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

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

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

22. Reading textbooks and resource materials in science

Why it matters

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

Primary education

Change at the OECD level: small

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

Countries where there has been the most change

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

Secondary education

Change at the OECD level: large

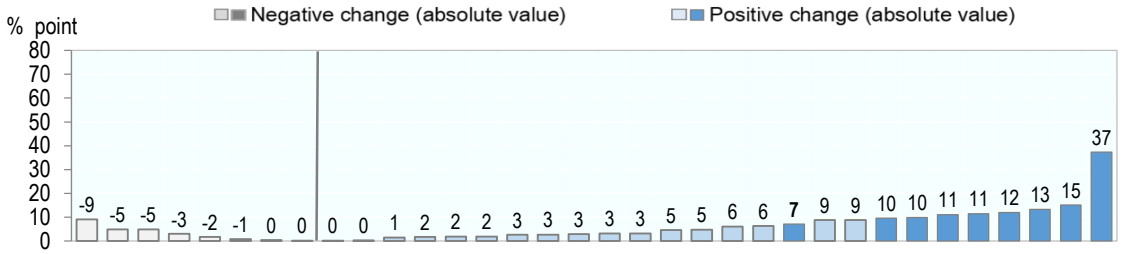
The average share of 8th grade students regularly being asked to read textbooks or resource materials during science lesson went up from 43 % in 2007 to 63% in 2015. This 20-percentage point absolute change between 2007 and 2015 corresponds to a large effect size of 0.41, a high level of innovation.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

Countries where there has been the most change

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

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

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

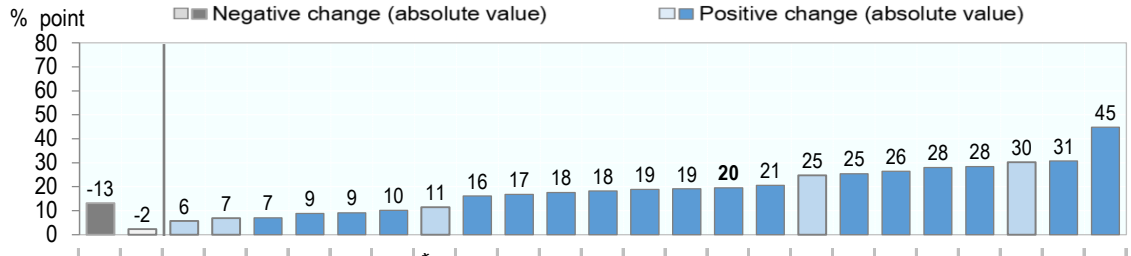


	Netherlands	Russian Federation	Denmark	Finland*	Northern Ireland (UK)*	Singapore	Belgium (Fl.)*	Chile*	New Zealand	Hong Kong, China	Ireland*	Slovak Republic	Turkey*	Spain*	Czech Republic	United States	Germany	Alberta (CAN)*	England (UK)	Poland*	Korea*	Italy	Austria*	**OECD average**	Ontario (CAN)	Quebec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

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

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

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



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

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

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

23. Reading non-fiction work

Why it matters

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

Change at the OECD level: large

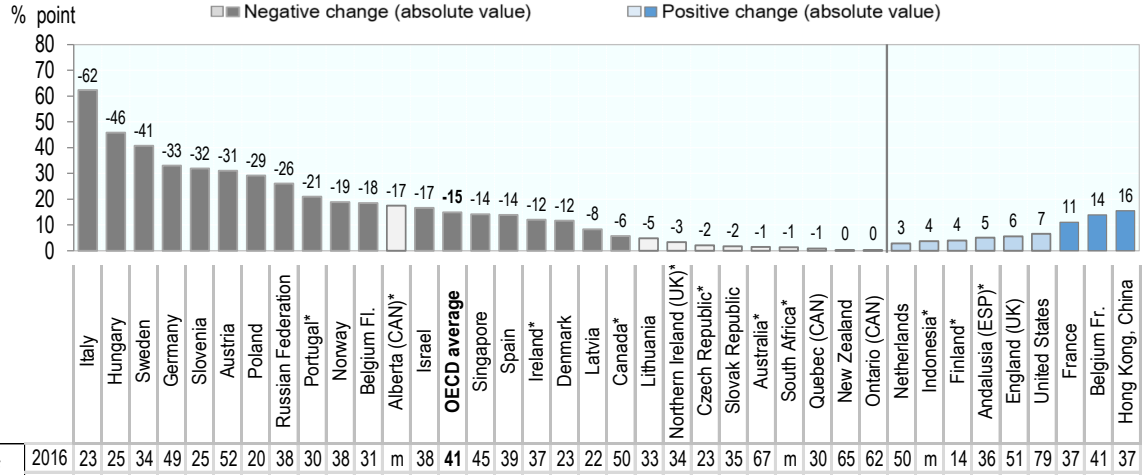
This practice has overwhelmingly declined across OECD countries. Between 2006 and 2016, there was a 15 percentage point decrease in the average proportion of 4th grade students regularly asked to read non-fiction – while the absolute change in both direction amounted to 19 percentage points, corresponding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

Countries where there has been the most change

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

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

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



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

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

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

24. Using computers to look for information in reading

Why it matters

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

Change at the OECD level: large

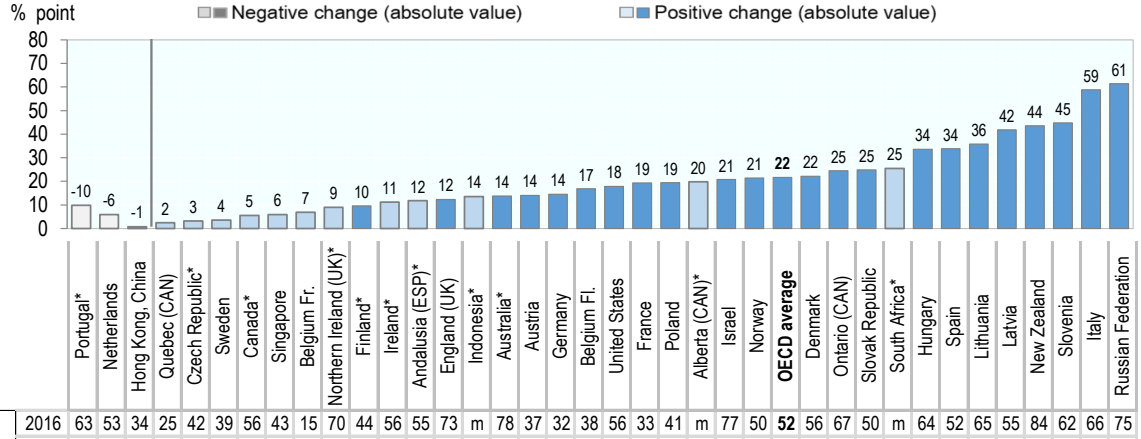
This practice has gained significant ground in OECD countries. Between 2006 and 2016, the share of 4th grade students regularly asked to look for information in reading increased by 22 percentage points on average. The absolute change was 22 percentage points as well, corresponding to a large effect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

Countries where there has been the most change

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

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

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



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

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

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

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

Why it matters

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

Primary education

Change at the OECD level: large

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

Countries where there has been the most change

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

Secondary education

Change at the OECD level: large

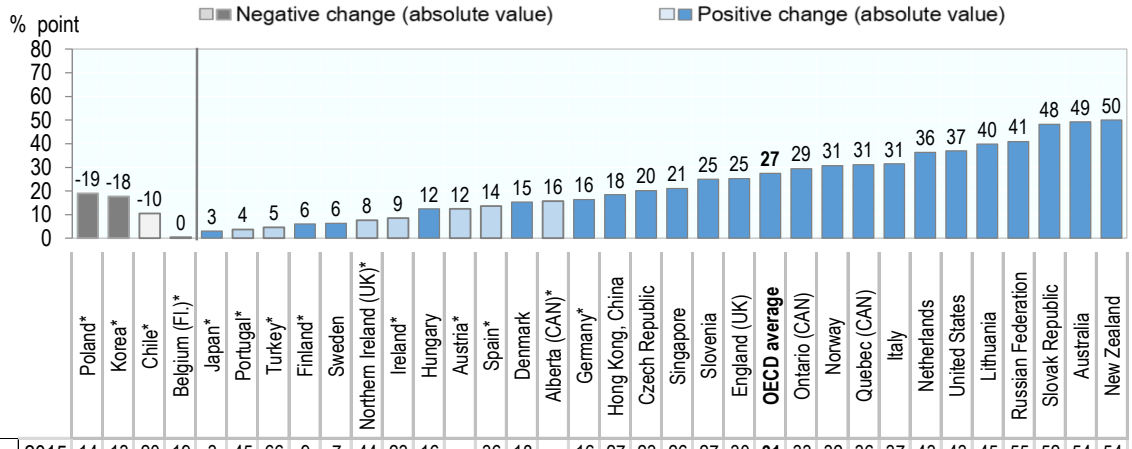
Like in primary education, the share of 8th grade students using computers to look up for ideas and information in mathematics lessons each week increased, this time by 18 percentage points. With an absolute change also equal to 18 percentage points between 2007 and 2015, corresponding to a very large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

Countries where there has been the most change

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

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

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



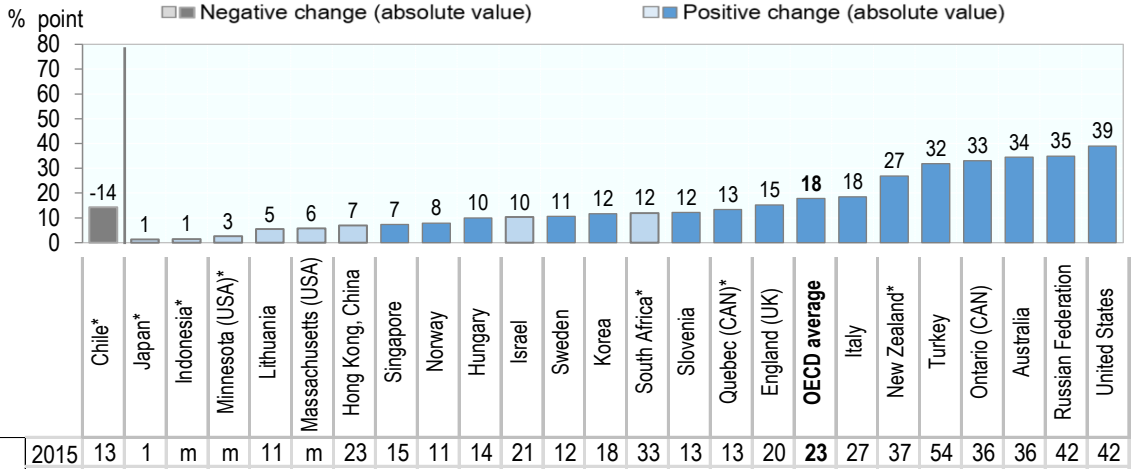
% of students	Poland*	Korea*	Chile*	Belgium (Fl.)*	Japan*	Portugal*	Turkey*	Finland*	Sweden	Northern Ireland (UK)*	Ireland*	Hungary	Austria*	Spain*	Denmark	Alberta (CAN)*	Germany*	Hong Kong, China	Czech Republic	Singapore	Slovenia	England (UK)	**OECD average**	Ontario (CAN)	Norway	Quebec (CAN)	Italy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

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

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

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

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



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

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

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

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

Why it matters

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

Primary education

Change at the OECD level: large

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

Countries where there has been the most change

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

Secondary education

Change at the OECD level: large

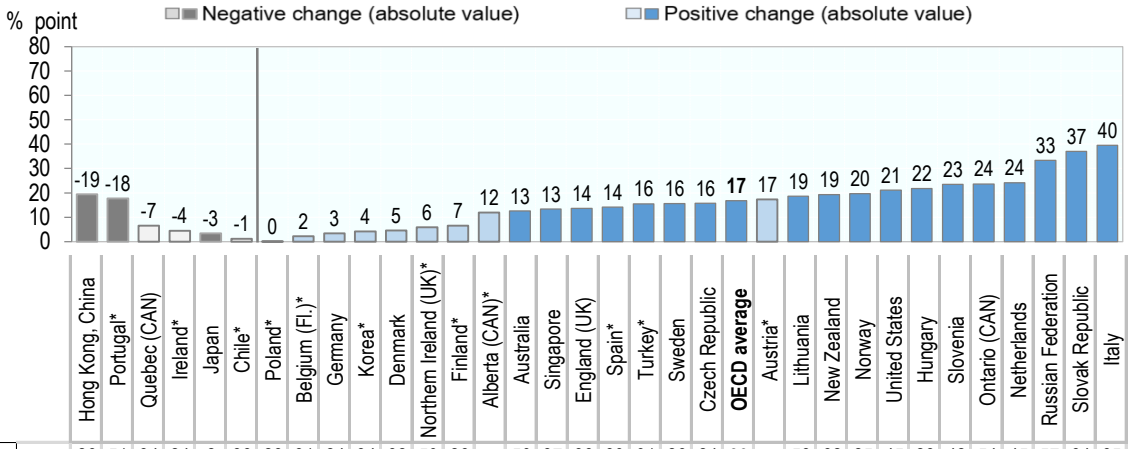
As in primary education, the use of computers to look up for ideas and information in science lessons has gained ground across secondary schools. The average share of 8th grade students regularly participating in this exercise has increased by 21 percentage points between 2007 and 2015 in OECD systems.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

Countries where there has been the most change

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

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

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



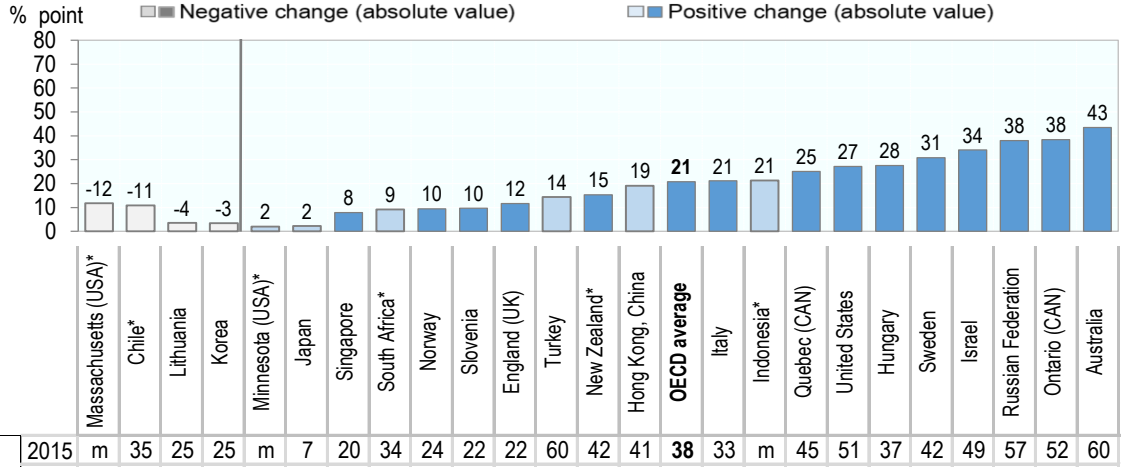
		Hong Kong, China	Portugal*	Quebec (CAN)	Ireland*	Japan	Chile*	Poland*	Belgium (Fl.)*	Germany	Korea*	Denmark	Northern Ireland (UK)*	Finland*	Alberta (CAN)*	Australia	Singapore	England (UK)	Spain*	Turkey*	Sweden	Czech Republic	**OECD average**	Austria*	Lithuania	New Zealand	Norway	United States	Hungary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

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

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

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

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



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

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

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

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

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

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

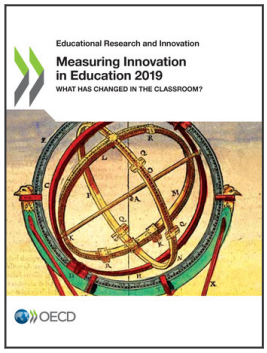
Effect size from -0.5 to -0.2 and from 0.2 and 0.5

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

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

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

StatLink https://doi.org/10.1787/888933904391



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