	m	-0.04	-0.30	-0.19	-0.22	m	m	m	m	-0.16	m	m
Ontario	m	m	m	m	m	-0.26	-0.14	-0.12	-0.03	m	-0.14	m
Quebec	m	m	m	m	m	0.16	0.17	-0.07	0.04	m	0.32	m
Chile	m	-0.21	-0.29	-0.19	-0.36	m	m	m	m	-0.02	m	m
Czech Republic	m	-0.09	-0.04	0.12	-0.03	m	m	m	m	-0.30	m	m
Denmark	0.11	0.00	m	-0.24	-0.25	m	m	m	m	0.03	m	m
Estonia	m	m	-0.31	-0.22	0.09	m	m	m	m	-0.38	m	m
Finland	m	-0.10	-0.08	-0.36	0.04	m	m	m	m	-0.11	m	m
France	m	m	m	m	m	m	m	m	m	m	m	-0.10
Germany	0.04	-0.16	-0.42	-0.12	-0.29	m	m	m	m	-0.10	m	-0.04
Greece	m	-0.10	-0.08	-0.12	0.45	m	m	m	m	-0.02	m	m
Hungary	m	-0.12	-0.20	0.14	0.01	0.29	0.28	0.12	0.05	0.12	-0.13	-0.03
Iceland	m	0.00	-0.42	-0.22	-0.25	m	m	m	m	0.11	m	-0.05
Ireland	m	0.02	0.01	-0.06	-0.12	m	m	m	m	-0.17	m	m
Israel	m	0.09	-0.38	0.04	-0.10	-0.26	m	0.06	m	-0.22	0.12	-0.07
Italy	0.02	-0.08	-0.14	-0.13	-0.16	-0.32	-0.24	-0.23	-0.25	-0.03	-0.16	-0.03
Japan	m	0.11	0.41	-0.04	m	-0.02	0.06	-0.19	-0.05	-0.28	-0.16	m
Korea	m	m	-0.36	0.09	-0.08	0.31	m	0.03	m	0.38	0.40	m
Luxembourg	m	0.00	0.14	0.48	-0.09	m	m	m	m	-0.30	m	m
Mexico	m	0.08	-0.02	0.44	0.03	m	m	m	m	-0.08	m	m
Netherlands	m	0.15	-0.38	-0.08	-0.30	m	0.16	m	-0.12	-0.42	m	m
New Zealand	0.02	-0.21	-0.07	0.03	0.28	m	0.20	m	0.20	0.64	m	-0.04
Norway	m	-0.02	0.00	0.16	0.26	-0.02	-0.07	0.35	0.29	-0.12	-0.44	-0.10
Poland	m	0.05	-0.42	-0.09	0.09	m	m	m	m	0.26	m	m
Portugal	0.11	0.00	-0.21	0.22	0.32	m	m	m	m	-0.04	m	m
Slovak Republic	m	m	-0.84	-0.14	-0.59	m	m	m	m	0.72	m	-0.05
Slovenia	m	m	-0.28	0.09	0.10	-0.45	-0.39	0.03	0.10	0.01	-0.38	-0.08
Spain	m	0.16	-0.24	0.22	0.04	m	m	m	m	-0.12	m	m
Basque country	m	m	m	m	m	0.20	m	0.10	m	m	-0.18	m
Sweden	m	0.02	-0.03	-0.22	-0.07	0.11	m	0.20	m	-0.10	-0.21	0.06
Switzerland	m	-0.11	-0.07	0.05	-0.15	m	m	m	m	-0.17	m	m

Table 16.1 Effect sizes for changes in school external relations practices (continued)

	Change in information provision to parents					Change in parents involvement				Change in public relations		
	Parental perceptions on provision of regular information	Achievement data to inform parent on child performance	Students performance relative to other students	Students performance relative to national/regional benchmarks	As a group relative to students in the same grade in other schools	Schools asking parents to serve on school committees		School asking parents to be volunteer for school projects, programs and trips		Achievement data to be posted publicly	Public relations and fund-raising by principals	Principal's time to community/parent relations
	8th grade					8th grade	4th grade	8th grade	4th grade	8th grade		4th grade
	06-09	06-09	06-09	06-09	06-09	03-07	03-07	03-07	03-07	06-09	03-07	01-06
Turkey	m	m	0.09	0.01	-0.07	m	m	m	m	0.29	m	m
United Kingdom	m	0.07	-0.39	-0.32	-0.15	m	m	m	m	-0.41	m	m
England	m	m	m	m	m	m	m	m	m	m	0.10	0.04
Scotland	m	m	m	m	m	0.17	0.34	-0.10	0.16	m	-0.18	-0.05
United States	m	0.66	-0.24	0.00	-0.11	0.38	0.19	0.31	0.08	-0.04	-0.34	-0.09
OECD (average)	0.04	0.01	-0.16	-0.01	-0.05	0.04	0.06	0.05	0.07	-0.05	-0.09	-0.04
OECD (average absolute)	0.11	0.06	0.22	0.17	0.16	0.23	0.20	0.16	0.14	0.20	0.22	0.06
Hong Kong, China	0.05	m	-0.23	-0.15	0.05	0.27	0.22	-0.17	-0.16	-0.17	-0.04	-0.08
Indonesia	m	-0.05	-0.31	-0.61	-0.25	0.31	m	-0.38	m	0.42	0.08	m
Russian Federation	m	0.11	-0.55	0.07	-0.20	0.27	0.23	0.22	0.18	0.09	0.03	-0.05
Singapore	m	m	m	m	m	-0.02	0.21	0.49	0.24	m	-0.01	-0.07

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Notes: OECD average includes all OECD education systems for which data is available for all years concerned
= Effect size (from -0.2 to -0.5 or 0.2 to 0.5)
= Effect size (from -0.5 to -0.8 or 0.5 to 0.8)
= Effect size (equal or above -0.8 or equal or below 0.8)

Source: Authors' calculations based on TIMSS (2003 and 2007), PIRLS (2001 and 2006) and PISA (2002, 2006 and 2009)

CHAPTER 17

Composite indices of innovation in classrooms and schools

Combining information about the extent to which school and classroom practices have changed provides important insights into the extent and focus of innovation within education in different education systems.

An education system may be widely innovative, changing many practices at different levels and across subjects, or it may focus on certain aspects more than others. A focus on school change rather than classroom change may indicate innovations designed to improve whole school results, whilst those education systems with more innovation at 8th grade than 4th grade may be seeking innovations that improve higher education options and labour market opportunities for students. Innovation activities that focus on one subject over another may be designed to address identified weaknesses or to build on perceived strengths within the wider economy, for example.

Composite innovation indices

The wide range of changes identified within an education system creates the opportunity to generate composite indices of innovation for 28 of the education systems discussed. These indices can be used to investigate which education systems are more or less innovative in terms of school or classroom practices, and can also show whether innovation more typically occurs in a particular grade or within a certain subject.

Aggregating information at both school and classroom level to provide an overall index identifies 13 education systems that are above the OECD mean (22 points) in terms of the extent of change across school and classroom practices between 2000 and 2011 (Figure 17.1). These include Denmark (37 points), Indonesia (36 points), Korea (32 points) and the Netherlands (30 points). At the other end of the range are New Zealand (17 points), Austria (16 points), the Czech Republic (15 points) and Massachusetts (14 points).

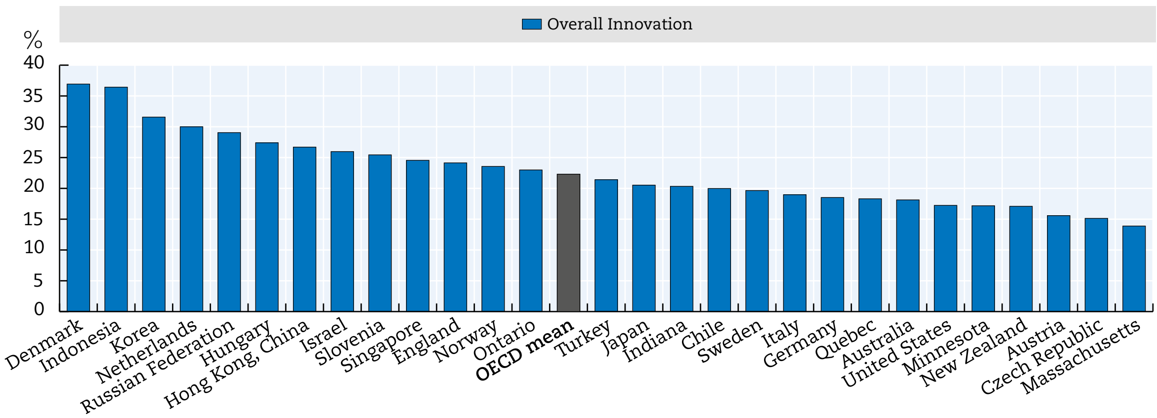
There is some variation in the extent to which the change occurs at classroom or school level (Figure 17.2). Denmark, Hungary, Israel, Korea, the Russian Federation and Slovenia stand out with scores above the relevant OECD mean at both school (23 points) and classroom level (22 points), suggesting that their education systems are characterised by innovation at both levels. In contrast, Australia, Austria, the Czech Republic, Germany, Italy, Japan, Minnesota, Massachusetts, Sweden and the United States, and exhibit scores below the OECD average across the two indicators.

In the case of England (33 points), Hong Kong (32 points) and Quebec (26 points) change occurs primarily in school practices. It is also noteworthy that the four education systems at the lower end of the range in terms of overall innovation have more innovation at the school level than within the classroom. In contrast, in most of the top ranking education systems in terms of overall innovation, Denmark (40 points), Indonesia (42 points), Korea (36 points), the Russian Federation (31 points) and Hungary (28 points), innovation is most apparent with regard to classroom practices.

Subject level composite innovation indices highlight the high level of innovation in the Russian Federation, in relation to both science (49 points) and maths (41 points) (Figure 17.3). In comparison, the OECD means for both maths and science are 24 points. Japan also stands out as having relatively high level of innovation in maths (28 points) and science (29 points), despite below average overall levels of innovation. In addition, innovation is above the means for both maths and science in Indonesia, Korea, the Netherlands, Israel, England, and Norway. Slovenia (29 points) and New Zealand (26 points) stand out as education systems with above average innovation in maths, but below in science (Slovenia 22 points and New Zealand 16 points). Conversely, Singapore (32 points), Hungary (31 points) and Hong Kong (27 points) have above average levels of innovation in science but below in maths.

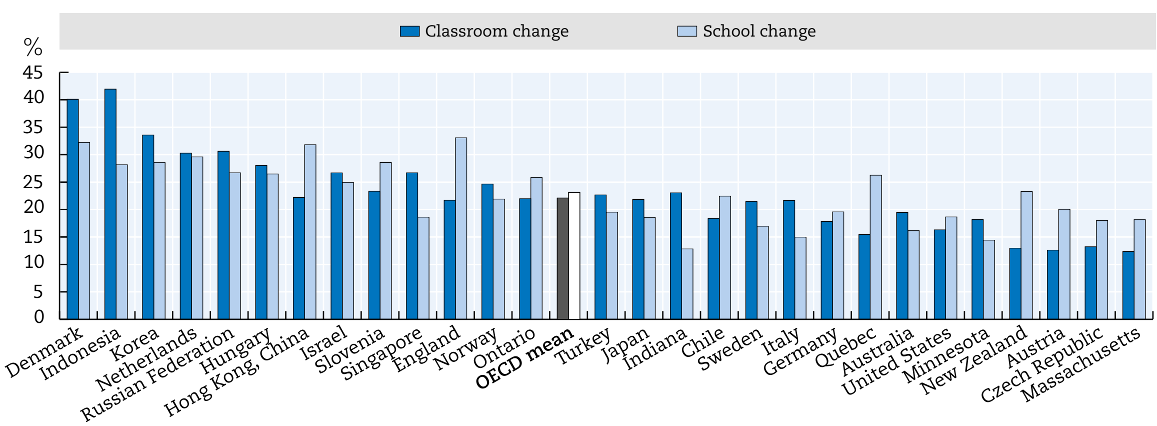
The composite indices show small differences in levels of innovation at 4th grade and 8th grade in many education systems (Figure 17.4), and the majority of systems are either above or below the relevant OECD mean on both indices. Denmark and Indonesia rank the highest at both grade levels, just as they rank highest overall. Only England stands above the OECD mean for innovation in the 8th grade (24 points compared with an OECD mean of 22 points) but below for innovation at 4th grade (19 points compared with an OECD mean 23 points). Similarly Quebec is the only education system to have a score above the OECD mean at 4th grade (24 points) but below at 8th grade (16 points).

Figure 17.1 **Overall composite education innovation index, 2000-2011**



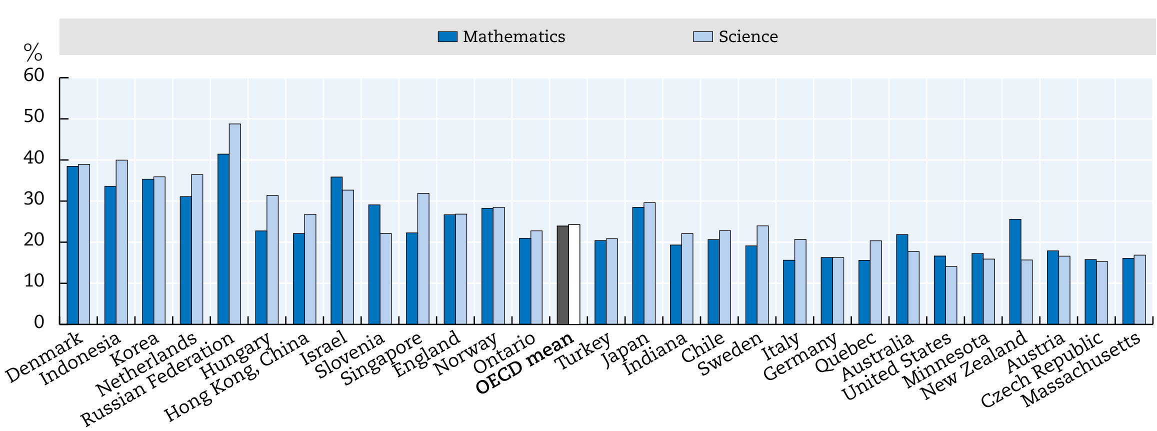
StatLink http://dx.doi.org/10.1787/888933086546

Figure 17.2 **School and classroom level composite innovation indices, 2000-2011**



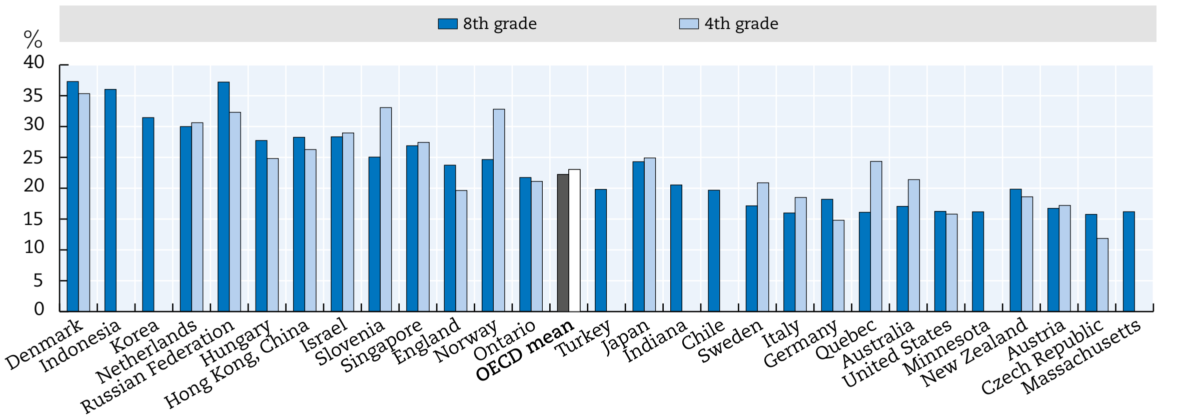
StatLink http://dx.doi.org/10.1787/888933086565

Figure 17.3 **Subject-level composite innovation indices for maths and science education, 2000-2011**



StatLink http://dx.doi.org/10.1787/888933086584

Figure 17.4 **Composite innovation indices for 8th grade and 4th grade, 2000-2011**



StatLink http://dx.doi.org/10.1787/888933086603

Box 17.1 **Data source details for Chapter 17**

The composite innovation indices are based on average absolute effect sizes of changes reported elsewhere in this chapter. A large value on the index shows that changes have occurred across different aspects of that education system, whether reductions or increases in a particular practice. Each set of indices, including the overall indices is calculated separately; it is not possible to sum two or more sets of indices to replicate this overall measure.

Note on Israel

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.

Table 17.1 Overall composite education innovation index, 2000-2011

Countries	Overall Innovation	Classroom change	School change	Mathematics	Science	8th grade	4th grade
Denmark	36.93	40.09	32.20	38.43	38.90	37.30	35.33
Indonesia	36.43	41.94	28.16	33.60	39.96	36.02	
Korea	31.57	33.58	28.55	35.31	35.91	31.45	
Netherlands	30.00	30.28	29.59	31.09	36.43	30.00	30.62
Russian Federation	29.05	30.62	26.69	41.42	48.76	37.21	32.31
Hungary	27.40	28.01	26.48	22.74	31.36	27.74	24.82
Hong Kong, China	26.70	22.20	31.81	22.11	26.79	28.26	26.27
Israel	25.97	26.68	24.90	35.85	32.67	28.34	28.96
Slovenia	25.44	23.34	28.58	29.09	22.14	25.05	33.07
Singapore	24.55	26.69	18.62	22.28	31.86	26.89	27.43
England	24.14	21.70	33.07	26.69	26.83	23.74	19.63
Norway	23.56	24.65	21.91	28.25	28.49	24.65	32.81
Ontario	22.99	21.97	25.82	20.95	22.77	21.74	21.11
OECD mean	22.31	22.10	23.12	23.92	24.26	22.23	23.04
Turkey	21.41	22.66	19.53	20.40	20.85	19.82	
Japan	20.53	21.83	18.58	28.46	29.62	24.30	24.91
Indiana	20.33	23.04	12.82	19.32	22.10	20.53	
Chile	19.98	18.34	22.45	20.63	22.80	19.68	
Sweden	19.65	21.44	16.97	19.12	23.98	17.15	20.88
Italy	18.97	21.63	14.98	15.62	20.68	15.99	18.50
Germany	18.52	17.82	19.57	16.28	16.26	18.21	14.81
Quebec	18.31	15.45	26.26	15.59	20.35	16.10	24.35
Australia	18.13	19.46	16.15	21.86	17.73	17.06	21.39
United States	17.24	16.30	18.65	16.64	14.08	16.24	15.80
Minnesota	17.18	18.16	14.43	17.24	15.90	16.18	
New Zealand	17.09	12.97	23.27	25.57	15.68	19.85	18.61
Austria	15.58	12.61	20.05	17.91	16.61	16.74	17.21
Czech Republic	15.13	13.22	17.98	15.78	15.27	15.76	11.86
Massachusetts	13.89	12.35	18.15	16.07	16.86	16.19	

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PART III

Change in educational outcomes

CHAPTER 18

Innovation and educational outcomes

Measures of innovation can be used to better understand how innovation relates to educational outcomes. The extent of innovation may be associated with various types of educational outcome, including learning outcomes, equality and equity. It may also be related to expenditure trends.

A positive association between innovation and specific outcomes might occur if the innovation led to some improvements at the classroom or school level. This could also be implied through a positive association with innovation and changes in outcomes across time. Innovation may also be positively associated with equity, particularly if innovation occurs to tackle previous inequalities or to drive improvements across the whole school. Conversely, certain outcomes my lead to more innovation at classroom or school level, either because they increase the freedom or the pressure to innovate.

If no association between innovation and outcomes is observed, it may be that innovations are expected to have an impact over the longer term or that other confounding factors have prevented an improvement in outcomes. Indeed, it is possible that innovation was necessary in order to arrest a potential fall in outcomes caused by issues such as budget cuts or staff shortages. Alternatively, it is possible that these innovations were not intended to target the outcomes analysed.

This chapter explores some of the complex relationships between innovation and outcomes in education and considers plausible explanations for the patterns found. More regular assessment would help to build on this knowledge to better understand the driving factors behind relationships observed.

Composite innovation indices and learning outcomes

Innovation and test scores

Are education system level changes in classroom and school practices associated with outcome measure taken from TIMSS, PIRLS and PISA studies, using the most recent outcomes available, or with change in outcomes across time? In other words, is there a link between innovation and learning outcomes?

The relationship between innovation and learning outcomes across education systems might be driven by two opposing factors. On the one hand, systems with low levels of performance may innovate in order to improve this important outcome. On the other hand, education systems with high levels of performance may exhibit continuous innovation as a means of keeping performance levels high. In other words, high levels of innovation can be associated both with high and low levels of performance. The relationship may not be causal, and at this stage in our knowledge, it should not be concluded that innovation results in a particular outcome.

Innovation and TIMSS 8th grade mathematics score

Higher levels of innovation are associated with higher maths scores (Figure 18.1 to Figure 18.3). Whilst there is considerable variation, education systems that have experienced more change in school and classroom practice, as indicated by a higher position on the overall innovation index, typically have higher maths scores than those with a lower position.

Education systems in the top right quadrant of Figure 18.1 (including Korea, the Russian Federation, Hungary and Hong Kong) have innovation scores that are above the OECD mean, and above average maths scores on TIMSS. These systems have innovated to keep their scores high, or may have achieved high scores as a result of the innovations that have occurred. Conversely, education systems in the bottom left quadrant (such as Sweden, Chile and Turkey) have lower than average maths scores and low levels of innovation.

However, there are also a number of education systems with high outcomes and relatively low levels of innovation (top left quadrant); these systems may have practices in place that they do not intend to change while performance is high.

Figure 18.2 and Figure 18.3 provide additional detail about how the outcomes are associated with school and classroom practices. The association between maths scores and classroom innovation is higher than that of school innovation, and whilst the data does not show causation, this pattern is consistent with the argument that changes in classroom practices may be more likely to lead to better performance than school level changes.

The top two quadrants of Figure 18.2 and Figure 18.3 show that there are many education systems with above average maths scores across all levels of school innovation, whilst the highest scoring systems have above average innovation at the classroom level.

Figure 18.1 **Overall education innovation and 8th grade mathematics outcomes**

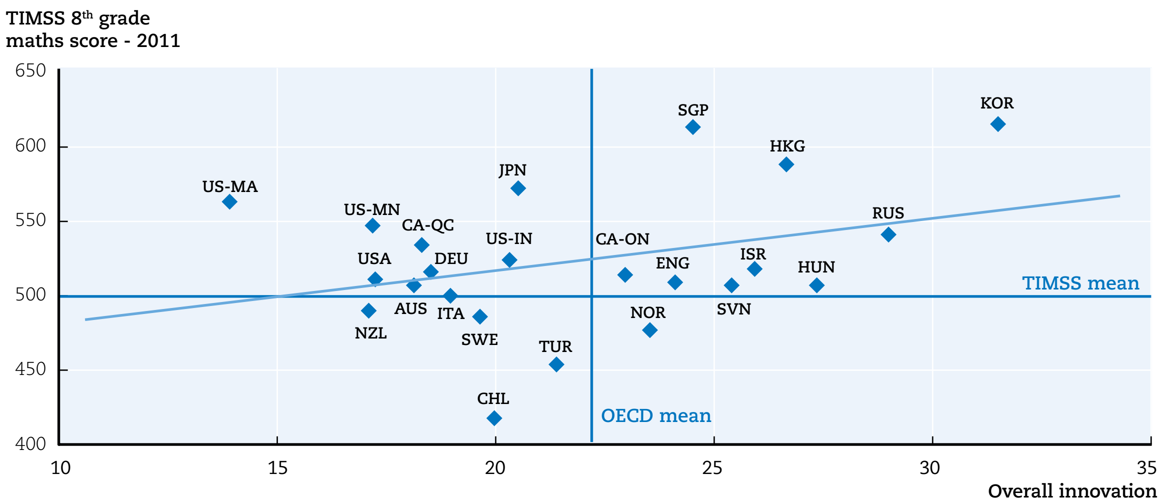

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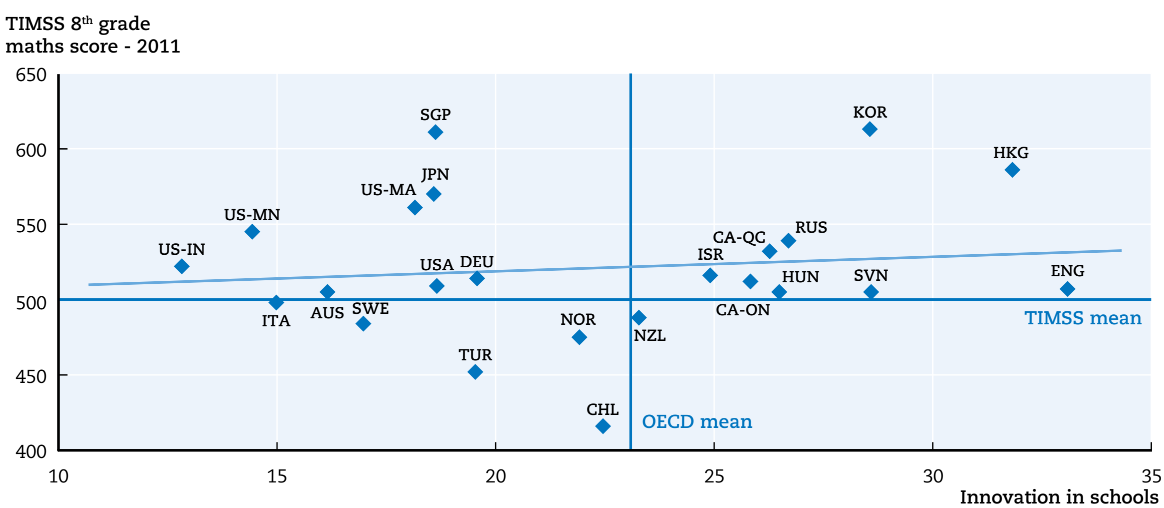
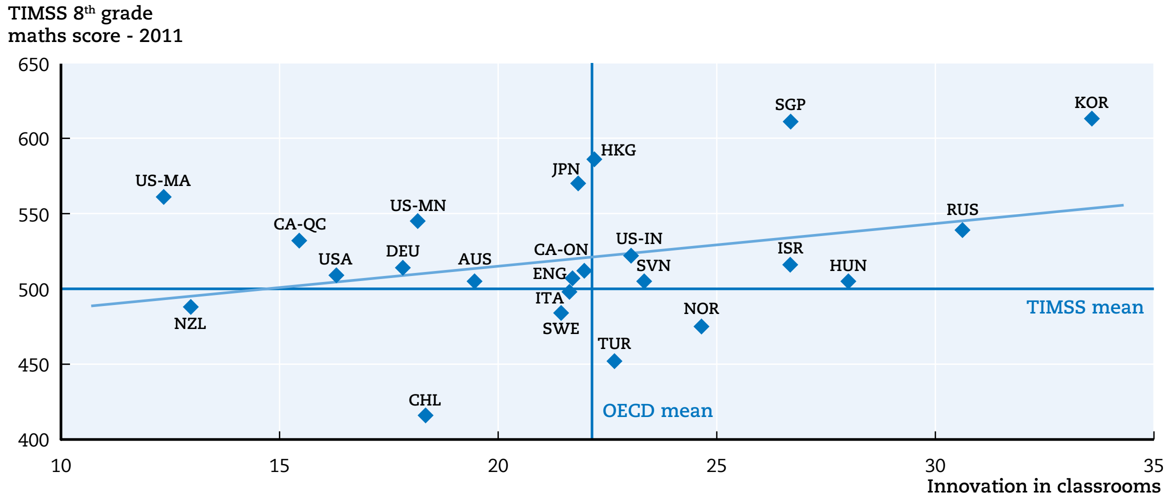
Figure 18.2 **School innovation and 8th grade mathematics outcomes**



StatLink http://dx.doi.org/10.1787/888933086660

Figure 18.3 **Classroom innovation and 8th grade mathematics outcomes**



StatLink http://dx.doi.org/10.1787/888933086679

The vertical lines on Figures in this section indicate the OECD mean for innovation, whilst the horizontal line indicates the mean value for the outcome, as reported in the original data

Box 18.1. **How to read the graphs**

The graphs used in this section show the association between the selected innovation and outcome variables. The innovation score is usually represented on the x axis, while the outcome variable is represented on the y axis. The vertical line dividing the quadrants represents the innovation score OECD mean, whereas the horizontal line represents the average of the selected measure taken from the original source. The trend line represents the line of best fit between the two variables..

Box 18.2. **Data source details for Figures 18.1 to 18.6**

In this chapter, Innovation is measured using various composite innovation indices as presented in Chapter 18. An overall indicator gathers information about educational change across grades and subjects at school and classroom level, whilst two separate indices look at innovation in school and classrooms separately. Innovation at 8th grade combines innovation in classrooms or schools with 8th grade students (using data from TIMSS), and schools with 15-year-olds students (using data from PISA). A 4th grade innovation index combines information from classrooms or schools that have 4th grade students, while the mathematics innovation index combines innovation in 8th or 4th grade in classrooms or schools that relates to mathematics practices.

The outcome measure used in the above figures is 2011 8th grade mathematics results from TIMSS. 8th grade mathematics results are available for 23 of the 28 education systems for which innovation scores have been calculated, excluding Austria, the Czech Republic, Denmark, Indonesia and the Netherlands.

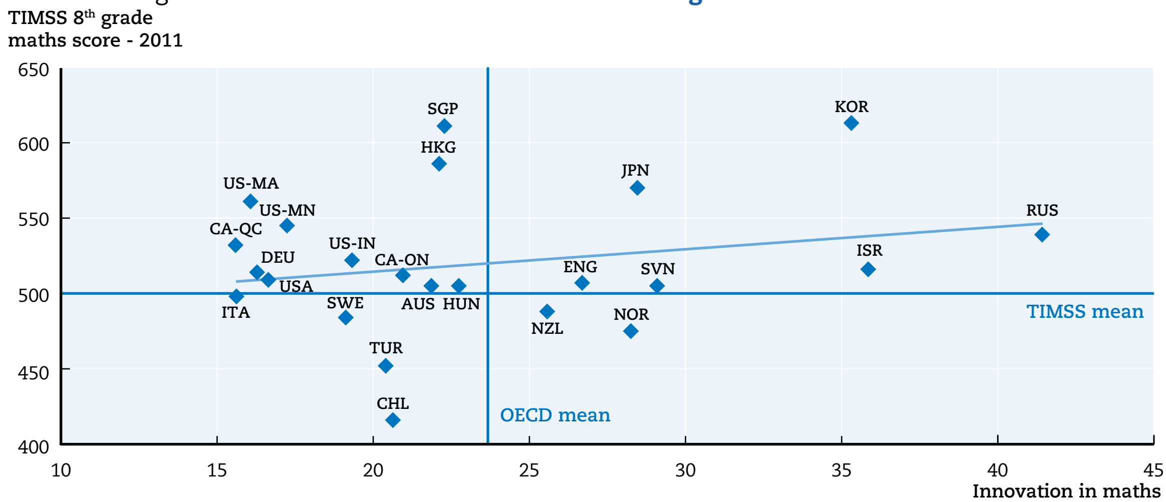
Innovation in mathematics education and mathematics outcomes

It is plausible that maths score outcomes would be most directly associated with innovation in mathematics. This is explored in Figure 18.4, which shows that there is some association between innovation in maths (across 8th and 4th grades) and maths performance, but that it is not the strongest of the associations explored. A possible explanation could be that some organisational, non-subject-specific factors might also have an indirect impact on performance. In particular, there are many education systems with above average maths scores that have not been particularly innovative in maths, including high scoring education systems such as Singapore and Hong Kong.

Figure 18.5 investigates the association between 8th grade maths performance and innovation occurring across 8th grade school and classroom practices. The association is similar to that between maths scores and the overall indicator of innovation. The education systems in the top right quadrant are characterised by high levels of innovation at 8th grade and correspondingly high maths scores. This may reflect the extent to which secondary schools and classroom teachers are working at maintaining or improving outcomes for their students in this core subject. There are several education systems with above average maths scores that are not particularly innovative in the 8th grade, but those with the highest performance (Korea, Singapore, Hong Kong and Japan) are all above the OECD mean in terms of innovation at 8th grade.

There is also a positive association between 4th grade maths performance and innovation at school and classroom level in 4th grade. The highest scoring education systems at 4th grade maths (Singapore, Korea, Hong Kong and Japan) were all above average in terms of innovation at 4th grade.

Figure 18.4 **Innovation in mathematics and 8th grade mathematics outcomes**



StatLink http://dx.doi.org/10.1787/888933086698

Figure 18.5 **Innovation at 8th grade and 8th grade mathematics outcomes**

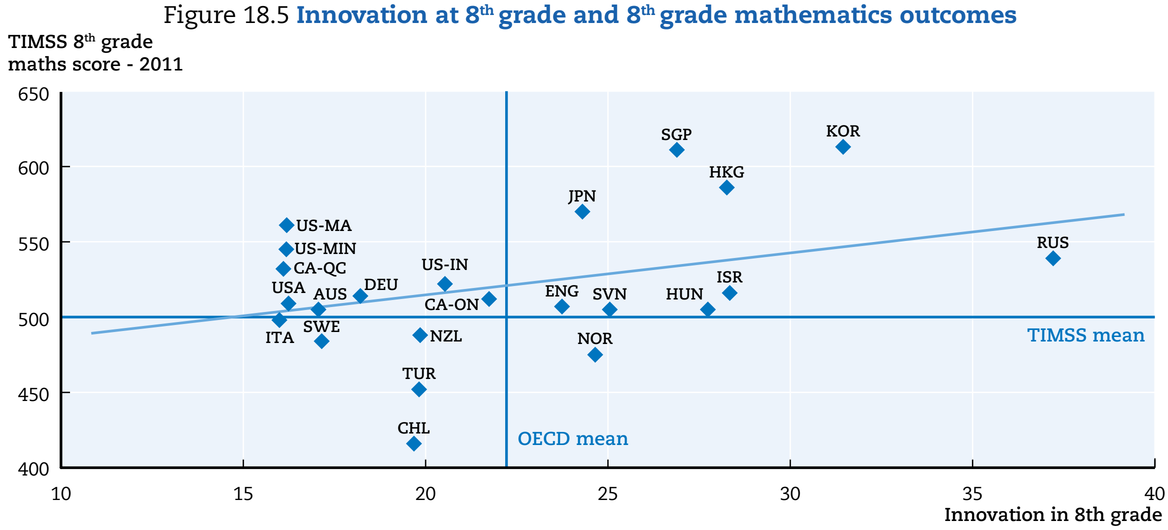


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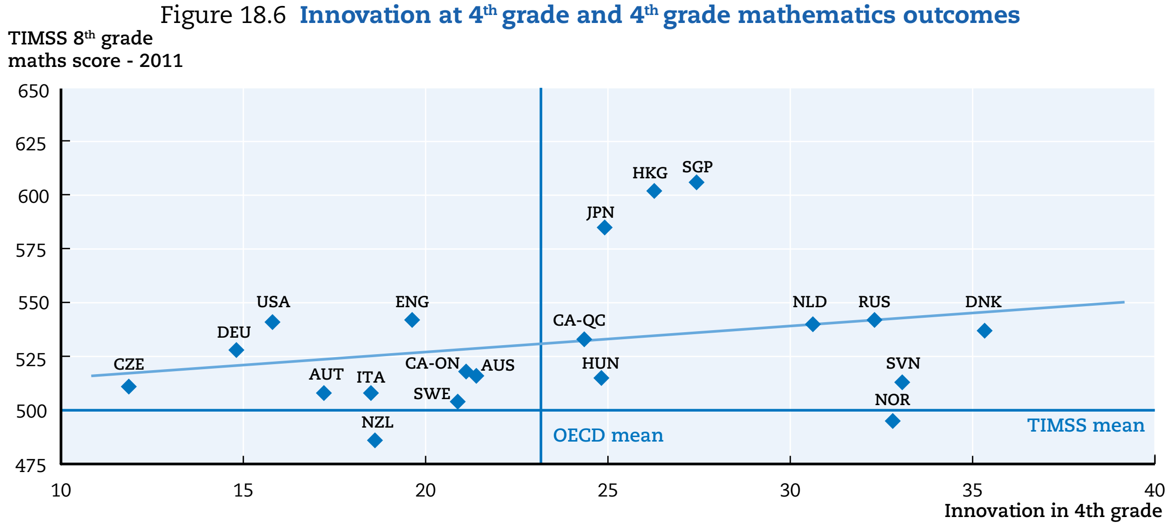
Figure 18.6 **Innovation at 4th grade and 4th grade mathematics outcomes**



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Innovation and TIMSS 8th grade mathematics trends

Trend data enable analysis of the association between innovation and improvement in performance over time. The following Figures indicate that there is a positive association between overall innovation and trends in 8th grade mathematics outcomes between 2003 and 2011 (Figure 18.7).

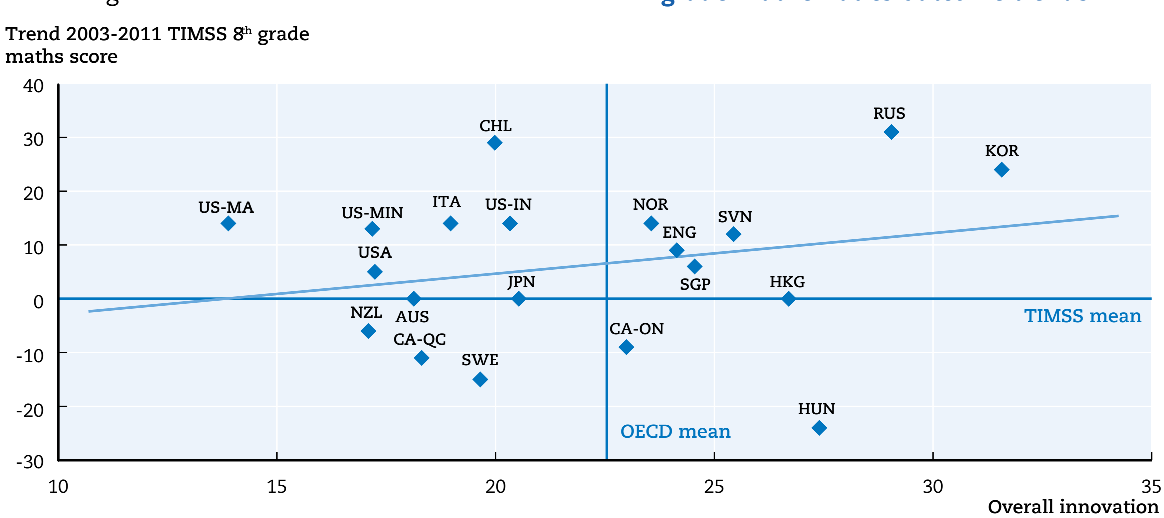
Some education systems, and particularly the Russian Federation and Korea, have exhibited large improvements in maths grades and correspondingly large amounts of change in school and classroom practices. However, positive change has also occurred without such high levels of innovation: Chile is an example of a country that has improved performance whilst levels of innovation remain below the OECD mean.

Two high performing education systems in terms of maths scores, Hungary and Hong Kong provide examples of education systems that have not experienced a positive trend in maths at 8th grade but have introduced many changes. This may indicate that the marginal return to innovation has been diminishing. Ontario is also characterised by above average levels of innovation and negative trends in maths performance.

There is no association between school level innovation and maths trends, with education systems scattered across the four quadrants (Figure 18.8). Of particular note is the right hand side of Figure 18.8, which shows that whilst several innovative systems (at the school level) have achieved positive change in their maths performance, slightly more have experienced negative trends. A more detailed analysis of these patterns would be necessary to comprehend the reasons but it may be that some school level changes are focused on improving test scores whilst others have other purposes.

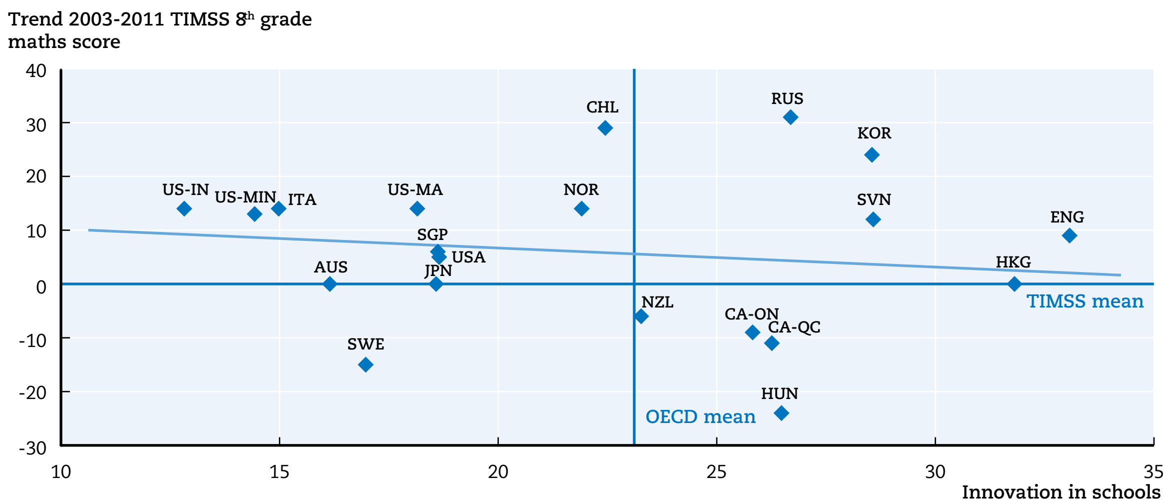
The analysis does suggest a positive association between changes in classroom practice and maths trends (Figure 18.9). However, this result appears to be driven by the significant improvements in the Russian Federation and Korea and their innovative attitude in classroom practices, while of the education systems analysed in this section most are at or below the OECD mean, making it difficult to draw.

Figure 18.7 **Overall education innovation and 8th grade mathematics outcome trends**



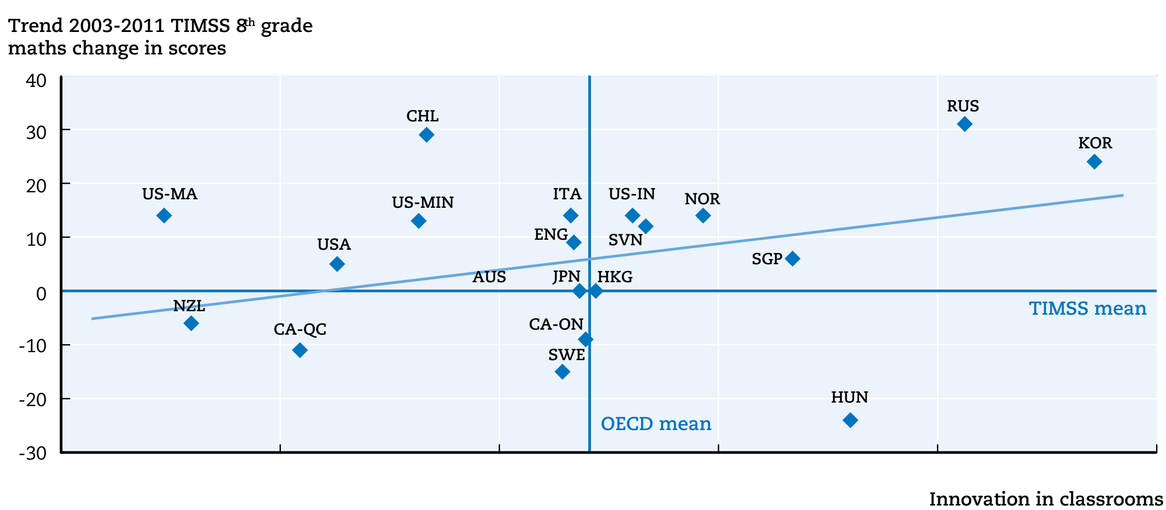
StatLink http://dx.doi.org/10.1787/888933086755

Figure 18.8 **School innovation and 8th grade mathematics outcome trends**



StatLink http://dx.doi.org/10.1787/888933086774

Figure 18.9 **Classroom innovation and 8th grade mathematics outcome trends**



StatLink http://dx.doi.org/10.1787/888933086793

Innovation and TIMSS 8th grade science trends

In contrast with the associations found between innovation and maths trends, a weak negative correlation is apparent between innovation and science trends (Figure 18.10).

Whilst there is no strong pattern, the association is driven in particular by Indonesia, Hong Kong and Hungary, as they have exhibited large decreases in science performance despite a large amount of change in school and classroom practices. This may indicate that the innovations were not relevant or appropriate for science performance. However, negative trends in science have also occurred without such high levels of innovation: Sweden and New Zealand are examples of countries where science performance decreased whilst levels of innovation remain below the OECD mean.

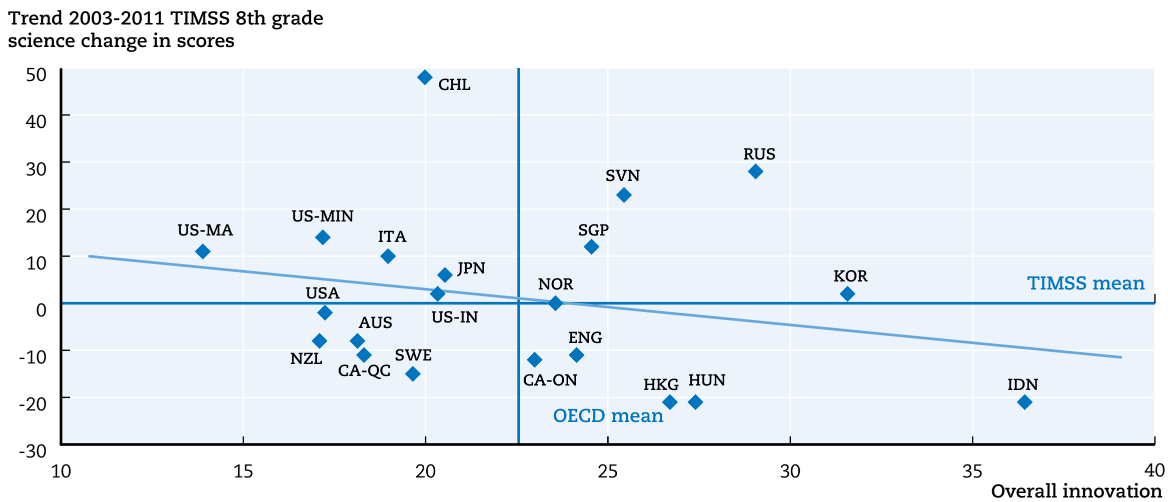
The Russian Federation and Slovenia provide examples of counties that have introduced many changes and experienced a positive trend in science at 8th grade. Singapore is also characterised by above average levels of innovation and positive trends in science performance.

Figure 18.11 shows a weak negative association between school level innovation and science trends. England and Hong Kong stands out as education systems with particularly high levels of change in school practices and substantial decrease in science performance, in contrast with the Russian Federation and Slovenia where science performance increased alongside innovation.

The analysis also finds a weak negative correlation between changes in classroom practice and science trends showing that more innovation at the school level is associated with a reduction in science performance over time (Figure 18.12). However, again this result appears to be influenced by the significant decrease in science performance in Indonesia combined with its particular innovative strength in classroom practices that alone drives the direction of the correlation. The other education systems analysed seems to scatter around the quadrants with many of them lying very close to the OECD average, making it difficult to establish a clear direction of the correlation between the two variables.

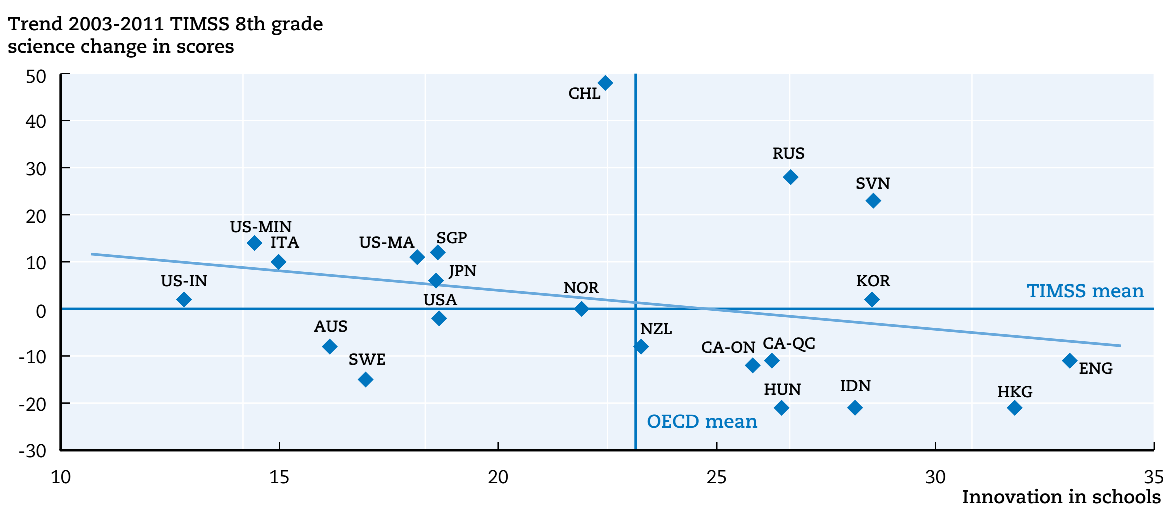
The difference in the associations between innovation and changes in maths and science scores could come from the fact that more innovation is required to improve some subjects than others, or that innovation is triggered by falling trends in some subjects. It could also be related to the extent to which change might be expected to improve performance; high performing education systems are unlikely to see very positive trends in grades over time as they are starting from near the top. Innovation may also be focused on aspects of education beyond subject level performance, such as equity or cost efficiency.

Figure 18.10 **Overall education innovation and 8th grade science outcome trends**



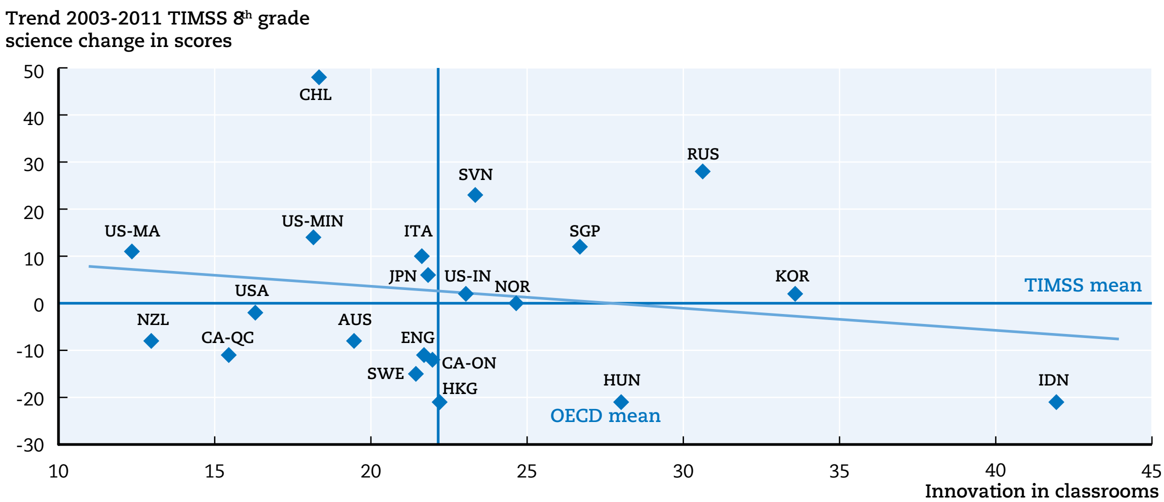
StatLink http://dx.doi.org/10.1787/888933086812

Figure 18.11 **School innovation and 8th grade science outcome trends**



StatLink http://dx.doi.org/10.1787/888933086831

Figure 18.12 **Classroom innovation and 8th grade science outcome trends**



StatLink http://dx.doi.org/10.1787/888933086850

Box 18.3. **Data source details for Figures 18.7 to 18.12**

TIMSS trend data for 8th grade maths is available for 20 of the 28 education systems for which we have innovation scores, excluding Austria, the Czech Republic, Denmark, Germany, Israel, Indonesia, the Netherlands, and Turkey. Trends are based on 8 education systems with a negative value indicating a reduction and 12 with a positive value indicating an increase in outcomes.

TIMSS trend data for 8th grade science is available for 21 of the 28 education systems for which we have innovation scores, excluding Austria, the Czech Republic, Denmark, Germany, Israel, the Netherlands, and Turkey. Trends are based on 11 education systems with a negative value indicating a reduction and 10 with a positive value indicating an increase in outcomes.

Composite innovation indices, equality and equity

One of the desirable outcomes of systemic change or innovation in education is an increase in equality. Educational equality can include equality in learning outcomes and learning opportunities.

The analysis in this section is based on PISA equality measures. Equality in learning outcomes has been measured by analysing the performance dispersion of students in reading, while the equity of learning opportunities can be measured by the percentage of students who come from a disadvantaged socio-economic background and perform much higher than would be predicted by their background, as discussed in OECD PISA 2009 Results: Overcoming Social Background- Volume II.

Innovation and equality in learning outcomes

The association between innovation and the dispersion in learning outcomes is analysed using the reading scores from PISA 2009 by measuring the distance between 10th and 90th percentile of the distribution of learning outcomes.

There is a positive association between innovation and equality in learning outcomes; education systems that have innovated the most are also the most equitable in terms of students' learning outcomes (Figure 18.13 to Figure 18.15). This is especially the case for Indonesia and Korea. Furthermore, very few education systems fall into the bottom right quadrant – in other words there are few systems that are innovative but not equal. However, it is important to note that equality in Chile and Turkey is slightly above countries such as Denmark, which have high innovation scores, and Israel has considerably lower reading equality than Hong Kong despite being well above the OECD mean in terms of overall innovation, indicating that there is some variability.

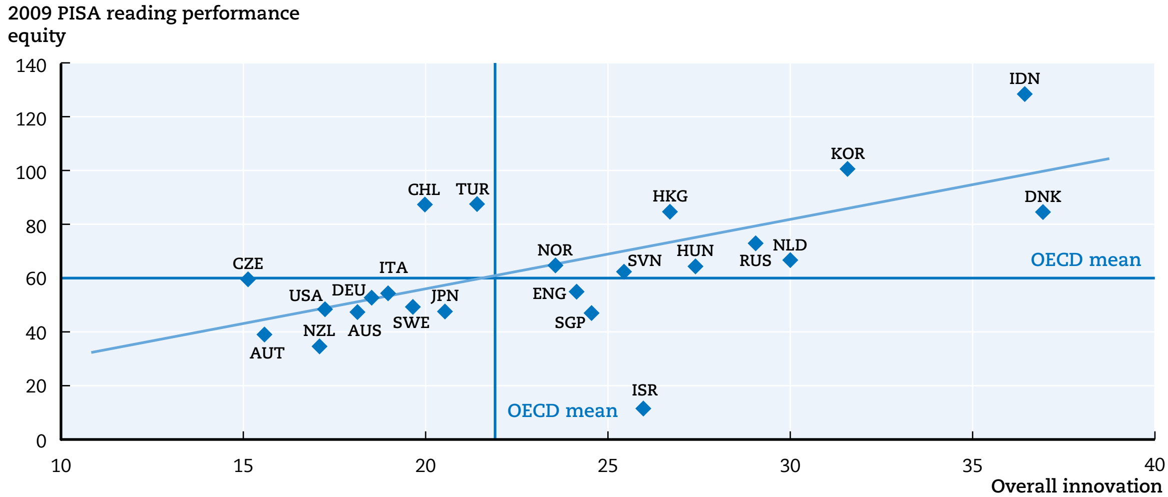
The general, positive pattern holds when looking at school or classroom level innovation separately. There are however some exceptions, with Turkey and Norway standing out as countries with high equality and low levels of innovation at the school level, and Chile standing out for its high levels of equality and low levels of innovation at classroom level. On the other hand, Israel and New Zealand have innovated at the school level and display low levels of equality, whilst Israel and Singapore exhibit low levels of equity alongside above average levels of innovation at the classroom level.

When the analysis is restricted to 8th grade innovation the positive association with equality still holds, although there is less correlation. Of particular note, many education systems are clustered in the bottom left hand quadrant of the Figure; these exhibit very similar levels of equality and innovation, with both being below average.

A possible explanation for the lower correlation between innovation at 8th grade rather than overall innovation centres on the fact that the equality measure focuses specifically on reading. It might be that reading performance is particularly influenced by changes in primary education than secondary, in which case innovation at the 8th grade is not fully capturing the potential relationship.

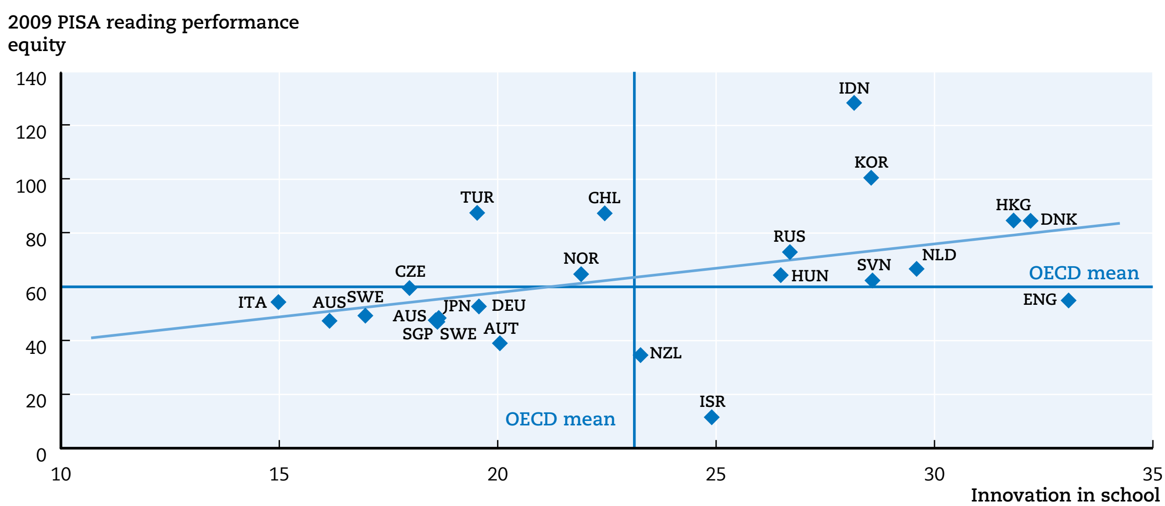
The general positive trend between innovation and equality of learning outcomes could result from a situation where education systems with higher level of equality in learning outcomes feel more secure and empowered to change their practices. In turn, it is possible that those with low equality prioritise some other educational objectives rather than innovating in order to promote equality. The assumption that more innovation could lead to higher levels of equality is plausible, though not proven: a high level of equality in learning outcomes may require responsiveness to students' needs, and therefore higher levels of change.

Figure 18.13 **Overall education innovation and students' performance variation in reading**



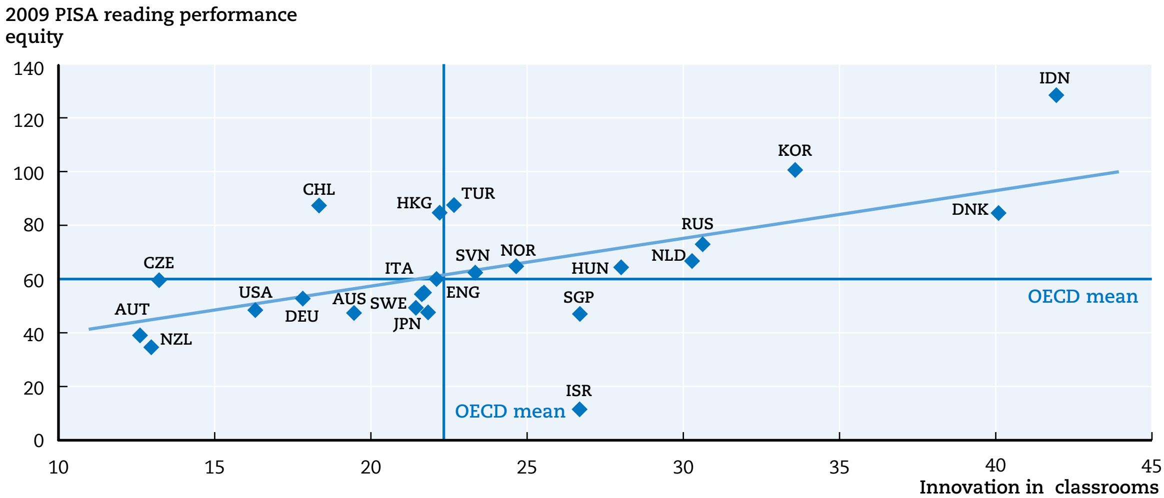
StatLink http://dx.doi.org/10.1787/888933086869

Figure 18.14 **Schools innovation and students' performance variation in reading**



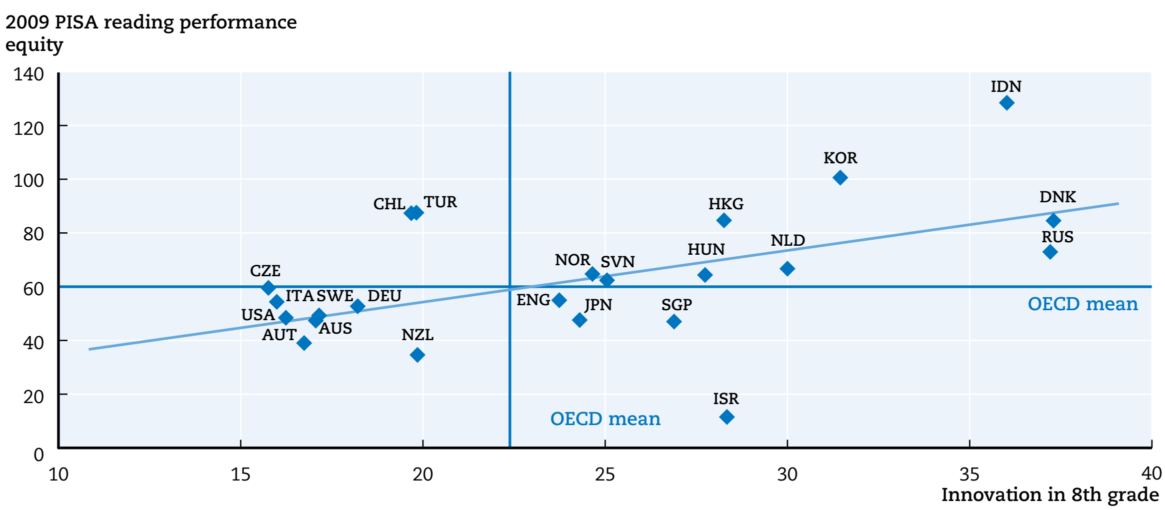
StatLink http://dx.doi.org/10.1787/888933086888

Figure 18.15 **Classroom innovation and students' performance variation in reading**



StatLink http://dx.doi.org/10.1787/888933086907

Figure 18.16 **Innovation at 8th grade and students' performance variation in reading**



StatLink http://dx.doi.org/10.1787/888933086926

* PISA reading performance variation is calculated across the whole United Kingdom.

Innovation and equity of learning opportunities

Equity of learning opportunities can be assessed through the proportion of disadvantaged students that show high levels of performance. The correlations between innovation and equity of learning opportunities are weak (Figure 18.17). In particular, across the whole distribution of innovation scores there are many education systems with poor equity in terms of learning opportunities. This is in noticeable contrast to the reading performance equality measure described above. However, the three most equitable education systems in this regard, Hong Kong, Korea and Singapore, are also above average in terms of overall innovation.

It may be that the societal factors that lead to underperformance amongst disadvantaged students in some education systems have a much greater impact than the changes observed in schools and classrooms.

The plots shown in Figure 18.18 indicate that the two most equitable education systems, Hong Kong and Korea are particularly innovative at the school level whilst the third, Singapore, is below the OECD mean in terms of school level innovation. At the classroom level, Korea and Singapore both have high levels of innovation and equity, whilst the most equitable education system, Hong Kong, sits on the OECD mean in terms of classroom innovation (Figure 18.19). This indicates that amongst these education systems changes at either the school or classroom level are associated with equity in opportunities.

Singapore, Japan and Turkey also stand out as being relatively equitable, with lower than average levels of innovation. Meanwhile, England and Denmark are noticeable in that they have below average levels of equity alongside high levels of innovation at the school level.

Denmark and Indonesia stand out for having below average levels of equity in learning opportunities and high levels of innovation at the classroom level. Given that Denmark is also innovative at the school level, it may be a country that is making efforts to improve equity by changing practices across the board.

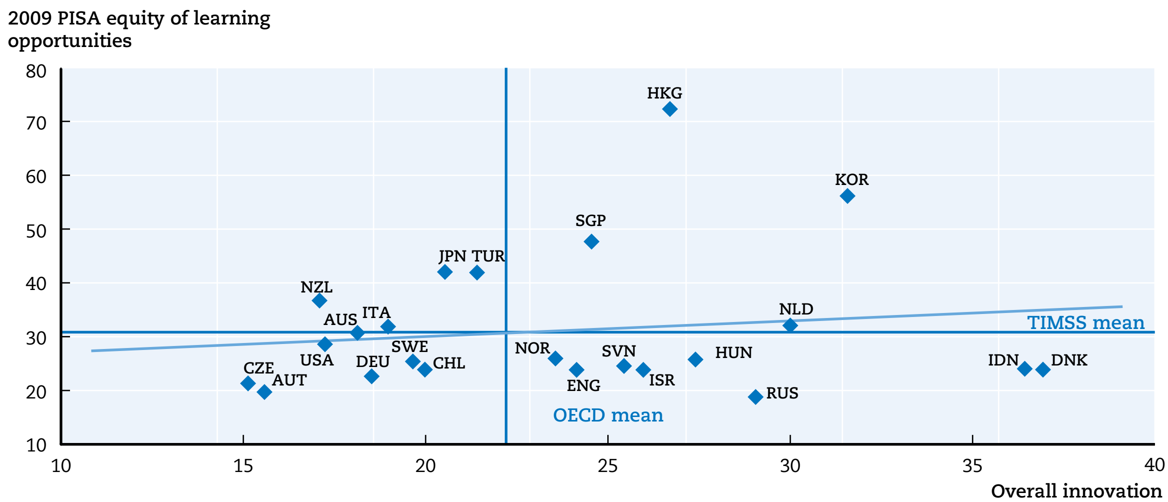
Box 18.4. **Data source details for Figures 18.13 to 18.21**

PISA data on equality in reading performance and on equity of learning opportunities are available for 23 of the 28 education systems for which we have innovation scores, excluding Indiana, Massachusetts, Minnesota, Ontario and Quebec.

The reported measure for equality in reading performance is based on the distance between the 10th and the 90th percentile for the PISA reading assessment in 2009 for each education system. Each equity measure is obtained by subtracting each inter-percentile distance from the maximum distance found in the sample. The reported measure for equity of learning opportunity corresponds to the percentage of students described as ‘resilient’ among disadvantaged students in “PISA 2009 Results: Overcoming Social Background, equity in learning opportunities and outcomes, volume II”.

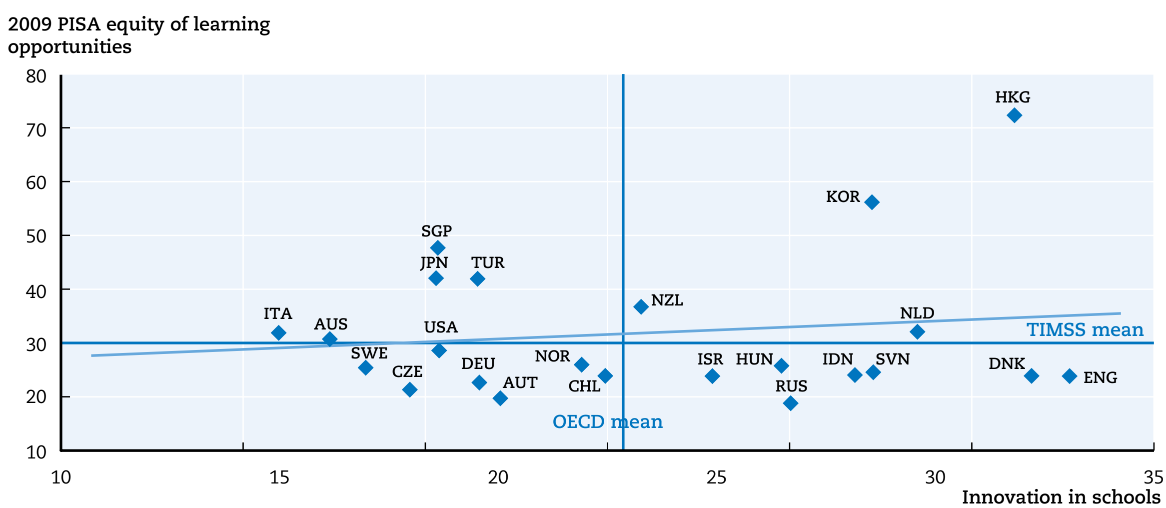
The reported analyses focus on the potential correlation between equality in reading performance and equity of learning opportunities across three innovation scores (overall, school and classroom).

Figure 18.17 **Overall education innovation and equity of learning opportunities**



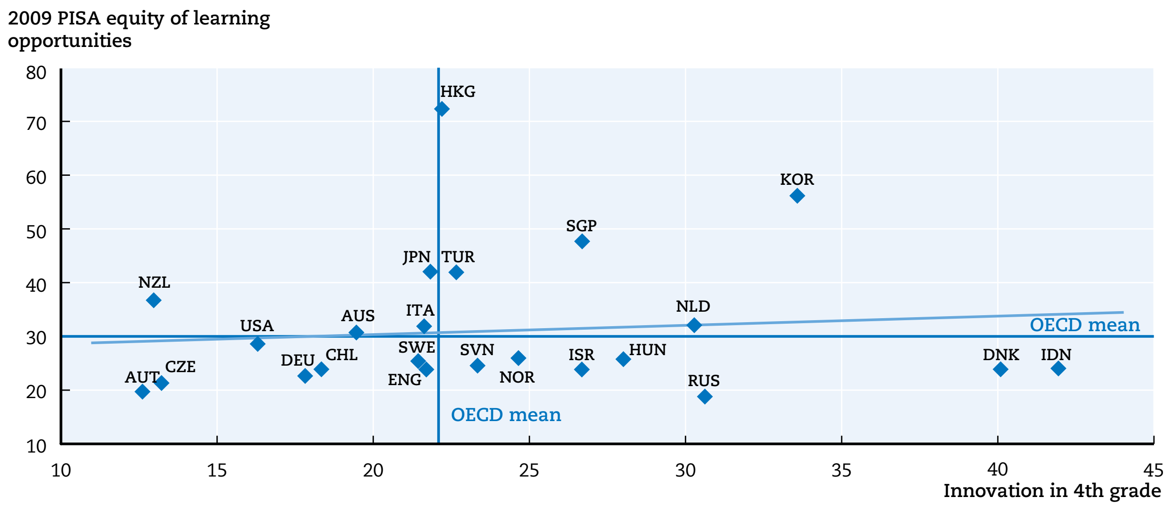
StatLink http://dx.doi.org/10.1787/888933086945

Figure 18.18 **School innovation and equity of learning opportunities**



StatLink http://dx.doi.org/10.1787/888933086964

Figure 18.19 **Classroom innovation and equity of learning opportunities**



StatLink http://dx.doi.org/10.1787/888933086983

Innovation and variation in outcomes within and across schools

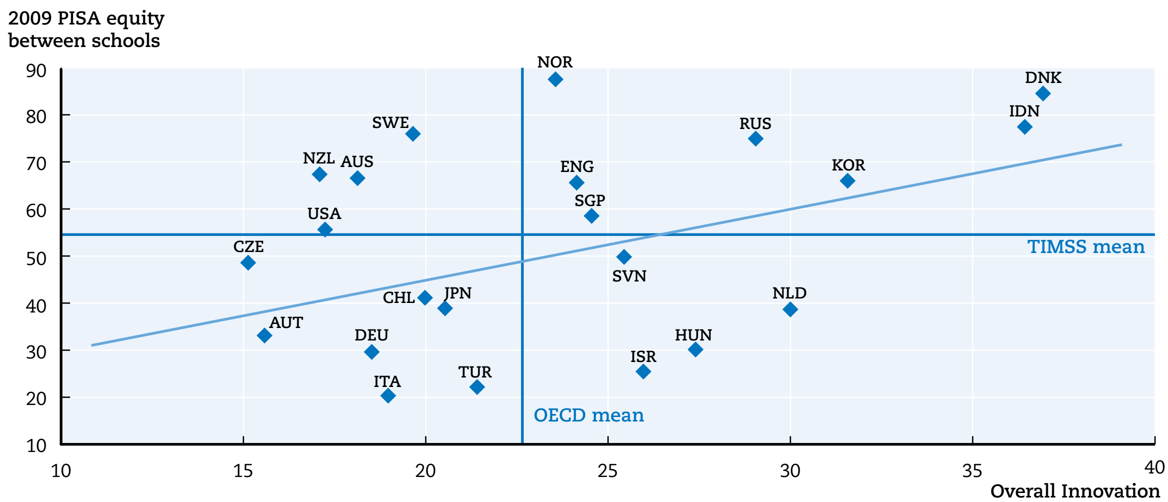
An education system may have more or less variation in outcomes within schools, depending on whether the school and education system works to improve the weakest students at the school or system level, and whether they segregate or stream students according to predicted ability. A low measure of variation across schools may indicate a more equitable system, whilst a low measure within schools may be more or less equitable depending on the approach used. There is some correlation between variation within and across schools and innovation, with more innovative education systems showing less variation (Figure 18.19 and Figure 18.20).

The three education systems with the lowest performance variation across schools, Norway, Denmark and Indonesia, also have above average levels of overall innovation. At the other end of the distribution, two countries with most variation across schools are not particularly innovative (Italy and Turkey). In contrast, Israel also has a large amount of variation in outcomes across schools, and is above the OECD average for overall innovation.

Education systems in the top right quadrant of Figure 18.20 are characterised by similar performance levels within schools and high levels of innovation. In particular, Indonesia, the Netherlands, Hungary and Sweden stand out for having relatively little performance variation at the school level, and overall innovation above the OECD mean. At the other extreme, Sweden, New Zealand, Austria and the US have rather high levels of within school variation, and lower levels of innovation.

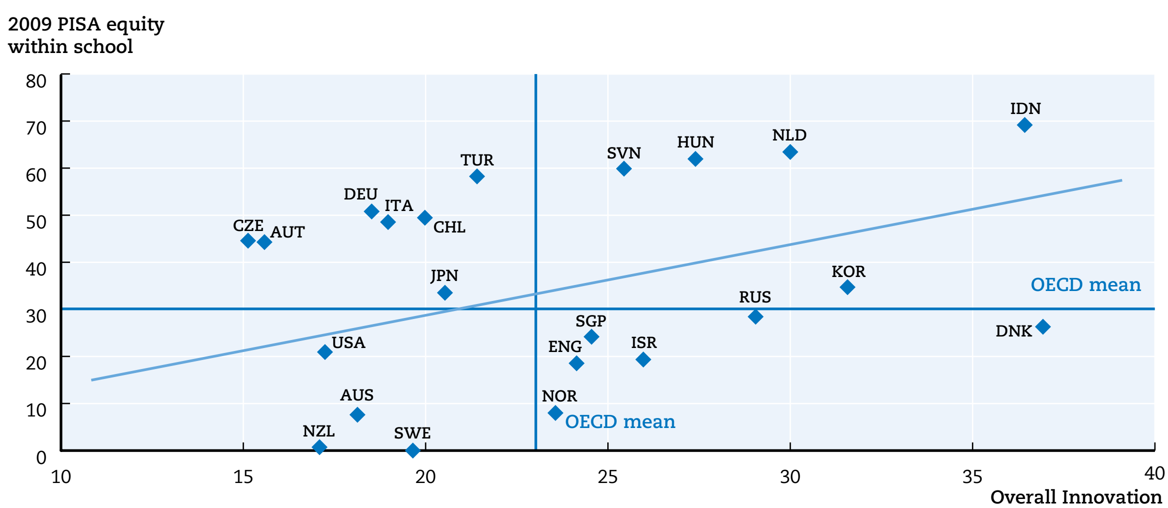
Denmark and Indonesia are noteworthy because they are both innovative but whilst Denmark has a small difference in outcomes across schools, it has a larger than average difference within schools. In contrast, Indonesia has very little variation either in or between schools, possibly reflecting lower outcomes overall.

Figure 18.20 **Overall education innovation and variation in equity between schools**



StatLink http://dx.doi.org/10.1787/888933087002

Figure 18.21 **Overall education innovation and variation in equity within schools**



StatLink http://dx.doi.org/10.1787/888933087021

Composite innovation indices and changes in education expenditure

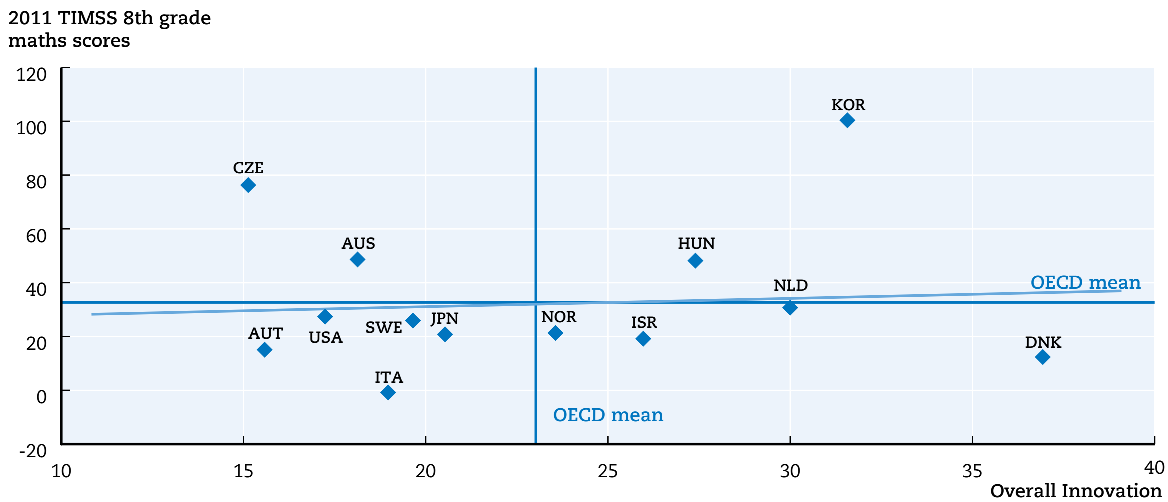
It might be possible to observe an association between overall innovation and change in expenditure per student as a result of a number of factors, some of them opposing. If innovation occurs in order to reduce expenditure or to overcome budget cuts one might expect to see a negative correlation between innovation and change in expenditure. Equally, if education systems with very low and falling expenditure per student feel obliged to take the chance on high risk innovations, there might be a negative correlation. Conversely, a positive correlation between change in expenditure and innovation might be interpreted as an investment in innovation or an indicator that schools have the freedom of a more generous budget to spend on innovation.

Most of the education systems included in the analysis of innovation and expenditure have increased their level of educational expenditure per student between 2000 and 2010 by similar amounts, regardless of their level of overall innovation (Figure 18.22). A positive but weak correlation between innovation and change in expenditure is found. This may suggest that on average for the education systems covered, innovation requires resources for its implementation. However, the hypothesis that innovation actually leads to a decrease in expenditure and therefore to more efficiency in the system cannot be supported as no country, except for Italy, has seen its educational expenditure per student decrease in the analysed period despite the global financial crisis.

Among the education systems registering the largest increases in educational expenditure per student, Korea and the Czech Republic exhibit two opposite behaviours regarding educational innovation, where Korea is above average in terms of innovation the Czech Republic is near the bottom of the innovation index. Korea's data may suggest that the educational innovation is costly, although this hypothesis should be verified against the actual percentages of educational expenditures dedicated to innovation. However, there is also evidence that some forms of innovation can cost little or nothing: Denmark, for example has increased expenditure by less than average whilst still exhibiting above average levels of change across the education system, suggesting that those innovations may not have been as resource consuming.

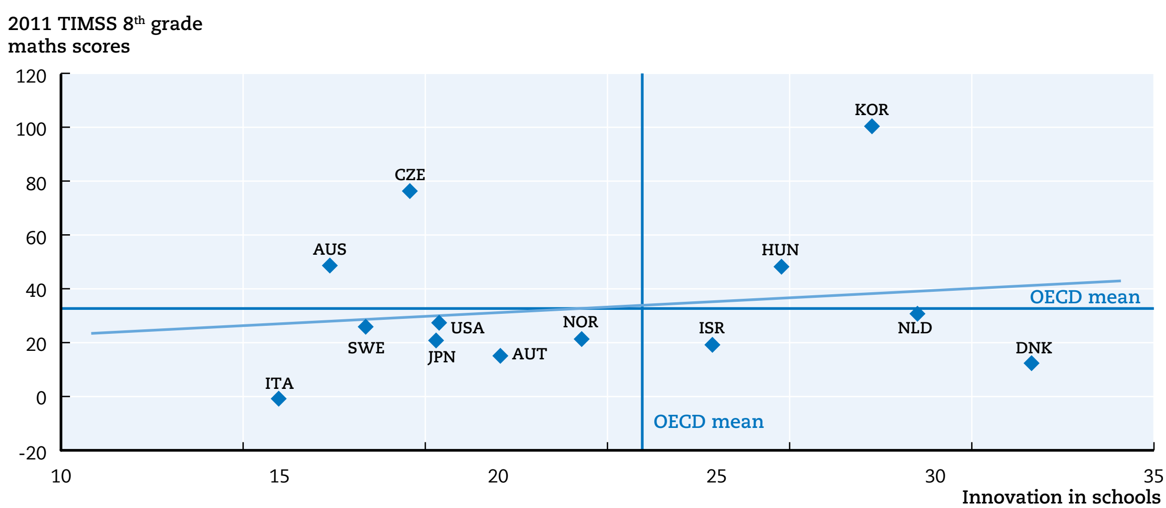
The general positive pattern seems to hold when looking at school innovation (Figure 18.23), while the relationship between expenditure trends and classroom innovation shows no association (Figure 18.24). These patterns are consistent with the potential scale of the different changes, with school change likely requiring more resources than classroom level changes.

Figure 18.22 **Overall education innovation and trend in expenditure per student**



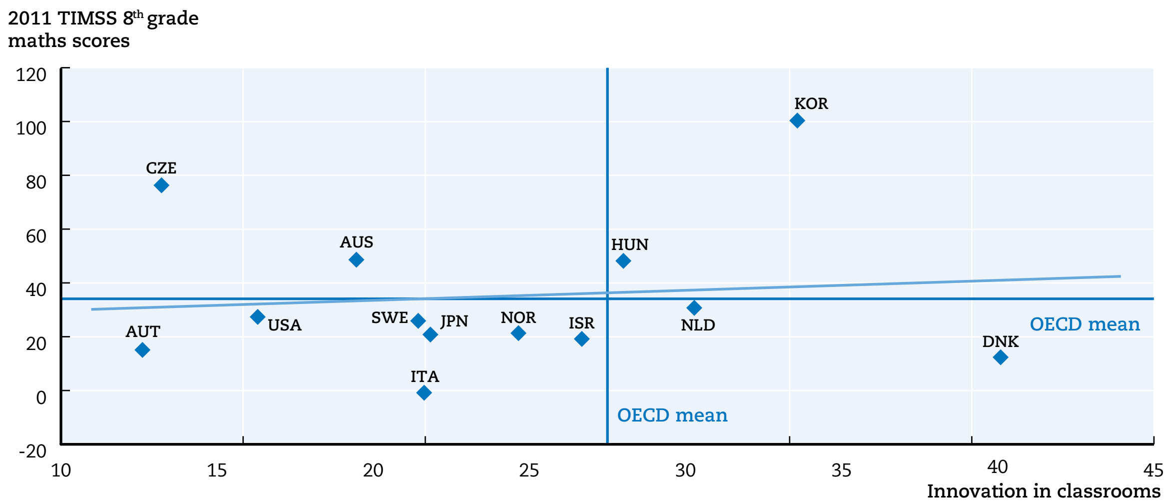
StatLink http://dx.doi.org/10.1787/888933087040

Figure 18.23 **School innovation and trend in expenditure per student**



StatLink http://dx.doi.org/10.1787/888933087059

Figure 18.24 **Classroom Innovation and trend in expenditure per student**



StatLink http://dx.doi.org/10.1787/888933087078

Box 18.5. **Data source details for Figures 18.22 to 18.24**

The reported analyses focus on the potential correlation between the change in expenditure per student, and various composite innovation indices. The OECD data on expenditure trends is an index of change in expenditure per student for all services at the primary, secondary and post-secondary non-tertiary levels of education between 2000 and 2010 using data from Education at a Glance 2013. This index takes 2005 as the baseline, and the change in expenditure is calculated as a percentage of this value.

Composite innovation indices and satisfaction

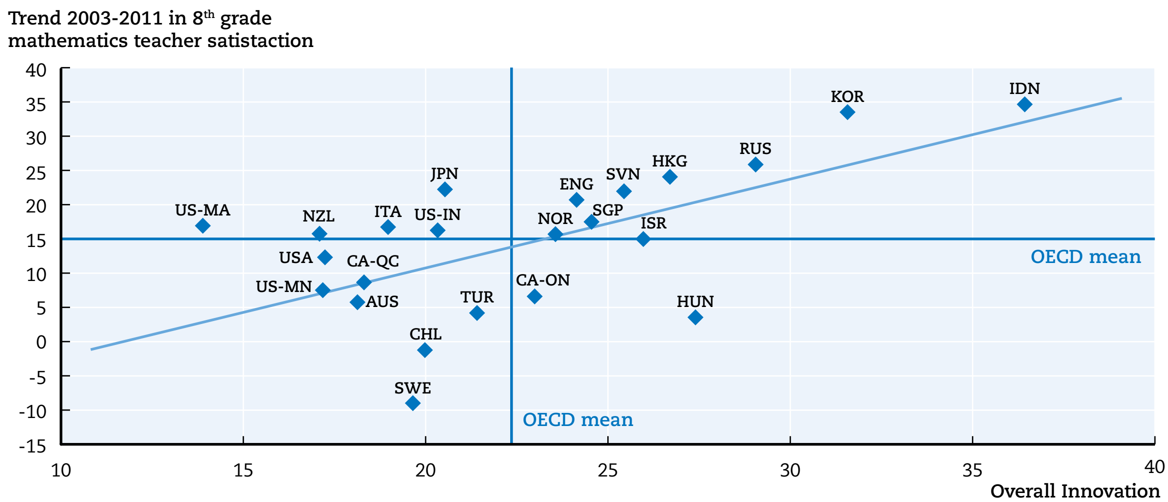
Innovation in schools and classroom may lead to greater satisfaction for teachers by increasing autonomy or the possibility to be adaptive or creative within the school setting. Students may also become more satisfied if changes are designed to better meet their needs or to improve the dynamic nature of their education. Alternatively change may be unsettling, leading to greater dissatisfaction amongst teachers and students, particularly if they feel that the innovations are not in their control or are detrimental to their work or studies.

Innovation and teacher satisfaction

Analysis of the relationship between overall innovation and changes in 8th grade maths teacher satisfaction shows a strong positive correlation, indicating that teachers in more innovative education systems have become more satisfied over time whilst satisfaction has fallen in less innovative places (Figure 18.25). Indonesia, Korea and the Russian Federation in particular have high levels of change in education practices alongside high levels of improvement in teach satisfaction over time.

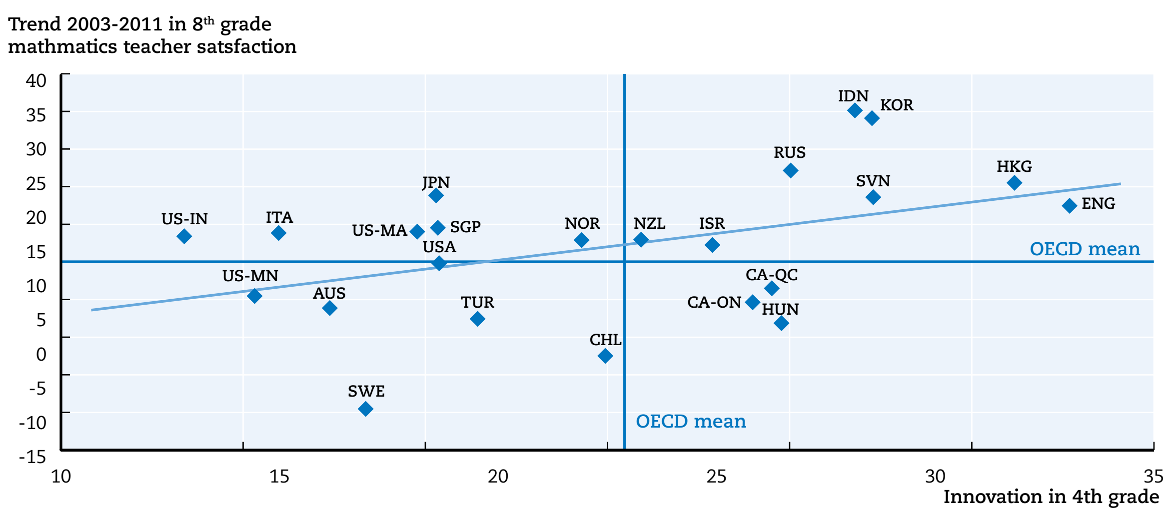
Separate analyses of the correlation between teacher satisfaction and innovation at school and classroom level indicate a particularly strong association between the improvement in maths teacher satisfaction over time and the amount of innovation in the classroom (Figure 18.26 and Figure 18.27). This is consistent with the argument that the teachers have a sense of autonomy in the classroom and have made changes according to their needs and preferences. However, in education systems such as Hong Kong and England where innovation is relatively high at the school level but not at the classroom level, teacher satisfaction has also improved. This may indicate that certain school level changes have a positive impact on the teachers in these systems.

Figure 18.25 **Overall education innovation and change in 8th grade maths teacher satisfaction**



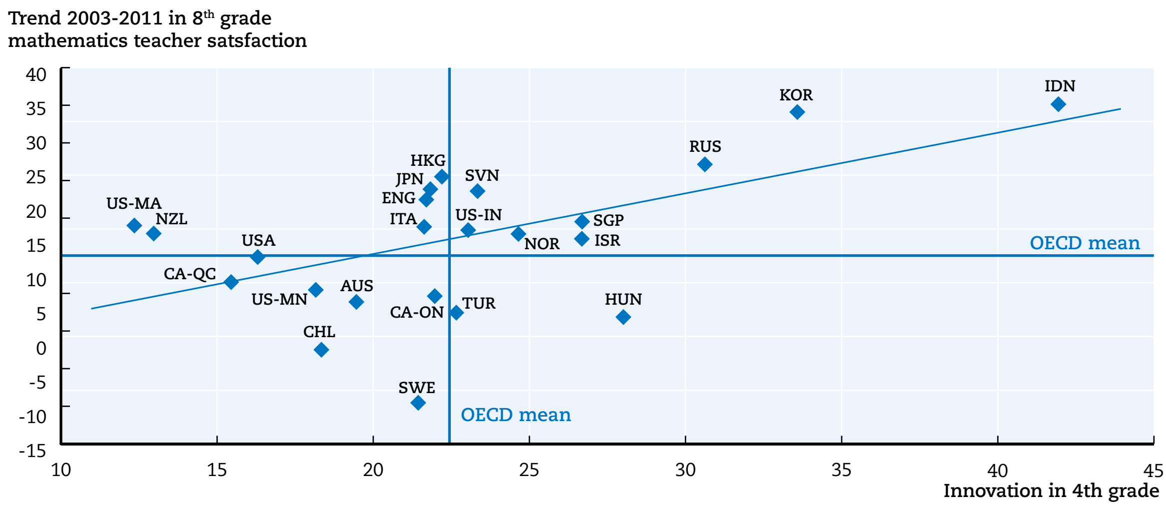
StatLink http://dx.doi.org/10.1787/888933087097

Figure 18.26 **School innovation and change in 8th grade maths teacher satisfaction**



StatLink http://dx.doi.org/10.1787/888933087116

Figure 18.27 **Classroom innovation and change in 8th grade maths teacher satisfaction**



StatLink http://dx.doi.org/10.1787/888933087135

Innovation and student satisfaction

There is no correlation between overall innovation and the change in 8th grade student satisfaction. Education systems are spread across high and low levels of innovation, and both increases and decreases in student satisfaction.

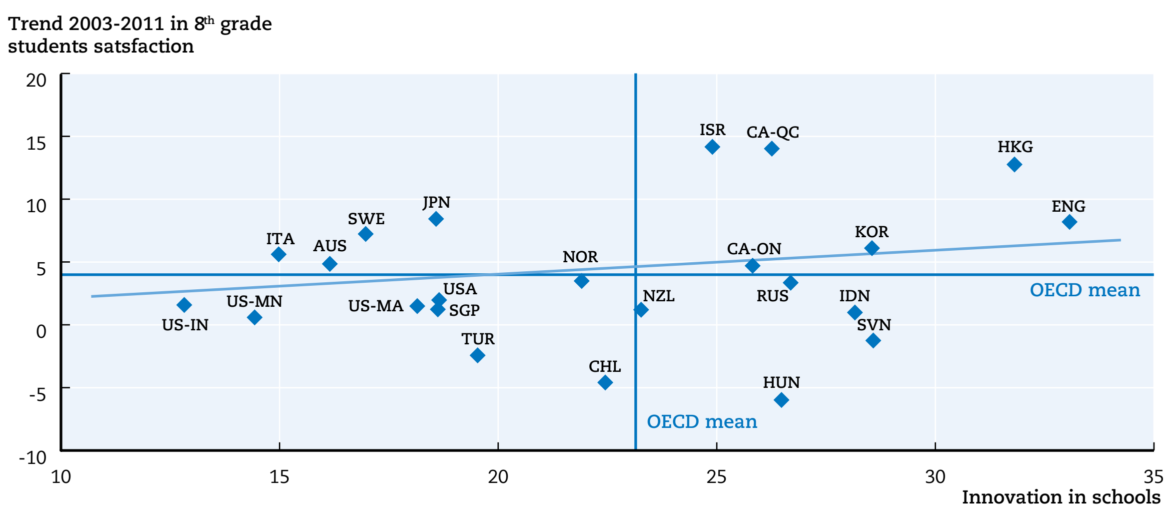
There is, however, a positive correlation with student satisfaction when focusing specifically on school level innovation. This may indicate that student satisfaction increases when schools innovate, or possibly that schools have been innovating in order to raise student satisfaction. Indeed those systems with the highest values on the school level innovation index also exhibit the largest improvement in student satisfaction. Nevertheless, the relationship is not particularly strong, and there are education systems in all four quadrants, indicating that some education systems are innovating at the school level but satisfaction is falling (such as Hungary and Slovenia), and others such as Japan have increased satisfaction without innovating at the school level.

In contrast with the findings for school level innovation, classroom level innovation appears to have no association with student satisfaction, although this is in part driven by the slight reduction in satisfaction amongst students in Indonesia. Israel and Korea stand out as countries that have innovated at the classroom level and seen an improvement in student satisfaction, but other education systems that have innovated in the classroom, such as Hungary and Turkey have not been so successful at improving satisfaction amongst their students. As with other such patterns observed, it may be that these systems are not seeking to improve this measure, either because it is already sufficiently high, or because other goals take priority.

Figure 18.28 **Overall education innovation and change in 8th grade student satisfaction**

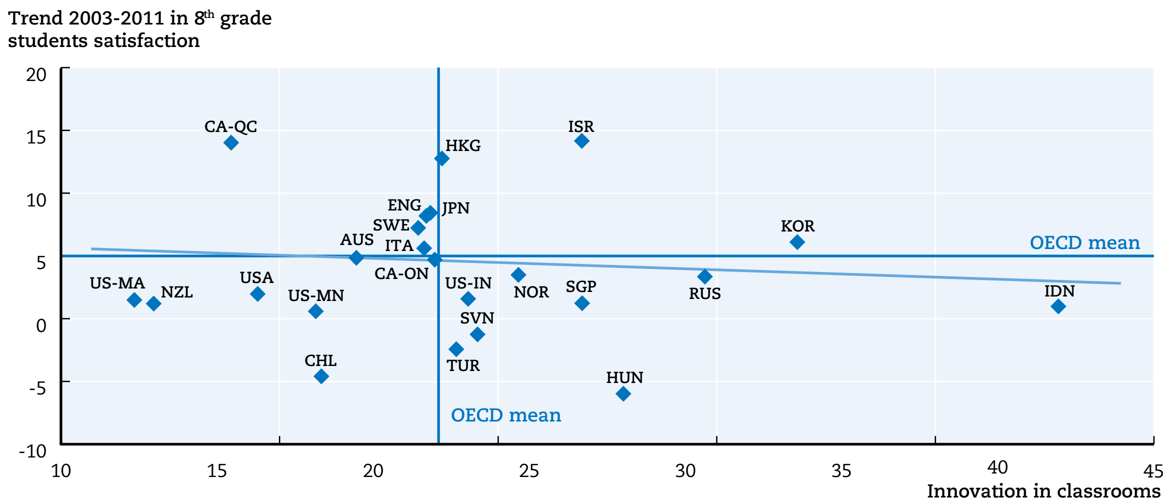
StatLink http://dx.doi.org/10.1787/888933087154

Figure 18.29 **School innovation and change in 8th grade student satisfaction**



StatLink http://dx.doi.org/10.1787/888933087173

Figure 18.30 **Classroom innovation and change in 8th grade student satisfaction**



StatLink http://dx.doi.org/10.1787/888933087192

Box 18.6. **Data source details for Figures 18.25 to 18.30**

TIMSS (2003, 2007 and 2011) surveys asked 8th grade teachers "How much do you agree with the following statements[...] b) I am satisfied with being a teacher at this school" with answer options "Agree a lot; Agree a little; Disagree a little; Disagree a lot". Students were asked "What do you think about your school? Tell how much you agree with these statements[...] a) I like being in school" with answer options "Agree a lot; Agree a little; Disagree a little; Disagree a lot". The same data restrictions as in International TIMSS and PIRLS Reports by the International Association for the Evaluation of Educational Achievement (IEA) apply to these data. Change in satisfaction is the percentage point difference between 2003 and 2011.

Note on Israel

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.

Table 18.1 **Correlations between innovation indices in education and educational outcomes**

Correlation coefficients	Overall index	School index	Classroom index	8th grade index	4th grade index	Mathematics index
TIMSS 8th grade maths score	0,3128	0,1309	0,3056	0,3903		0,2048
TIMSS 4th grade maths score					0,2430	
TIMSS 8th grade maths changes in score	0,1646	0,0255	0,2305			
TIMSS 8th grade science changes in score	-0,1938	-0,2454	-0,1494			
PISA reading performance equality	0,6143	0,4276	0,6078	0,4985		
PISA equity of learning opportunities	0,1284	0,1384	0,0594			
PISA performance variation between schools	0,3791					
PISA performance variation within school	0,2699					
Change in expenditure per student 00-10	0,1011	0,1821	0,0574			
Trends in teacher satisfaction 8th grade maths	0,5914	0,4380	0,5306			
Trends in student satisfaction 8th grade	0,0191	0,2311	-0,0559			

StatLink http://dx.doi.org/10.1787/888933087211

Annex A

Data sources and methods

Annex A presents the different data sources, the coverage of the statistics (target, countries, years), as well as sample sizes for the different data.

Data sources: overview

This publication reports the results of secondary analysis of data from several sources.

The first chapter uses REFLEX (Research into Employment and professional Flexibility) and HEGESCO (Higher Education as a Generator of Strategic Competences) data. REFLEX surveys higher education graduates five years after their graduation and asks a range of questions about their workplace. HEGESCO uses the same method and questionnaire, but applied to other European countries.

The remaining chapters report the analysis of data collected in surveys of students, teachers and principals collected to inform assessments of student outcomes. 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 has been used to identify the extent to which they have changed over time. All these surveys are cross-sectional.

Coverage of the statistics

REFLEX data cover recent higher education graduates working as highly skilled professionals. The target population is graduates from ISCED 5A (2004 definition) who got their degree in the academic year 1999/2000 (including foreign students, distance learners and those who subsequently moved abroad, but excluding graduates from ISCED 6) and were surveyed in 2005. HEGESCO carried out the survey in 2008. Percentages should be read as "the percentage of recent higher education graduates who report….".

PISA is designed to assess learning outcomes of 15-year-old students and make comparisons over time. The PISA assessment focuses on the extent to which students can apply the knowledge and skills they have learned 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 education 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 respsectively, 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.

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 38 education systems or countries within the OECD, and 5 partner countries.

- 19 education systems participated in REFLEX-HEGESCO in 2005 or 2008 [note Portugal is not included in graphs by sector and Spain is not included in graphs by education level];
- 34 education systems within the OECD participated in PISA in 2009, 32 participated in 2006, and 30 education systems participated in 2000 and 2003.
- 38 education systems within the OECD participated in TIMSS in 2011, 27 education systems in 2007 and 23 in 2003.
- 29 education systems within the OECD participated in PIRLS in 2011, 27 in 2006 and 23 in 2001
- 23 education systems are included in the composite innovation indices.

Sample sizes

Table A.1. REFLEX-HEGESCO sample sizes

Smallest sample sizes for REFLEX-HEGESCO 2005 or 2008 (based on analysis in Chapter 4)

	At least one type of innovation		Three types of innovation	
	All sectors	Education sector	All sectors	Education sector
Italy	2,595	264	2,335	225
Spain	3,169	576	2,871	497
France	1,312	275	1,260	256
Austria	1,437	233	1,368	215
Germany	1,451	290	1,373	260
Netherlands	2,954	418	2,884	404
United kingdom	1,275	223	1,224	215
Finland	2,165	435	2,108	415
Norway	1,873	308	1,807	291
Czech republic	5,878	878	5,679	814
Switzerland	4,262	187	4,117	179
Portugal	577	122	557	117
Belgium	1,213	187	1,182	182
Estonia	840	147	783	132
Slovenia	2,578	409	2,461	373
Turkey	1,995	248	1,879	235
Lithuania	783	103	747	96
Poland	1,112	222	1,100	219
Hungary	1,058	139	1,020	138
Total	38,527	5,664	36,755	5,263

Note that education sector sample size includes graduates working in primary, secondary and higher education, with the exception of Spain, where all education professionals are counted, including those in 'other' kinds of education.

Table A.2. **TIMSS sample sizes: Principals**

OECD countries	4th grade			8th grade			
	2003	2007	2011	1999	2003	2007	2011
Australia	204	229	280	201	207	228	277
Austria		196	158				
Belgium Flemish	149		142	165	144		
Canada				408			
Ontario	189	188	146		186	176	143
Quebec	193	186	190		175	170	189
Alberta		146	143				145
British Columbia		150				150	
Chile			200	189	195		193
Czech Republic		144	177	162		147	
Denmark		137	216				
Estonia					151		
Finland			145	175			145
Germany		246	197				
Hungary	157	144	149	147	155	144	146
Ireland			150				
Israel				139	146	146	151
Italy	171	170	202	191	171	170	197
Japan	150	148	149	140	146	146	138
Korea			150	150	149	150	150
Netherlands	130	141	128	182	130		
New Zealand	220	220	180	160	169		158
Norway	139	145	119		138	139	134
Poland			150				
Portugal			147				
Slovak Republic		184	197	145	179		
Slovenia	174	148	195	153	174	148	186
Spain			151				
Basque country					115	112	
Sweden		155	152		159	159	153
Turkey			257	206		146	239
England	123	143	125	206	87	137	118
Scotland	125	139			128	129	
United States	248	257	369	240	232	239	501
Alabama							55
California							82
Colorado							53
Connecticut							62
Florida			77				60
Indiana	56				54		56
Massachusetts		47				48	56
Minnesota		50				49	55
North Carolina			46				59
Non OECD countries							
Hong Kong	132	126	136	183	125	120	117
Indonesia				168	150	149	153
Russian Federation	205	206	202	194	214	210	210
Singapore	182	177	176	145	164	164	165
South Africa				233	255		285

Table A.3. **TIMSS sample sizes: Teachers**

OECD countries	4th grade			8th grade maths			8th grade science		
	2003	2007	2011	2003	2007	2011	2003	2007	2011
Australia	300	360	594	246	251	802	520	496	1049
Austria		356	296						
Belgium Flemish	547		268	272			641		
Canada									
Ontario	255	279	362	203	214	244	206	219	245
Quebec	269	308	300	181	226	265	442	192	323
Alberta		252	235			222			234
British Columbia		313			187			464	
Chile			200	215		194	214		194
Czech Republic		253	291		212			845	
Denmark		246	341						
Estonia				168			521		
Finland			310			264			827
Germany		373	312						
Hungary	158	255	324	198	289	280	627	987	1005
Ireland			220						
Israel				353	394	514	308	270	282
Italy	243	323	314	217	287	205	217	287	205
Japan	178	250	265	146	216	181	146	178	151
Korea			168	365	243	376	357	181	202
Netherlands	141	218	210	130			377		
New Zealand	722	609	494	261		354	176		265
Norway	228	310	280	179	270	175	179	264	171
Poland			257						
Portugal			240						
Slovak Republic		343	422	179			599		
Slovenia	180	340	245	238	503	523	528	779	901
Spain			200						
Basque country				123	164		124	155	
Sweden		396	369	300	491	405	647	680	540
Turkey			263		146	240		146	240
England	165	250	261	139	235	212	503	615	751
Scotland	199	291		172	330		677	859	
United States	921	904	767	456	532	559	1090	687	931
Alabama						107			130
California						111			210
Colorado						105			151
Connecticut						120			148
Florida			191			113			212
Indiana	138			128		113	285		146
Massachusetts		156			103	105		114	107
Minnesota		168			104	110		116	147
North Carolina			120			105			114
Non OECD countries									
Hong Kong	297	282	267	147	145	148	131	123	124
Indonesia				155	149	170	278	276	259
Russian Federation	206	268	218	215	273	239	855	1083	916
Singapore	246	508	515	332	357	330	336	429	330
South Africa				256		327	255		316

Table A.4. **TIMSS sample sizes: Students**

OECD countries	4th grade			8th grade		
	2003	2007	2011	2003	2007	2011
Australia	4321	4108	6146	4791	4069	7556
Austria		4859	4668			
Belgium Flemish	4712		4849	4970		
Canada						
Ontario	4362	3496	4570	4217	3448	4756
Quebec	4350	3885	4235	4411	3956	6149
Alberta		4037	3645			4799
British Columbia		4153			4256	
Chile			5585	6377		5835
Czech Republic		4235	4578		4845	
Denmark		3519	3987			
Estonia				4040		
Finland			4638			4266
Germany		5200	3995			
Hungary	3319	4048	5204	3302	4111	5178
Ireland			4560			
Israel				4318	3294	4699
Italy	4282	4470	4200	4278	4408	3979
Japan	4535	4487	4411	4856	4312	4414
Korea			4334	5309	4240	5166
Netherlands	2937	3349	3229	3065		
New Zealand	4308	4940	5572	3801		5336
Norway	4342	4108	3121	4133	4627	3862
Poland			5027			
Portugal			4042			
Slovak Republic		4963	5616	4215		
Slovenia	3126	4351	4492	3578	4043	4415
Spain			4183			
Basque country				2514	2296	
Sweden		4676	4663	4256	5215	5573
Turkey			7479		4498	6928
England	3585	4316	3397	2830	4025	3842
Scotland	3936	3929		3516	4070	
United States	9829	7896	12569	8912	7377	10477
Alabama						2113
California						2614
Colorado						2167
Connecticut						2099
Florida			2661			1712
Indiana	2233			2188		2260
Massachusetts		1747			1897	2075
Minnesota		1846			1777	2500
North Carolina			1792			2103
Non OECD countries						
Hong Kong	4608	3791	3957	4972	3470	4015
Indonesia				5762	4203	5795
Russian Federation	3963	4464	4467	4667	4472	4893
Singapore	6668	5041	6368	6018	4599	5927
South Africa				8952		11969

Table A.5. **PIRLS sample sizes: Principals, teachers and students**

	Principals		Teachers			Students		
OECD countries	2001	2006	2001	2006	2011	2001	2006	2011
Australia					519			6126
Austria		158		263	284		5067	4670
Belgium Flemish		137		237			4479	
Belgium French		150		278	218		4552	3727
Canada			409		1405			23206
Ontario	190	180	222	200	282	4295	3988	4561
Quebec	182	185	187	210	220	3958	3748	4244
Alberta		150		233	219		4243	3789
British Columbia		148		273			4150	
Nova Scotia		201		258			4436	
Czech Republic	141		141		235	3022		4556
Denmark		145		216	237		4001	4594
Finland					291			4640
France	145	169	228	261	276	3538	4404	4438
Germany	211	405	393	418	222	7633	7899	4000
Greece	145		145			2494		
Hungary	216	149	220	196	252	4666	4068	5204
Iceland	133	128	242	239		3676	3673	
Ireland					221			4524
Israel	147	149	147	149	166	3973	3908	4186
Italy	184	150	184	198	239	3502	3581	4189
Luxembourg		178		363			5101	
Netherlands	135	139	195	207	207	4112	4156	3995
New Zealand	156	243	175	514	434	2488	6256	5644
Norway	136	135	199	228	200	3459	3837	3190
Poland		148		250	257		4854	5005
Portugal					242			4085
Slovak Republic	150	167	176	263	316	3807	5380	5630
Slovenia	148	145	155	315	243	2952	5337	4512
Spain		152		193	403		4094	8580
Andalusia					198			4333
Sweden	146	147	398	258	271	6044	4394	4622
Turkey	154		154			5125		
United Kingdom			268					
England	131	148	132	186	182	3156	4036	3927
Scotland	118	130	136	202		2717	3775	
United States	174	183	176	253	618	3763	5190	12726
Florida					150			2598
Non OECD countries								
Hong Kong	147	144	147	144	138	5050	4712	3875
Indonesia		168		168	163		4774	4791
Russian Federation	206	232	206	232	209	4093	4720	4461
Singapore	196	178	196	357	356	7002	6390	6367
South Africa		397		403	111		14657	3515

Table A.6. **PISA sample sizes: Principals**

OECD countries	2000	2003	2006	2009
Australia	228	314	350	345
Austria	213	192	197	280
Belgium	214	282	269	275
Belgium Flemish	119		162	156
Canada	1098	1066	861	908
Chile			173	199
Czech Republic	227	259	244	260
Denmark	223	205	209	285
Estonia			169	175
Finland	155	197	155	203
France	174	163	179	166
Germany	213	213	225	226
Greece	139	171	189	183
Hungary	193	252	189	187
Iceland	130	129	135	129
Ireland	135	143	164	141
Israël			149	176
Italy	170	406	796	1095
Japan	135	144	181	185
Korea	146	149	154	157
Luxembourg	23	29	31	39
Mexico	182	1102	1128	1531
Netherlands	100	153	183	185
New Zealand	152	171	170	161
Norway	176	180	203	197
Poland	126	163	221	179
Portugal	145	152	172	212
Slovak Republic		281	188	189
Slovenia			356	337
Spain	185	383	686	888
Sweden	159	185	197	189
Switzerland	282	444	509	425
Turkey		159	160	170
United Kingdom	349	361	494	481
Scotland	88	96	94	97
United States	145	262	166	160
Non OECD countries				
Hong Kong		145	146	151
Indonesia		344	352	183
Russian Federation	238	211	209	213
Singapore				171

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 2003 and 2011, although data from PISA for 2000, 2003 and 2009 are also used, and from PIRLS 2001 and 2006. 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 from European Union countries (as in the chapter based on REFLEX–HEGESCO data) or from OECD countries (as in PISA, TIMSS, PIRLS). For each indicator in TIMSS, PIRLS and PISA, the OECD average is computed taking into account the subset of education systems for which data is available for all years concerned.

The cross-country average is calculated as the unweighted mean of the data values of all relevant countries for which data are available or can be estimated. It therefore refers to an average of data values at the level of the national (or regional) systems and can be used to answer the question of how an indicator value for a given country compares with the value for a typical or average country. It does not take into account the absolute size of the education system in each country. This approach is taken for the purpose of comparing, for example, changes within individual countries with those across the entire cross-country area for which valid data are available, with this area considered as a single entity.

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:

$$E = \frac{X_2 - X_1}{\sigma_{21}}$$

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, $\hat{\sigma}_1$ and , $\hat{\sigma}_2$ 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 or very small, between 0.2 and 0.5 are considered to be small, effect sizes between 0.5 and 0.8, medium, and effect sizes above 0.8 are considered 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.

Note on Israel

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.

Annex B

Composite innovation indices

This Annex explains how the composite innovation indices have been computed.

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 school and classroom level practices, or practices at different grade levels. For this reason, several indices have been created (specifically, indices at school, classroom, 8th grade and 4th grade levels, and by maths and science), as well as an overall score. This allows readers and policy makers to identify which aspects of countries' education system(s) appear to be relatively innovative, and identifies countries that are innovating throughout the education system.

Creating the indices

The indices of change draw on the analysis reported in this book. The approach used is broadly based on the guidance provided in the 2008 OECD handbook on constructing composite indicators. In particular, the indicators are derived (as far as possible) on 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 data does not need to be weighted or normalised, since we are using the same measure across all our indicators, and they each add such a small amount to the overall indicator.

Data sources for each indicator vary only slightly, as shown in the following table.

Table B.1 Data Sources for Indices

Study name	Questionnaires used	Grades/age covered	Incorporated in indices
TIMSS	Principals	4th	Classroom, School, 4th grade
		8th	Classroom, School, 8th grade
	Teachers	4th	Classroom, School, 4th grade
		8th	Classroom, School, 8th grade
PIRLS	Principals	4th	Classroom, School, 4th grade
	Teachers	4th	Classroom, School, 4th grade
PISA	Principals	15-year-olds	Classroom, School, 8th grade

Notes: All questions used in the indices have been asked in more than one wave of data collection, allowing analysis of change over time. Information from student level questionnaires has not been used due to the lower level of country level coverage and corresponding high level of missing data.

The indices are based on the effect sizes of changes in responses to specific questions. 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. Given that both increases and decreases indicate change and can be considered to be innovative, the absolute value of the effect size has been used to create the indicator. 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.

Missing values

Variation in the coverage of PISA and TIMSS/PIRLS means that data are not available for all education systems across both databases. 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 imputation:

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 the index:

1. Education systems that had effect size data for fewer than 10% of the potential question set (that is all questions reported in the preceding chapters) were excluded. This left us with 43 education systems.
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 40% valid data on the remaining questions were then excluded from the analysis. A total of 28 education systems are covered in the final indices.
4. At this point, those questions that still had missing change effect sizes for more than 50% of the education systems covered have been dropped. A total of 75 questions remained, to be used to impute missing values (School: 13 PISA questions, 20 TIMSS and PIRLS questions; Classroom: 8 PISA questions, 34 TIMSS and PIRLS questions). Some of these questions were not used in the final indices, as discussed below.

The remaining missing values have been replaced using imputed values. The imputation process uses several stages and takes into account information across all available questions and countries. The method provides replicable values with the same data (in other words, another analyst would get the same results by applying this method to the same data), and is equally applicable to different data.

Imputation was undertaken on 4 separate groups of data, incorporating information from both 4^{th} and 8^{th} grade where relevant:

- Missing PISA data was imputed using existing PISA data separately at classroom and school levels.
- Missing TIMSS/PIRLS data was imputed using existing TIMSS/PIRLS data separately at classroom and school levels.

The imputation process uses relative information about how question responses vary across countries and information about the extent of change within an education system, as follows:

1. For each available question, the mean absolute effect size was calculated across countries (i.e. the sum of absolute effect sizes on a particular question divided by the number of countries) (A))
2. For each country, the ratio of absolute effect sizes (AES) to this cross country mean was then calculated for every variable by country [RatioQ =AESQC/AQ]
3. Then, for each country, the mean ratio of absolute effect size to cross country mean was calculated (i.e. the sum of the ratio on each question, divided by the number of questions with valid data (MeanRatio))
4. Finally, missing values were replaced by the product of the mean ratio and the mean absolute effect size: [Imputed value=MeanRatio*A]

Criteria for including questions in the indices

Valid data from all relevant questions were used in the missing data imputation. However, 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 0.2 below shows the final number of questions included in the classroom and schools indices, and the number of imputed values per country. The overall index combines information from both classroom and school; it is calculated as the sum of the two indices, divided by the total number of available questions.

Table B.2 **Count of imputed values**

	Overall index		Classroom index		School index		Mathematics index		Science index		8th grade index		4th grade index	
	n. of potentially available questions	% of imputed values	n. of potentially available questions	% of imputed values	n. of potentially available questions	% of imputed values	n. of potentially available questions	% of imputed values	n. of potentially available questions	% of imputed values	n. of potentially available questions	% of imputed values	n. of potentially available questions	% of imputed values
Australia	55	4%	33	0%	22	9%	22	0%	25	0%	57	0%	18	11%
Austria	55	51%	33	58%	22	41%	22	82%	25	80%	57	63%	18	22%
Chile	55	35%	33	45%	22	36%	22	32%	25	44%	57	26%		
Czech Republic	55	49%	33	67%	22	36%	22	77%	25	72%	57	65%	18	22%
Denmark	55	53%	33	58%	22	45%	22	82%	25	80%	57	65%	18	22%
England	42	0%	33	12%	9	0%	22	0%	25	0%	57	30%	18	0%
Germany	55	47%	33	58%	22	32%	22	82%	25	80%	57	63%	18	11%
Hong Kong	47	23%	25	0%	22	50%	22	0%	25	0%	57	33%	18	0%
Hungary	55	2%	33	3%	22	0%	22	0%	25	4%	57	2%	18	0%
Indiana	34	44%	25	44%	9	44%	22	32%	25	40%	36	75%		
Indonesia	55	20%	33	27%	22	9%	22	23%	25	28%	57	2%		
Israel	55	22%	33	36%	22	18%	22	23%	25	24%	57	14%	18	89%
Italy	55	0%	33	0%	22	0%	22	0%	25	0%	57	0%	18	0%
Japan	55	5%	33	0%	22	14%	22	0%	25	0%	57	2%	18	11%
Korea	55	25%	33	45%	22	27%	22	23%	25	24%	57	19%		
Massachusetts	34	44%	25	44%	9	44%	22	32%	25	40%	36	75%		
Minnesota	34	44%	25	44%	9	44%	22	32%	25	40%	36	75%		
Netherlands	55	44%	33	52%	22	32%	22	77%	25	76%	57	63%	18	0%
New Zealand	55	9%	33	9%	22	9%	22	9%	25	16%	57	11%	18	0%
Norway	55	4%	33	0%	22	9%	22	5%	25	8%	57	5%	18	0%
Ontario	34	0%	25	0%	9	0%	22	0%	25	0%	36	58%	18	0%
Quebec	34	0%	25	0%	9	0%	22	0%	25	0%	36	58%	18	0%
Russian Federation	55	5%	33	15%	22	5%	22	0%	25	8%	57	9%	18	6%
Singapore	34	0%	25	0%	9	0%	22	0%	25	0%	36	58%	18	0%
Slovenia	55	13%	33	21%	22	27%	22	0%	25	4%	57	23%	18	0%
Sweden	55	5%	33	9%	22	0%	22	5%	25	8%	57	2%	18	11%
Turkey	55	31%	33	42%	22	23%	22	27%	25	36%	57	16%		
United States	55	0%	33	0%	22	0%	22	0%	25	0%	57	0%	18	0%

(light blue) = between 40% and 50% of values used in the composite index were imputed
(dark blue) = more than 50% of values used in the composite index were imputed.
Note that all imputations have been undertaken using the maximum number of valid observations (allowing for a better estimate of the true value), before creating the composite indices using different combinations of variables.

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 in terms of school and classroom practices.

The final indices for each country =100 x (sum of absolute effect sizes/number of questions included).

The number of questions included depends on whether data exists in PISA and/or TIMSS/PIRLS and therefore differs across education systems. It also clearly depends on the indicator itself: up to 22 questions are used at school level (depending on the availability of PISA data), 33 at classroom level, 45 at 8th grade (including PISA data) and 10 at 4th grade; with up to 55 questions combined into an overall indicator (combining school and classroom level).

It is possible for the absolute effect size to take a value that is greater than one; however in practice it typically ranges from zero to one. In theory, it is therefore possible for the indicator to take a minimum value of zero and a maximum value of over 100.

The use of Principal Components Analysis (PCA) was explored as an alternative approach to creating indices. Criteria for selecting factors were eigenvalues >=1. Combined factor scores (adding the individual scores from each factor identified) were found to be highly correlated with the final approach taken.

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 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 imputation 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 of 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 Belgium Flanders among others.

Time periods

The effect size of the change in responses to a particular question is 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 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 relatively large proportion of missing data imputations that was 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.

Note on Israel

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Countries' top 5 areas of classroom-level innovations

	Subject	Grade	Australia	Canada (Ontario)	Canada (Québec)	Hungary	Israel	Italy	Japan	Korea	Netherlands	New Zealand	Norway	Slovenia	Sweden	United Kingdom (England)	United States	Hong Kong, China	Indonesia	Russian Federation	Singapore
Science experiments demonstration		8th								5											
Reading on their own		4th			4														5		
Student relating to real life	ma	4th															4	3			
		8th					3	1	3					2	4				3		
	sci	4th			2			1						2			4	3			3
		8th		1			3	1		1						4			3		3
	rea	4th		1									3								
Data interpretation in maths		8th							4	3											
Text interpretation		4th		5			5							4			5	2			
Explain answers in maths		4th	2										2				3	5			
		8th	2						2						5				4		4
Explain subjects in science		4th							5		2				2						
		8th	5		1				5	2					2			4			5
Observe and describe in science		8th	1	2		2	4								3	1	1				2
Group work in maths		8th			5				1							3					
Class ability grouping school policy		8th																	2		
Decide procedures in maths		8th	4	3																	
Design and plan experiments in science		4th		4																	1
		8th														2					1
Choose book to read		4th						3					1								
Use of individualised instruction in reading		4th				1	2									5	2				
Textbook as primary resource of instruction	ma	4th						2						1							
		8th					1	2		4				1	1						
	sci	4th						2					5	1							
		8th					1	2		4				1	1				1		
	rea	4th									1										
Textbook as supplementary resource	ma	4th																			
		8th																			
	sci	4th	3		3							2									
		8th																			
Computer availability	ma	4th										5									
		8th																			
	sci	4th																		2	
		8th																		2	
Network availability	ma	4th				5						3	4							4	
		8th											4							4	
	sci	4th				5					3		4	3						4	
		8th											4							4	
Use of computer to practice skills and procedures	ma	4th										1									
		8th																			
	sci	4th				3		4												1	
		8th				3														1	
Use of computer to look up information	ma	4th										4								3	
		8th																		3	
	sci	4th				4					4			5						3	
		8th				4														3	
Use of computer to conduct scientific experiments		4th						5													
Use of computer to read text		4th									5							1			

Note: Israel and Indonesia: 8th grade and 4th grade reading; Korea: 8th grade only; The Netherlands and Sweden: no TIMSS for 8th grade; ma: mathematics; sci: science; rea: reading.
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Countries' top 5 areas of school-level innovations

	Subject	Grade	Australia	Canada (Ontario)	Canada (Québec)	Hungary	Israel	Italy	Japan	Korea	Netherlands	New Zealand	Norway	Slovenia	Sweden	United Kingdom (England)	United States	Hong Kong, China	Indonesia	Russian Federation	Singapore
Remedial education	ma	4th			3															3	
	ma	8th				1			2	2						1		3			
	sci	4th			3															3	
	sci	8th				1			2	2						1					
Enrichment education	ma	4th						3	1							2				4	
	ma	8th				4			1	3						2					
	sci	4th			2			3	1							2				4	
	sci	8th							1	3						2					5
	rea	4th									1							5			
Teachers peer discussions		4th																			
	ma	8th					1	5						4		4					
	sci	8th		4			1	5						4							
Teachers joined for preparation of materials		4th												5							
	ma	8th					2							5							
	sci	8th					2							5							
Visits of others teachers classrooms		4th												1		5					
	ma	8th		2										1							
	sci	8th		2										1				4	5		
Use of assessment data for comparison with district/ national performance		8th						1	5								2				
Use of assessment data for comparison with other schools		8th																			
Use of assessment data for monitoring school progress		8th											2		3		1			2	
tracking over time by admin authority		8th						4		4			3								
Use of assessment data for instructional or curriculum improvement		8th						2											1		
Principal time devoted to curriculum development		4th												3	1						
Assessment data to judge teachers' effectiveness		8th									5								2		
Achievement data to evaluate teachers performance		8th																			
Achievement data to evaluate principal's performance		8th										5	4	2							
Change in inspector's practices		4th	2	1	1						2	3	1			3		2			2
	ma	8th		1	1		3					3			5	3	4	2			2
	sci	8th		1	1		3					3			5	3	4	2			2
Change in peer review evaluation of teachers' practices		4th	1	5		5					4	2						1			
	ma	8th	1				5			1		2			2			1			4
	sci	8th	1				5			1		2			2			1			4
Change in use of incentives for teachers' recruitment and retention		4th		3	5	3					3									1	
	ma	8th		3	5	3	4		3											1	1
	sci	8th		3	5	3	4		3											1	1
Achievement data to inform parent on child performance		8th															3				
Information provision to parents : student performance relative to other students		8th	5						4												

	Subject	Grade	Australia	Canada (Ontario)	Canada (Québec)	Hungary	Israel	Italy	Japan	Korea	Netherlands	New Zealand	Norway	Slovenia	Sweden	United Kingdom (England)	United States	Hong Kong, China	Indonesia	Russian Federation	Singapore
Information provision to parents : relative to students in the same grade in other schools		8th										4									
Parental involvement : to be serve on school committees		4th	4			2														5	
		8th	4			2											5		4	5	
Parental involvement : to be volunteer for school projects, programs and trips		4th	3										5								
		8th	3										5		4						3
Public relations : achievement data publicly posted		8th										1							3		
Public relations and fundraising by the principal		8th			4					5											

Note: Israel and Indonesia: 8th grade and 4th grade reading; Korea: 8th grade only; The Netherlands and Sweden: no TIMSS for 8th grade; ma: mathematics; sci: science; rea: reading.
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Country index

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OECD PUBLISHING, 2, rue André-Pascal, 75775 PARIS CEDEX 16
(96 2014 05 1 P) ISBN 978-92-64-21568-9 – 2014

Educational Research and Innovation

Measuring Innovation in Education

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This book is the beginning of a new journey: it calls for innovations in the field of measurement – and not just of education.

Contents

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ISBN 978-92-64-21568-9
96 2014 05 1 P