5

Mathematics performance among 15-year-olds

This chapter compares countries' and economies' performance in mathematics in 2015 and analyses the changes in performance since 2003. Changes since the PISA 2012 assessment, when mathematics was most recently the major domain, are highlighted. The chapter also discusses differences in mathematics performance related to gender.

A note regarding 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.

The PISA assessment of mathematics focuses on measuring students' capacity to formulate, use and interpret mathematics in a variety of contexts. To succeed on the PISA test, students must be able to reason mathematically and use mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. Competence in mathematics, as defined in PISA, assists individuals in recognising the role that mathematics plays in the world and in making the well-founded judgements and decisions needed to be constructive, engaged and reflective citizens (OECD, 2016a).

Performance in mathematics described in this way encompasses more than the ability to reproduce the knowledge of mathematics concepts and procedures acquired in school. PISA seeks to measure how well students can extrapolate from what they know and apply their knowledge of mathematics, including in new and unfamiliar situations. To this end, most PISA mathematics units make reference to real-life contexts in which mathematics abilities are required to solve a problem. The focus on real-life contexts is also reflected in the reference to the possibility of using "tools", such as a calculator, a ruler or a spreadsheet, for solving problems, just as one would do in a real-life situation, such as at work.

Mathematics was the major domain assessed in 2003, the second PISA assessment, and in 2012, the fifth PISA assessment. In this sixth PISA assessment, science is the major domain, thus less time was devoted to assessing students' mathematics skills. As a result, only an update on overall performance is possible, rather than the kind of in-depth analyses of knowledge and skills that were contained in the reports based on PISA 2003 and PISA 2012 data (OECD, 2004; OECD, 2010; OECD, 2014; OECD, 2016b).

This chapter presents the results of the assessment of mathematics in PISA 2015. Mathematics was tested using computers (as were science and reading) in 57 of the 72 participating countries and economies; the remaining 15 countries and economies, as well as Puerto Rico, an unincorporated territory of the United States, delivered the test in a pencil-and-paper format, as in previous cycles of PISA.[1] All countries/economies, regardless of the assessment mode, used the same mathematics questions, which were initially developed for the paper-based assessments used in PISA 2012 and PISA 2003. Results of the PISA test are reported on the same scale, regardless of the mode of delivery, and can be compared across all 72 participating countries and economies.[2] PISA 2015 results in mathematics can also be compared to results of the PISA 2003, 2006, 2009 and 2012 assessments (see Box I.2.3 and Annex A5).

What the data tell us

- Four countries/economies in Asia outperform all other countries/economies in mathematics: Singapore, Hong Kong (China), Macao (China) and Chinese Taipei. Japan is the strongest performer among OECD countries.
- Albania, Colombia, Montenegro, Peru, Qatar and Russia improved their students' mean performance between 2012 and 2015, contributing to an overall positive trend since these countries began participating in PISA.
- More than one in four students in Beijing-Shanghai-Jiangsu-Guangdong (China), Hong Kong (China), Singapore and Chinese Taipei are top-performing students in mathematics – meaning that they can, for instance, handle tasks that require the ability to formulate complex situations mathematically, using symbolic representations.
- On average across OECD countries, boys score 8 points higher than girls in mathematics. Boys' advantage in mathematics is most apparent among the best-performing students: the 10% highest-achieving boys score 16 points higher than the 10% highest-achieving girls.

STUDENT PROFICIENCY IN MATHEMATICS

In PISA 2003, the mean mathematics score for the 30 OECD countries at the time was set at 500 score points, with a standard deviation of 100 points (OECD, 2004). To help interpret what students' scores mean in substantive terms, the scale is divided into levels of proficiency that indicate the kinds of tasks that students at those levels are capable of completing successfully. Descriptions of the proficiency levels are revisited and updated each time a domain returns as a major domain, to reflect revisions in the framework and in the demands of the new tasks developed for the assessment. The most recent descriptions of proficiency levels are based on the PISA 2012 assessment (OECD, 2014).

Average performance in mathematics

One way to summarise student performance and to compare the relative standing of countries in mathematics is through countries' and economies' mean performance, both relative to each other and to the OECD mean. For PISA 2015, the mean performance across the 35 OECD countries is 490 score points.

Figure I.5.1 ■ **Comparing countries' and economies' performance in mathematics**

- Statistically significantly **above** the OECD average
- Not statistically significantly different from the OECD average
- Statistically significantly **below** the OECD average

Mean score	Comparison country/ economy	Countries and economies whose mean score is NOT statistically significantly different from the comparison country's/economy's score
564	Singapore	
548	Hong Kong (China)	Macao (China), Chinese Taipei
544	Macao (China)	Hong Kong (China), Chinese Taipei
542	Chinese Taipei	Hong Kong (China), Macao (China), B-S-J-G (China)
532	Japan	B-S-J-G (China), Korea
531	B-S-J-G (China)	Chinese Taipei, Japan, Korea, Switzerland
524	Korea	Japan, B-S-J-G (China), Switzerland, Estonia, Canada
521	Switzerland	B-S-J-G (China), Korea, Estonia, Canada
520	Estonia	Korea, Switzerland, Canada
516	Canada	Korea, Switzerland, Estonia, Netherlands, Denmark, Finland
512	Netherlands	Canada, Denmark, Finland, Slovenia, Belgium, Germany
511	Denmark	Canada, Netherlands, Finland, Slovenia, Belgium, Germany
511	Finland	Canada, Netherlands, Denmark, Slovenia, Belgium, Germany
510	Slovenia	Netherlands, Denmark, Finland, Belgium, Germany
507	Belgium	Netherlands, Denmark, Finland, Slovenia, Germany, Poland, Ireland, Norway
506	Germany	Netherlands, Denmark, Finland, Slovenia, Belgium, Poland, Ireland, Norway
504	Poland	Belgium, Germany, Ireland, Norway
504	Ireland	Belgium, Germany, Poland, Norway, Viet Nam
502	Norway	Belgium, Germany, Poland, Ireland, Austria, Viet Nam
497	Austria	Norway, New Zealand, Viet Nam, Russia, Sweden, Australia, France, United Kingdom, Czech Republic, Portugal, Italy
495	New Zealand	Austria, Viet Nam, Russia, Sweden, Australia, France, United Kingdom, Czech Republic, Portugal, Italy
495	Viet Nam	Ireland, Norway, Austria, New Zealand, Russia, Sweden, Australia, France, United Kingdom, Czech Republic, Portugal, Italy, Iceland, Spain, Luxembourg
494	Russia	Austria, New Zealand, Viet Nam, Sweden, Australia, France, United Kingdom, Czech Republic, Portugal, Italy, Iceland
494	Sweden	Austria, New Zealand, Viet Nam, Russia, Australia, France, United Kingdom, Czech Republic, Portugal, Italy, Iceland
494	Australia	Austria, New Zealand, Viet Nam, Russia, Sweden, France, United Kingdom, Czech Republic, Portugal, Italy
493	France	Austria, New Zealand, Viet Nam, Russia, Sweden, Australia, United Kingdom, Czech Republic, Portugal, Italy, Iceland
492	United Kingdom	Austria, New Zealand, Viet Nam, Russia, Sweden, Australia, France, Czech Republic, Portugal, Italy, Iceland
492	Czech Republic	Austria, New Zealand, Viet Nam, Russia, Sweden, Australia, France, United Kingdom, Portugal, Italy, Iceland
492	Portugal	Austria, New Zealand, Viet Nam, Russia, Sweden, Australia, France, United Kingdom, Czech Republic, Italy, Iceland, Spain
490	Italy	Austria, New Zealand, Viet Nam, Russia, Sweden, Australia, France, United Kingdom, Czech Republic, Portugal, Iceland, Spain, Luxembourg
488	Iceland	Viet Nam, Russia, Sweden, France, United Kingdom, Czech Republic, Portugal, Italy, Spain, Luxembourg
486	Spain	Viet Nam, Portugal, Italy, Iceland, Luxembourg, Latvia
486	Luxembourg	Viet Nam, Italy, Iceland, Spain, Latvia
482	Latvia	Spain, Luxembourg, Malta, Lithuania, Hungary
479	Malta	Latvia, Lithuania, Hungary, Slovak Republic
478	Lithuania	Latvia, Malta, Hungary, Slovak Republic
477	Hungary	Latvia, Malta, Lithuania, Slovak Republic, Israel, United States
475	Slovak Republic	Malta, Lithuania, Hungary, Israel, United States
470	Israel	Hungary, Slovak Republic, United States, Croatia, CABA (Argentina)
470	United States	Hungary, Slovak Republic, Israel, Croatia, CABA (Argentina)
464	Croatia	Israel, United States, CABA (Argentina)
456	CABA (Argentina)	Israel, United States, Croatia, Greece, Romania, Bulgaria
454	Greece	CABA (Argentina), Romania
444	Romania	CABA (Argentina), Greece, Bulgaria, Cyprus[1]
441	Bulgaria	CABA (Argentina), Romania, Cyprus[1]
437	Cyprus[1]	Romania, Bulgaria
427	United Arab Emirates	Chile, Turkey
423	Chile	United Arab Emirates, Turkey, Moldova, Uruguay, Montenegro, Trinidad and Tobago, Thailand
420	Turkey	United Arab Emirates, Chile, Moldova, Uruguay, Montenegro, Trinidad and Tobago, Thailand, Albania
420	Moldova	Chile, Turkey, Uruguay, Montenegro, Trinidad and Tobago, Thailand, Albania
418	Uruguay	Chile, Turkey, Moldova, Montenegro, Trinidad and Tobago, Thailand, Albania
418	Montenegro	Chile, Turkey, Moldova, Uruguay, Trinidad and Tobago, Thailand, Albania
417	Trinidad and Tobago	Chile, Turkey, Moldova, Uruguay, Montenegro, Thailand, Albania
415	Thailand	Chile, Turkey, Moldova, Uruguay, Montenegro, Trinidad and Tobago, Albania
413	Albania	Turkey, Moldova, Uruguay, Montenegro, Trinidad and Tobago, Thailand, Mexico
408	Mexico	Albania, Georgia
404	Georgia	Mexico, Qatar, Costa Rica, Lebanon
402	Qatar	Georgia, Costa Rica, Lebanon
400	Costa Rica	Georgia, Qatar, Lebanon
396	Lebanon	Georgia, Qatar, Costa Rica, Colombia
390	Colombia	Lebanon, Peru, Indonesia
387	Peru	Colombia, Indonesia, Jordan
386	Indonesia	Colombia, Peru, Jordan
380	Jordan	Peru, Indonesia, Brazil
377	Brazil	Jordan, FYROM
371	FYROM	Brazil, Tunisia
367	Tunisia	FYROM, Kosovo, Algeria
362	Kosovo	Tunisia, Algeria
360	Algeria	Tunisia, Kosovo
328	Dominican Republic	

1. Note by Turkey: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue".
Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.
Source: OECD, PISA 2015 Database, Table I.5.3.
StatLink http://dx.doi.org/10.1787/888933432605

When interpreting mean performance, only statistically significant differences among countries and economies should be taken into account (see Box I.2.2 in Chapter 2). Figure I.5.1 shows each country's/economy's mean score and also indicates for which pairs of countries/economies the differences between the means are statistically significant. For country/economy A, shown in the middle column, the mean score achieved by students is shown in the left column, and the countries/economies whose mean scores are *not* statistically significantly different are listed in the right column.[3] For all other countries/economies not listed in the right column, country/economy B scores higher than country/economy A if country/economy B is situated above country/economy A in the middle column, and scores lower if country/economy B is situated below country/economy A. For example: Singapore, whose mean score is 564 points, has a higher score than all other PISA-participating countries/economies; whereas the performance of Hong Kong (China), which appears second on the list, with a mean score of 548 points, cannot be distinguished with confidence from that of Macao (China) and Chinese Taipei, which appear third and fourth, respectively.

In Figure I.5.1, countries and economies are divided into three broad groups: those whose mean scores are statistically around the OECD mean (highlighted in dark blue), those whose mean scores are above the OECD mean (highlighted in pale blue), and those whose mean scores are below the OECD mean (highlighted in medium blue).

As shown in Figure I.5.1, four countries and economies outperform all others in mathematics in PISA 2015, with mean scores of about half a standard deviation above the OECD average or more. Singapore is the highest-performing country in mathematics, with a mean score of 564 points – more than 70 points above the OECD average. Three countries/economies – Hong Kong (China), Macao (China) and Chinese Taipei – perform below Singapore, but higher than any OECD country in PISA. Japan is the highest-performing OECD country, with a mean score of 532 points. Other countries and economies with mean performance above the average include (in descending order of mean performance) Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]"), Korea, Switzerland, Estonia, Canada, the Netherlands, Denmark, Finland, Slovenia, Belgium, Germany, Poland, Ireland, Norway, Austria, New Zealand and Australia. Countries that perform around the average include Viet Nam, the Russian Federation (hereafter "Russia"), Sweden, France, the United Kingdom, the Czech Republic, Portugal, Italy and Iceland. Thirty-six participating countries and economies have a mean score that is below the OECD average.

The gap in performance between the highest- and the lowest-performing OECD countries is 124 score points. That is, while the average score of the highest-performing OECD country, Japan, is about 40 points above the OECD average, the average score of the lowest-performing OECD country, Mexico, is more than 80 points – or the equivalent of more than two years of school (see Box I.2.2 in Chapter 2) – below the OECD average. But the performance difference observed among partner countries and economies is even larger, with a 236 score-point difference between Singapore (564 points) and the Dominican Republic (328 points).

Because the figures are derived from samples, it is not possible to determine a country's or economy's precise ranking among all countries and economies. However, it is possible to determine, with confidence, a range of rankings in which the country's/economy's performance lies (Figure I.5.2). For subnational entities whose results are reported in Annex B2, a rank order was not estimated; but the mean score and its confidence interval allow for a comparison of the performance of these subnational entities with that of countries and economies. For example, the Flemish community of Belgium shows a mean score of 521 points in mathematics, below that of top performers Hong Kong (China), Japan or Singapore but close to the score achieved by students in Estonia, Korea and Switzerland on average, and clearly above the national average for Belgium (507 points).

Trends in average mathematics performance

The change in a school system's average performance over time can indicate how and to what extent the system is progressing towards achieving the goal of providing its students with the knowledge and skills needed to become full participants in a knowledge-based society. PISA 2015 mathematics results can be compared with those from PISA 2003 and from later PISA mathematics assessments. A comprehensive analysis of trends between 2003 and 2012 was included in the PISA 2012 initial report (OECD, 2014). This chapter focuses on changes in mathematics performance since PISA 2012, the most recent cycle in which mathematics was the major domain, while also reporting the average three-year trend since 2003 or a country's/economy's earliest participation in PISA. PISA 2012 and PISA 2015 results can be compared for 60 countries and economies; for 56 of these, earlier results are available too. For another four countries, PISA 2012 results are not available; only results from PISA 2009 (for Trinidad and Tobago) or from PISA 2009+ (for Georgia, Malta and Moldova) can be compared with PISA 2015 results.

Figure I.5.2 [Part 1/2] ■ Mathematics performance among PISA 2015 participants, at national and subnational levels

	Mathematics scale					
			Range of ranks			
			OECD countries		All countries/economies	
	Mean score	95% confidence interval	Upper rank	Lower rank	Upper rank	Lower rank
Singapore	564	561 - 567			1	1
Hong Kong (China)	548	542 - 554			2	3
Quebec (Canada)[1]	544	535 - 553				
Macao (China)	544	542 - 546			2	4
Chinese Taipei	542	536 - 548			2	4
Japan	532	527 - 538	1	1	5	6
B-S-J-G (China)	531	522 - 541			4	7
Korea	524	517 - 531	1	4	6	9
British Columbia (Canada)	522	512 - 531				
Flemish community (Belgium)	521	517 - 526				
Switzerland	521	516 - 527	2	5	7	10
Estonia	520	516 - 524	2	5	7	10
Bolzano (Italy)	518	505 - 531				
Navarre (Spain)	518	503 - 533				
Trento (Italy)	516	511 - 521				
Canada	516	511 - 520	3	7	8	12
Netherlands	512	508 - 517	5	9	10	14
Alberta (Canada)	511	502 - 521				
Denmark	511	507 - 515	5	10	10	15
Finland	511	507 - 516	5	10	10	15
Slovenia	510	507 - 512	6	10	11	15
Ontario (Canada)	509	501 - 518				
Lombardia (Italy)	508	495 - 520				
Belgium	507	502 - 512	7	13	12	18
Castile and Leon (Spain)	506	497 - 515				
Germany	506	500 - 512	8	14	12	19
La Rioja (Spain)	505	486 - 523				
Poland	504	500 - 509	10	14	14	19
Ireland	504	500 - 508	10	14	15	19
Madrid (Spain)	503	495 - 511				
German-speaking community (Belgium)	502	492 - 512				
Norway	502	497 - 506	11	15	16	20
Aragon (Spain)	500	490 - 510				
Massachusetts (United States)	500	489 - 511				
Catalonia (Spain)	500	491 - 509				
Prince Edward Island (Canada)	499	486 - 511				
Nova Scotia (Canada)	497	488 - 506				
Austria	497	491 - 502	14	21	18	27
New Zealand	495	491 - 500	15	22	20	28
Cantabria (Spain)	495	477 - 513				
Viet Nam	495	486 - 503			18	32
Russia	494	488 - 500			20	30
Sweden	494	488 - 500	15	24	20	30
Australia	494	491 - 497	15	22	21	29
Galicia (Spain)	494	486 - 502				
England (United Kingdom)	493	488 - 499				
France	493	489 - 497	15	23	21	30
Northern Ireland (United Kingdom)	493	484 - 502				
New Brunswick (Canada)	493	483 - 502				
United Kingdom	492	488 - 497	15	24	21	31
Czech Republic	492	488 - 497	16	24	21	31
Basque Country (Spain)	492	484 - 499				
Portugal	492	487 - 497	16	24	21	31
Asturias (Spain)	492	481 - 502				
Scotland (United Kingdom)	491	486 - 496				
Italy	490	484 - 495	17	26	23	33
French community (Belgium)	489	481 - 498				
Manitoba (Canada)	489	481 - 497				
Iceland	488	484 - 492	21	26	27	33
Castile-La Mancha (Spain)	486	479 - 493				
Spain	486	482 - 490	23	27	29	34
Luxembourg	486	483 - 488	24	27	31	34

* See note 1 under Figure I.5.1.
1. Results for the province of Quebec in this figure should be treated with caution due to a possible non-response bias.
2. Puerto Rico is an unincorporated territory of the United States. As such, PISA results for the United States do not include Puerto Rico.
Note: OECD countries are shown in bold black. Partner countries, economies and subnational entities that are not included in national results are shown in bold blue. Regions are shown in black italics (OECD countries) or blue italics (partner countries).
Countries and economies are ranked in descending order of mean mathematics performance.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432613

Figure I.5.2 [Part 2/2] ■ Mathematics performance among PISA 2015 participants, at national and subnational levels

	Mathematics scale					
			Range of ranks			
			OECD countries		All countries/economies	
	Mean score	95% confidence interval	Upper rank	Lower rank	Upper rank	Lower rank
Newfoundland and Labrador (Canada)	486	479 - 492				
Comunidad Valenciana (Spain)	485	478 - 492				
Saskatchewan (Canada)	484	479 - 490				
Latvia	482	479 - 486	26	28	32	36
Malta	479	475 - 482			34	38
Lithuania	478	474 - 483			34	38
Wales (United Kingdom)	478	471 - 485				
Hungary	477	472 - 482	28	30	35	39
Balearic Islands (Spain)	476	464 - 489				
Slovak Republic	475	470 - 480	28	30	35	39
Extremadura (Spain)	473	464 - 482				
North Carolina (United States)	471	462 - 480				
Murcia (Spain)	470	457 - 484				
Israel	470	463 - 477	29	31	37	41
United States	470	463 - 476	29	31	38	41
Dubai (UAE)	467	464 - 471				
Andalusia (Spain)	466	458 - 474				
Croatia	464	459 - 469			40	42
Região Autónoma dos Açores (Portugal)	462	458 - 467				
CABA (Argentina)	456	443 - 470			40	44
Campania (Italy)	456	445 - 466				
Greece	454	446 - 461	32	32	42	43
Canary Islands (Spain)	452	443 - 461				
Romania	444	437 - 451			43	45
Bulgaria	441	433 - 449			44	46
Cyprus*	437	434 - 441			45	46
Sharjah (UAE)	429	414 - 444				
United Arab Emirates	427	423 - 432			47	48
Bogotá (Colombia)	426	417 - 435				
Chile	423	418 - 428	33	34	47	51
Turkey	420	412 - 429	33	34	47	54
Moldova	420	415 - 424			48	54
Uruguay	418	413 - 423			49	55
Montenegro	418	415 - 421			49	54
Trinidad and Tobago	417	414 - 420			50	55
Thailand	415	410 - 421			49	55
Albania	413	406 - 420			51	56
Abu Dhabi (UAE)	413	403 - 422				
Mexico	408	404 - 412	35	35	55	57
Medellín (Colombia)	408	399 - 416				
Manizales (Colombia)	407	400 - 415				
Georgia	404	398 - 409			56	59
Qatar	402	400 - 405			57	59
Ras Al Khaimah (UAE)	402	383 - 420				
Costa Rica	400	395 - 405			57	60
Lebanon	396	389 - 403			58	61
Cali (Colombia)	394	385 - 402				
Fujairah (UAE)	393	382 - 404				
Colombia	390	385 - 394			60	63
Ajman (UAE)	387	374 - 400				
Peru	387	381 - 392			61	64
Indonesia	386	380 - 392			61	64
Umm Al Quwain (UAE)	384	375 - 394				
Jordan	380	375 - 385			63	65
Puerto Rico[2]	378	367 - 389				
Brazil	377	371 - 383			64	65
FYROM	371	369 - 374			66	67
Tunisia	367	361 - 373			66	68
Kosovo	362	358 - 365			67	69
Algeria	360	354 - 365			68	69
Dominican Republic	328	322 - 333			70	70

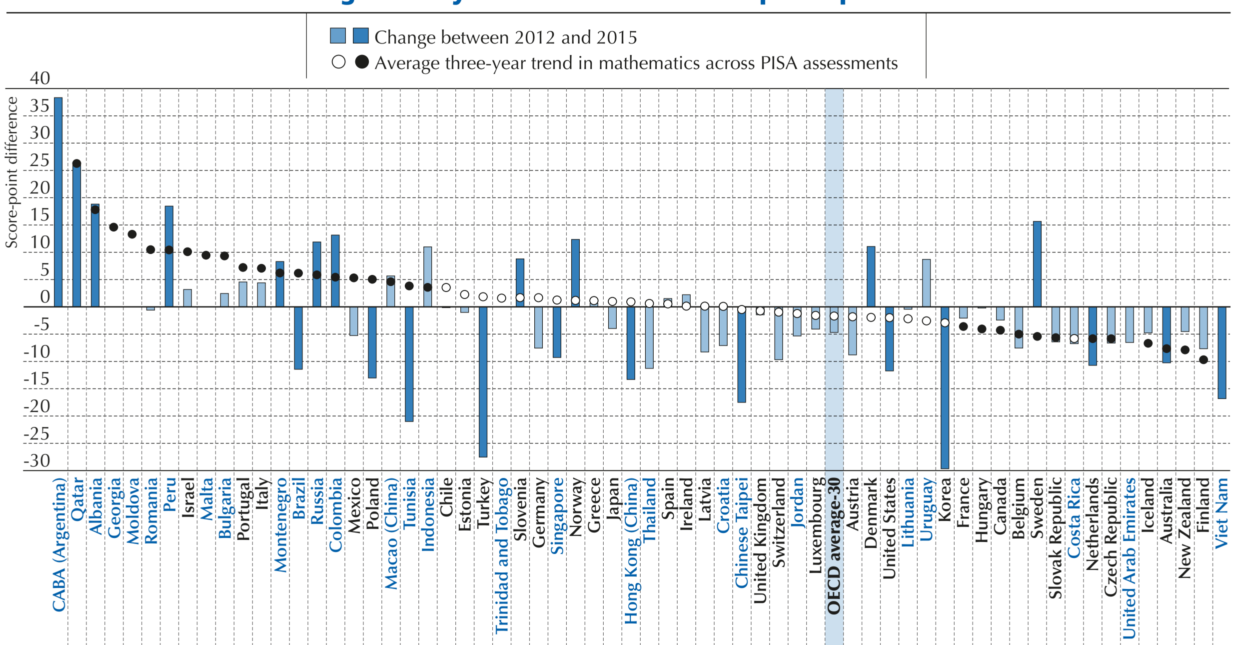
* See note 1 under Figure I.5.1.
1. Results for the province of Quebec in this figure should be treated with caution due to a possible non-response bias.
2. Puerto Rico is an unincorporated territory of the United States. As such, PISA results for the United States do not include Puerto Rico.
Note: OECD countries are shown in bold black. Partner countries, economies and subnational entities that are not included in national results are shown in bold blue. Regions are shown in black italics (OECD countries) or blue italics (partner countries).
Countries and economies are ranked in descending order of mean mathematics performance.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432613

On average across OECD countries, mathematics performance remained broadly stable between 2012 and 2015; the average score-point difference between PISA 2012 and PISA 2015, for the 35 OECD countries, is -4 points, a non-significant difference given the uncertainty about the link between the PISA 2015 and the PISA 2012 scales (see Box I.2.3 in Chapter 2 and Annex A5). Longer trends also show overall stability of average results. For OECD countries with valid data for PISA 2003, mathematics results declined, on average, by 1.7 score points every three years between 2003 and 2015 – a non-significant trend.

Among all PISA participants, 11 countries/economies – including four OECD countries – saw significant improvements since 2012. Performance improved by 38 score points in Ciudad Autónoma de Buenos Aires (Argentina) (hereafter "CABA [Argentina]") and by 26 score points in Qatar. Performance improved by between 15 and 20 score points in Albania, Peru and Sweden and by between 10 and 15 score points in Colombia, Denmark, Norway and Russia. Significant improvements since 2012 are also observed in Montenegro and Slovenia, but mean scores improved by less than 10 points in these countries. Performance also improved by more than 15 score points in Georgia, Malta and Moldova since they first participated in PISA in 2010, as part of the PISA 2009+ programme (Figure I.5.3 and Table I.5.4a).

Meanwhile, 12 countries and economies saw deteriorating performance between 2012 and 2015 (Figure I.5.3 and Table I.5.4a). In most countries and economies, however, performance remained stable between 2012 and 2015 – as can be expected, given the short period of time between the two assessments.

Figure I.5.3 ■ **Change between 2012 and 2015 in mathematics performance and average three-year trend since earliest participation in PISA**



Notes: Statistically significant differences are shown in a darker tone (see Annex A3).

The average three-year trend is the average rate of change, per three-year period, between the earliest available measurement in PISA and PISA 2015. For countries and economies with more than one available measurement, the average three-year trend is calculated with a linear regression model. The average three-year trend is the average rate of change, per three-year period, between the earliest available measurement in PISA and PISA 2015. For countries and economies with more than one available measurement, the average three-year trend is calculated with a linear regression model. This model takes into account that Costa Rica, Georgia, Malta and Moldova conducted the PISA 2009 assessment in 2010 as part of PISA 2009+. For countries/economies with comparable data for PISA 2012 and PISA 2015 only, the average three-year trend coincides with the change between 2012 and 2015.

Only countries/economies with valid results for PISA 2015 and at least one prior assessment are shown.

Countries and economies are ranked in descending order of the average three-year trend in mathematics performance since the earliest participation in PISA.

Source: OECD, PISA 2015 Database, Table I.5.4a.

StatLink http://dx.doi.org/10.1787/888933432623

Figure I.5.3 shows that the positive changes in performance observed in recent years in Albania, Colombia, Montenegro, Peru, Qatar and Russia are consistent with longer-term trends seen since these countries/economies first participated in PISA. By contrast, the recent improvements observed in Denmark, Norway, Slovenia and Sweden reverse an earlier drop in PISA scores (which was not always significant). The overall trajectory for these countries since their earliest participation

in PISA, indicated by the dots in Figure I.5.3 representing the average three-year trend, corresponds to a non-significant improvement in Norway and Slovenia, a non-significant decline in Denmark, and a decline, by 5.4 points every three years, in Sweden. Between 2003 and 2012, Sweden saw one of the steepest declines in mean mathematics performance (more than 30 score points); but the most recent change between 2012 and 2015, when mathematics scores in Sweden improved by 16 points, slowed, and perhaps reversed, this trend.

Among the countries and economies that saw a deterioration in performance between 2012 and 2015, the overall trajectory across PISA assessments is nevertheless positive in Brazil (which gained 6.2 points in every PISA round, on average, since 2003), in Poland (+5.0 points every three years) and in Tunisia (+3.8 points every three years). In Hong Kong (China), Korea, Singapore, Chinese Taipei, Turkey and the United States, there was no significant improvement or deterioration in performance over the longer time period; in Australia and the Netherlands, the change between 2012 and 2015 is the most recent part of a deteriorating trend in performance over a longer period of time.

At any given point in time, some countries and economies perform similarly. But as time passes and school systems evolve, certain countries and economies improve their performance, pull ahead of the group of countries with which they shared similar performance levels, and catch up to another group of countries. Other countries and economies see a decline in their performance, and fall behind in rankings relative to other countries. Figure I.5.4 shows, for each country and economy, those other countries and economies with comparable results in mathematics in 2012, but whose performance differed in 2015, reflecting a faster, or slower, improvement or deterioration over time.

Figure I.5.5 shows the relationship between each country's and economy's average mathematics performance in PISA 2012 and their score difference between 2012 and 2015. Countries and economies whose performance declined during this period are found both among countries that performed above the OECD average in 2012, such as Korea, and among countries that had comparatively low performance in PISA 2012, such as Tunisia. Improvements are found among both low-performing countries (such as Peru) and among countries performing close to the OECD average (such as Denmark). The correlation between a country's/economy's mathematics score in PISA 2015 and its change in mathematics performance since 2012 is -0.4 – indicating a moderate, negative association.

Annex A5 discusses the extent to which changes in the scaling procedures, introduced for the first time in PISA 2015, influence the results of reported changes between PISA 2012 and PISA 2015. It shows that the negative changes between PISA 2012 and PISA 2015 reported for Chinese Taipei (-18 score points) and Viet Nam (-17 score points) are, to a large extent, due to the use of a different scaling approach in 2015; and that the reported change between PISA 2012 and PISA 2015 for Turkey (-28 score points) would have been -18 score points had all results been generated under a consistent scaling approach. Annex A5 also shows that the improvement between PISA 2012 and PISA 2015 in Albania's mean score in mathematics (+19 score points) would have been smaller and most likely be reported as not significant (+7 points) had all results been generated under a consistent scaling approach. All other differences between reported changes and those based on applying the PISA 2015 approach to scaling to previous PISA assessments are well within the confidence interval indicated for the reported changes.

But the question remains: to what extent do changes in the way the test is delivered (the test mode) influence the ability to monitor trends in mathematics? Great care was taken to ensure that trends would not be significantly affected by the shift from a paper- to a computer-based test. For instance, when developing a fully equivalent computer version for a paper-based task proved challenging because of interface issues, such as students' unfamiliarity with equation editors or drawing tools on computers, these tasks were treated as distinct in paper and computer modes, with mode-specific difficulty parameters. In this way, only tasks that proved fully equivalent across the two modes and on aggregate across countries (51 items in mathematics) were used to indicate improving or deteriorating performance over time (see Box I.2.3 in Chapter 2 and Annex A5 for further details on how the computer- and paper-based versions of the test are linked for the purpose of scaling results).

The estimation of mode-specific difficulty parameters for the remaining 30 items was based on strong evidence of mode differences at the international level. It did not take into account country-specific factors that may have affected the equivalence of computer- and paper-based tasks.[4] Box I.5.1 explores the extent to which changes in PISA performance between 2012 and 2015 are related to differences in familiarity with ICT tools across countries. It shows that the between-country variation in exposure to computers can account for only a limited fraction of the observed variation in trends.

Figure I.5.4 [Part 1/4] ■ **Multiple comparisons of mathematics performance between 2012 and 2015**

Comparison country/economy	Mathematics performance in 2012	Mathematics performance in 2015	Countries/economies with… ... similar performance in 2012 and in 2015	... similar performance in 2012, but higher performance in 2015	... similar performance in 2012, but lower performance in 2015
Singapore	573	564			
Hong Kong (China)	561	548	Chinese Taipei		Korea
Macao (China)	538	544			Japan
Chinese Taipei	560	542	Hong Kong (China)		Korea
Japan	536	532		Macao (China)	Switzerland
Korea	554	524		Hong Kong (China), Chinese Taipei	
Switzerland	531	521		Japan	Netherlands
Estonia	521	520	Canada		Netherlands, Finland, Poland, Viet Nam
Canada	518	516	Estonia, Netherlands, Finland		Belgium, Germany, Poland, Viet Nam
Netherlands	523	512	Canada, Finland	Switzerland, Estonia	Poland, Viet Nam
Denmark	500	511	Slovenia		Ireland, Austria, New Zealand, Australia, France, United Kingdom, Czech Republic
Finland	519	511	Canada, Netherlands, Belgium, Germany	Estonia	Poland, Viet Nam
Slovenia	501	510	Denmark		Ireland, Austria, New Zealand, Australia, Czech Republic
Belgium	515	507	Finland, Germany, Poland	Canada	Viet Nam
Germany	514	506	Finland, Belgium, Poland	Canada	Viet Nam
Poland	518	504	Belgium, Germany	Estonia, Canada, Netherlands, Finland	Viet Nam
Ireland	501	504	Viet Nam	Denmark, Slovenia	Austria, New Zealand, Australia, France, United Kingdom, Czech Republic
Norway	489	502			Russia, France, United Kingdom, Portugal, Italy, Iceland, Spain, Luxembourg, Latvia, Slovak Republic, United States
Austria	506	497	New Zealand, Viet Nam, Australia, Czech Republic	Denmark, Slovenia, Ireland	
New Zealand	500	495	Austria, Australia, France, United Kingdom, Czech Republic	Denmark, Slovenia, Ireland	
Viet Nam	511	495	Ireland, Austria, Australia	Estonia, Canada, Netherlands, Finland, Belgium, Germany, Poland	
Russia	482	494	Sweden, Portugal, Italy	Norway	Spain, Lithuania, Hungary, Slovak Republic, United States
Sweden	478	494	Russia		Lithuania, Hungary, Slovak Republic, United States, Croatia
Australia	504	494	Austria, New Zealand, Viet Nam, Czech Republic	Denmark, Slovenia, Ireland	
France	495	493	New Zealand, United Kingdom, Czech Republic, Portugal, Iceland	Denmark, Ireland, Norway	Luxembourg, Latvia
United Kingdom	494	492	New Zealand, France, Czech Republic, Portugal, Iceland	Denmark, Ireland, Norway	Luxembourg, Latvia
Czech Republic	499	492	Austria, New Zealand, Australia, France, United Kingdom, Iceland	Denmark, Slovenia, Ireland	

* See note 1 under Figure I.5.1.
Note: Only countries and economies with valid results for the PISA 2012 and PISA 2015 assessments are shown.
Countries and economies are ranked in descending order of mean mathematics performance in 2015.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432638

Figure I.5.4 [Part 2/4] ■ **Multiple comparisons of mathematics performance between 2012 and 2015**

Comparison country/economy	Mathematics performance in 2012	Mathematics performance in 2015	Countries/economies with… ... higher performance in 2012, but similar performance in 2015	... higher performance in 2012, but lower performance in 2015	... lower performance in 2012, but similar performance in 2015	... lower performance in 2012, but higher performance in 2015
Singapore	573	564				
Hong Kong (China)	561	548			Macao (China)	
Macao (China)	538	544	Hong Kong (China), Chinese Taipei	Korea		
Chinese Taipei	560	542			Macao (China)	
Japan	536	532	Korea			
Korea	554	524			Japan, Switzerland, Estonia, Canada	Macao (China)
Switzerland	531	521	Korea		Estonia, Canada	
Estonia	521	520	Korea, Switzerland			
Canada	518	516	Korea, Switzerland		Denmark	
Netherlands	523	512			Denmark, Slovenia, Belgium, Germany	
Denmark	500	511	Canada, Netherlands, Finland, Belgium, Germany	Poland, Viet Nam		
Finland	519	511			Denmark, Slovenia	
Slovenia	501	510	Netherlands, Finland, Belgium, Germany	Poland, Viet Nam		
Belgium	515	507	Netherlands		Denmark, Slovenia, Ireland, Norway	
Germany	514	506	Netherlands		Denmark, Slovenia, Ireland, Norway	
Poland	518	504			Ireland, Norway	Denmark, Slovenia
Ireland	501	504	Belgium, Germany, Poland		Norway	
Norway	489	502	Belgium, Germany, Poland, Ireland, Austria, Viet Nam	New Zealand, Australia, Czech Republic		
Austria	506	497			Norway, Russia, Sweden, France, United Kingdom, Portugal, Italy	
New Zealand	500	495	Viet Nam		Russia, Sweden, Portugal, Italy	Norway
Viet Nam	511	495			Norway, New Zealand, Russia, Sweden, France, United Kingdom, Czech Republic, Portugal, Italy, Iceland, Spain, Luxembourg	Denmark, Slovenia
Russia	482	494	Austria, New Zealand, Viet Nam, Australia, France, United Kingdom, Czech Republic, Iceland	Luxembourg, Latvia		
Sweden	478	494	Austria, New Zealand, Viet Nam, Australia, France, United Kingdom, Czech Republic, Portugal, Italy, Iceland	Spain, Luxembourg, Latvia		
Australia	504	494			Russia, Sweden, France, United Kingdom, Portugal, Italy	Norway
France	495	493	Austria, Viet Nam, Australia		Russia, Sweden, Italy	
United Kingdom	494	492	Austria, Viet Nam, Australia		Russia, Sweden, Italy	
Czech Republic	499	492	Viet Nam		Russia, Sweden, Portugal, Italy	Norway

* See note 1 under Figure I.5.1.
Note: Only countries and economies with valid results for the PISA 2012 and PISA 2015 assessments are shown.
Countries and economies are ranked in descending order of mean mathematics performance in 2015.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432638

Figure I.5.4 [Part 3/4] ▪ **Multiple comparisons of mathematics performance between 2012 and 2015**

Comparison country/economy	Mathematics performance in 2012	Mathematics performance in 2015	Countries/economies with… ... similar performance in 2012 and in 2015	... similar performance in 2012, but higher performance in 2015	... similar performance in 2012, but lower performance in 2015
Portugal	487	492	Russia, France, United Kingdom, Italy, Iceland, Spain	Norway	Luxembourg, Latvia, Lithuania, Slovak Republic, United States
Italy	485	490	Russia, Portugal, Spain	Norway	Latvia, Lithuania, Slovak Republic, United States
Iceland	493	488	France, United Kingdom, Czech Republic, Portugal, Luxembourg	Norway	Latvia
Spain	484	486	Portugal, Italy, Latvia	Norway, Russia	Lithuania, Hungary, Slovak Republic, United States
Luxembourg	490	486	Iceland, Latvia	Norway, France, United Kingdom, Portugal	
Latvia	491	482	Spain, Luxembourg	Norway, France, United Kingdom, Portugal, Italy, Iceland	
Lithuania	479	478	Hungary, Slovak Republic	Russia, Sweden, Portugal, Italy, Spain	United States, Croatia
Hungary	477	477	Lithuania, Slovak Republic, Israel, United States	Russia, Sweden, Spain	Croatia
Slovak Republic	482	475	Lithuania, Hungary, United States	Norway, Russia, Sweden, Portugal, Italy, Spain	
Israel	466	470	Hungary, Croatia		
United States	481	470	Hungary, Slovak Republic	Norway, Russia, Sweden, Portugal, Italy, Spain, Lithuania	
Croatia	471	464	Israel	Sweden, Lithuania, Hungary	
CABA (Argentina)	418	456			Chile, Uruguay, Montenegro, Thailand, Mexico, Costa Rica
Greece	453	454	Romania		Turkey
Romania	445	444	Greece, Bulgaria, Cyprus*		Turkey
Bulgaria	439	441	Romania, Cyprus*		United Arab Emirates, Turkey
Cyprus*	440	437	Romania, Bulgaria		Turkey
United Arab Emirates	434	427		Bulgaria	Thailand
Chile	423	423	Thailand	CABA (Argentina)	
Turkey	448	420		Greece, Romania, Bulgaria, Cyprus*	
Uruguay	409	418	Montenegro	CABA (Argentina)	Mexico, Costa Rica
Montenegro	410	418	Uruguay	CABA (Argentina)	Costa Rica
Thailand	427	415	Chile	CABA (Argentina), United Arab Emirates	
Albania	394	413			Tunisia
Mexico	413	408		CABA (Argentina), Uruguay	Costa Rica
Qatar	376	402			Colombia, Indonesia
Costa Rica	407	400		CABA (Argentina), Uruguay, Montenegro, Mexico	
Colombia	376	390	Peru, Indonesia	Qatar	
Peru	368	387	Colombia, Indonesia		
Indonesia	375	386	Colombia, Peru	Qatar	
Jordan	386	380	Brazil		Tunisia
Brazil	389	377	Jordan		Tunisia
Tunisia	388	367		Albania, Jordan, Brazil	

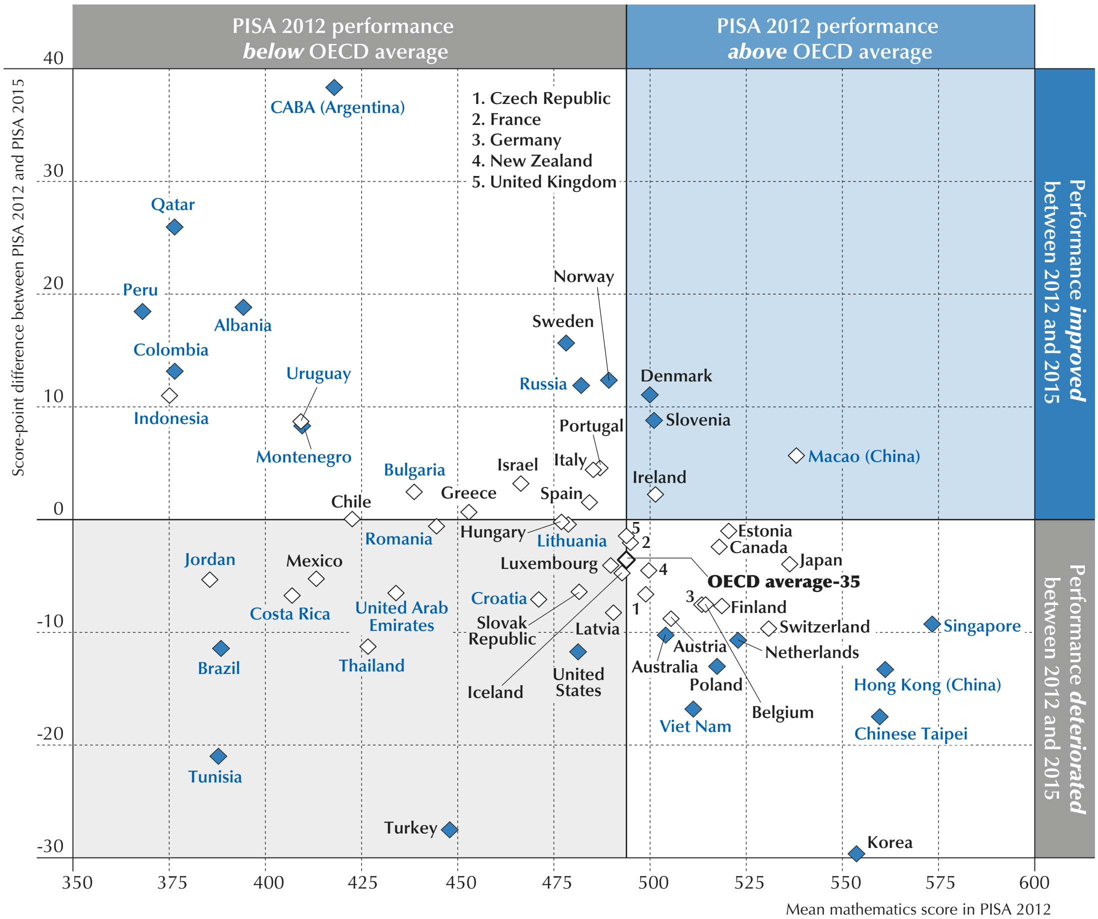
* See note 1 under Figure I.5.1.
Note: Only countries and economies with valid results for the PISA 2012 and PISA 2015 assessments are shown.
Countries and economies are ranked in descending order of mean mathematics performance in 2015.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432638

Figure I.5.4 [Part 4/4] ■ Multiple comparisons of mathematics performance between 2012 and 2015

Comparison country/economy	Mathematics performance in 2012	Mathematics performance in 2015	Countries/economies with… ... higher performance in 2012, but similar performance in 2015	... higher performance in 2012, but lower performance in 2015	... lower performance in 2012, but similar performance in 2015	... lower performance in 2012, but higher performance in 2015
Portugal	487	492	Austria, New Zealand, Viet Nam, Australia, Czech Republic		Sweden	
Italy	485	490	Austria, New Zealand, Viet Nam, Australia, France, United Kingdom, Czech Republic, Iceland, Luxembourg		Sweden	
Iceland	493	488	Viet Nam		Russia, Sweden, Italy, Spain	
Spain	484	486	Viet Nam, Iceland, Luxembourg			Sweden
Luxembourg	490	486	Viet Nam		Italy, Spain	Russia, Sweden
Latvia	491	482			Lithuania, Hungary	Russia, Sweden
Lithuania	479	478	Latvia			
Hungary	477	477	Latvia			
Slovak Republic	482	475			Israel	
Israel	466	470	Slovak Republic, United States		CABA (Argentina)	
United States	481	470			Israel, Croatia, CABA (Argentina)	
Croatia	471	464	United States		CABA (Argentina)	
CABA (Argentina)	418	456	Israel, United States, Croatia, Greece, Romania, Bulgaria	Cyprus*, United Arab Emirates, Turkey		
Greece	453	454			CABA (Argentina)	
Romania	445	444			CABA (Argentina)	
Bulgaria	439	441			CABA (Argentina)	
Cyprus*	440	437				CABA (Argentina)
United Arab Emirates	434	427	Turkey		Chile	CABA (Argentina)
Chile	423	423	United Arab Emirates, Turkey		Uruguay, Montenegro	
Turkey	448	420			United Arab Emirates, Chile, Uruguay, Montenegro, Thailand, Albania	CABA (Argentina)
Uruguay	409	418	Chile, Turkey, Thailand		Albania	
Montenegro	410	418	Chile, Turkey, Thailand	Mexico	Albania	
Thailand	427	415	Turkey		Uruguay, Montenegro, Albania	
Albania	394	413	Turkey, Uruguay, Montenegro, Thailand, Mexico	Costa Rica		
Mexico	413	408			Albania	Montenegro
Qatar	376	402	Costa Rica	Jordan, Brazil, Tunisia		
Costa Rica	407	400			Qatar	Albania
Colombia	376	390		Jordan, Brazil, Tunisia		
Peru	368	387	Jordan	Brazil, Tunisia		
Indonesia	375	386	Jordan	Brazil, Tunisia		
Jordan	386	380			Peru, Indonesia	Qatar, Colombia
Brazil	389	377				Qatar, Colombia, Peru, Indonesia
Tunisia	388	367				Qatar, Colombia, Peru, Indonesia

* See note 1 under Figure I.5.1.
Note: Only countries and economies with valid results for the PISA 2012 and PISA 2015 assessments are shown.
Countries and economies are ranked in descending order of mean mathematics performance in 2015.
Source: OECD, PISA 2015 Database.
StatLink http://dx.doi.org/10.1787/888933432638

Figure I.5.5 ▪ **Relationship between change in mathematics performance and average PISA 2012 mathematics scores**



Notes: Score-point difference in mathematics between PISA 2012 and PISA 2015 that are statistically significant are indicated in a darker tone (see Annex A3).
The correlation between a country's/economy's mean score in 2012 and its change is -0.4.
Only countries and economies with valid results for the PISA 2012 and PISA 2015 assessments are shown.
Source: OECD, PISA 2015 Database, Table I.5.4a.
StatLink http://dx.doi.org/10.1787/888933432646

Box I.5.1 **Between-country differences in students' exposure to computers and changes in mean performance between 2012 and 2015**

Despite the attention given to ensuring comparability of test results across modes, it was not possible – nor desired – to adjust the scaling of results to take country differences in familiarity with computer tools, or in student motivation to take the PISA test on computer, into account. Indeed, PISA aims to measure student performance in different countries against a common, but evolving, benchmark – one that includes the ability to use today's tools for solving problems in the different subjects assessed.

But is there any evidence that changes in a country's/economy's mean score reflect differences across countries/economies in students' familiarity with ICT?

The field trial for PISA 2015 provides a partial, negative answer to this question: in no country/economy that participated in the mode-effect study did the difference between students' results on the computer- and paper-based tests deviate significantly from the average between-country difference, which was set to zero in the scaled results (see Annex A6).

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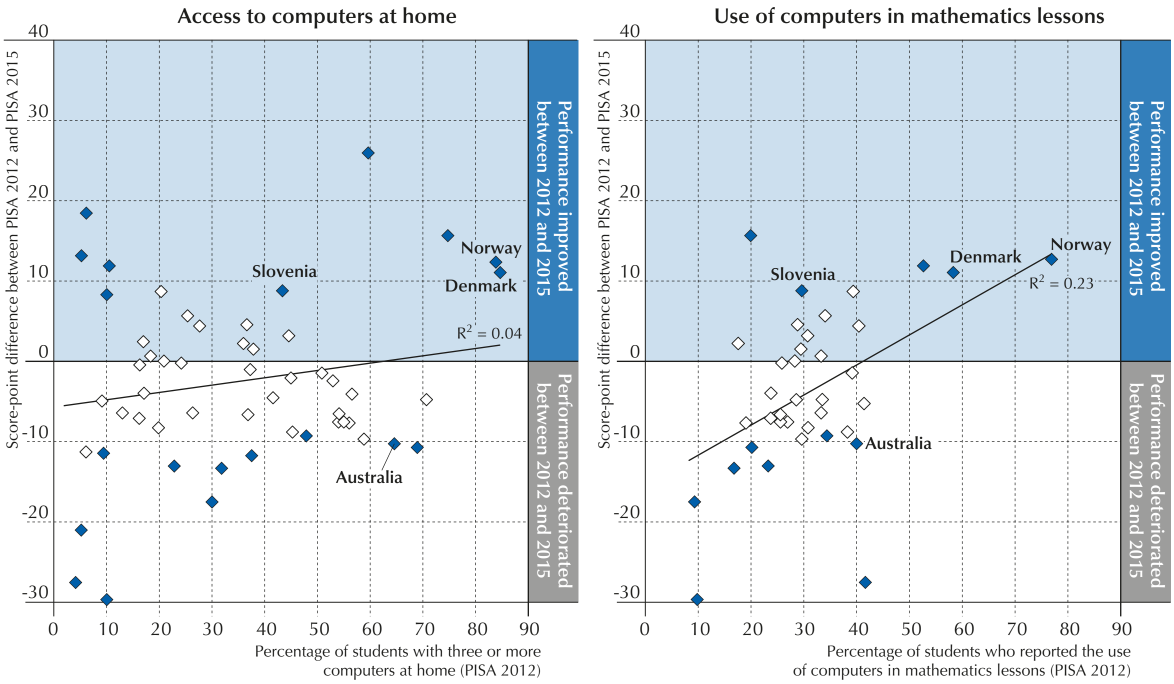
However, because the national field-trial samples were small, only large differences in performance between students who were given the computer-based version of the test and an equivalent group of students, selected through random assignment, who were given the paper-based version of the test could be detected. It was not possible to rule out small and moderate effects of the mode of delivery on the mean performance of countries/economies.

Correlational analyses corroborate the conclusion that changes in the mode of delivery are, at best, only a partial explanation for changes in performance between PISA 2012 and PISA 2015 that are observed in countries that conducted the 2012 test on paper and the 2015 test on computer. Figure I.5.6 shows shows the relationship between a simple indicator of familiarity with ICT that is available for all countries participating in PISA 2012 (the share of students who reported, in PISA 2012, having "three or more" computers in their homes; on average across OECD countries, 43% of students so reported) and the difference in mathematics performance between the PISA 2012 and the PISA 2015 assessments, for countries that conducted PISA 2015 on computer. Across all countries and economies, greater exposure to ICT devices in the home explains, at best, only 4% of the variation in the difference between PISA 2012 and 2015 scores (correlation: 0.21).[1] After excluding two countries that show both greater exposure and significant and positive trends (Denmark and Norway), the correlation between these two measures is only 0.10 across the remaining countries/economies. This means that in Denmark and Norway, students' greater familiarity with ICT (or, perhaps, greater motivation to take a test delivered on computer rather than one delivered on paper) could be part of the observed improvement in performance.

Figure I.5.6 ▪ **Relationship between change in mathematics performance and students' exposure to computers in 2012**



Notes: Score-point differences in mathematics between PISA 2012 and PISA 2015 that are statistically significant are indicated in a darker tone (see Annex A3).

Only countries and economies with available data since 2012 and who conducted the PISA 2015 test on computer are shown.

Sources: OECD, PISA 2012 Database, Tables 1.1 and 2.5 from OECD (2015), *Students, Computers and Learning: Making the Connection,* PISA, OECD Publishing.

OECD, PISA 2015 Database, Table I.5.4.

StatLink http://dx.doi.org/10.1787/888933432654

...

But in general, countries where students have greater familiarity with ICT tools are almost equally likely to observe positive and negative trends, as are countries where students have less familiarity with ICT.

For 38 countries and economies, a more specific indicator of familiarity with ICT tools for mathematics is also available, through the optional ICT questionnaire for students that was distributed in PISA 2012. Students were asked to report whether they use computers during mathematics lessons for specific tasks, such as drawing the graph of a function or calculating with numbers. The share of students who reported doing at least one of these tasks on computer during mathematics lessons in the month prior to the PISA 2012 test correlates positively with the difference in mathematics performance between PISA 2012 and PISA 2015 in these 38 countries and economies (correlation 0.48). But clearly, not all changes in performance can be explained by the use of ICT tools in mathematics lessons. An improvement in mathematics performance was observed in Slovenia, for instance, despite the fact that students reported only average levels of familiarity with ICT in the PISA 2012 survey. In Australia, a negative trend in performance between PISA 2012 and PISA 2015 was observed despite the fact that students in 2012 reported frequent use of ICT tools in mathematics lessons.

Another 30 countries and economies can also compare changes in performance between 2012 and 2015 with the difference in mean performance between the main, paper-based assessment of mathematics conducted in 2012, and an optional, computer-based assessment of mathematics. This second test was conducted among some of the same students who also sat the paper-based PISA test, often in the afternoon of the main testing day. Results were reported on the same mathematics scale as the results of the paper-based test (OECD, 2015b). The PISA 2015 mathematics test (both in its computer-based and in its paper-based versions) used only items that were developed originally for the paper-based test; it is therefore closer, in terms of the questions asked and in timing (as part of the main, two-hour test session) to the PISA 2012 paper-based test, even though it was conducted on computer.

The correlation of changes in mean mathematics performance between 2012 and 2015 with differences between the computer-based and the paper-based mathematics performance in 2012 is only 0.18 – signalling a weak association. This may imply that the aspects that are unique to the PISA 2012 computer-based assessment (the inclusion of items that explicitly measure students' ability to use ICT tools for solving mathematics problems, and when the test was conducted) explain a bigger part of the performance differences in 2012 than how the test was delivered. It may also imply that changes in performance between 2012 and 2015 largely reflect other factors than the mode of delivery, such as changes in student proficiency, or the sampling variability and scaling changes that contribute to the uncertainty associated with trend estimates (the sampling error and link error; see Annex A5).

1. Changes in mean mathematics performance are even less correlated with other indicators of access to computers at home. The correlation is only 0.17 with the share of students in 2012 who reported having "two or more computers" at home, and close to 0 (0.05) with the share of students in 2012 who reported having "one or more computer" at home.

Changes in mathematics performance between 2012 and 2015, after accounting for changes in enrolment rates and demographic factors

Changes in performance over a short period of time may also be due to rapid demographic changes that shift the profile of the country's/economy's population. For example, because of trends in enrolment rates or migration, the characteristics of the PISA reference population – 15-year-olds enrolled in school – may have changed between PISA 2012 and PISA 2015. Adjusted changes shed light on differences in mathematics performance that are not due to alterations in the demographic characteristics of the student population or the sample. Annex A5 provides details on how these figures are estimated.

Table I.5.4d presents the change in mathematics performance between PISA 2012 and PISA 2015 at the median and at the top of the performance distribution among all 15-year-olds – assuming that 15-year-olds who are not represented in the PISA sample would have performed among the weakest 50%, had they been assessed. The difference between observed and adjusted trends, in these cases, reflects changes in the percentage of 15-year-olds that the PISA sample represents.

Among the countries and economies where the PISA sample covers less than 80% of the population of 15-year-olds (Coverage index 3; see Chapter 6 for a detailed discussion), and that have comparable data for PISA 2012 and PISA 2015, the coverage of the PISA sample grew by more than 10 percentage points in Costa Rica and Colombia, and by about 5 percentage points in Indonesia (see Table I.6.1 and the related discussion in Chapter 6). Table I.5.4d shows that in Colombia, the level at which at least 50% of all 15-year-olds perform (adjusted median) improved by more than 20 score points over the reported improvement in mean performance.

Significant improvements in the scores corresponding to the (adjusted) 75th and 90th percentiles, but not at the median, were also observed in Indonesia. The mathematics score attained by at least a quarter of the country's 15-year-olds increased by about 20 points, while coverage increased by about 5 percentage points between 2012 and 2015. In Costa Rica, average performance declined (not significantly) in 2015, but the PISA 2015 sample covered a larger proportion of the 15-year-old population than the PISA 2012 sample did. It is not possible to estimate whether the median score for 15-year-olds improved, because less than 50% of 15-year-olds were covered in 2012. But the adjusted change observed at the 75th percentile indicates that the mathematics score attained by at least one in four 15-year-olds rose by about 14 points during the period (Table I.2.4d).

Table I.5.4e presents an estimate of the change in mean performance between PISA 2015 and prior assessments that would have been observed had the proportion of immigrants, the share of girls, and the age distribution of students in the PISA sample stayed constant across assessments. In some countries, the demographics of the student population have changed considerably in recent years. In these countries, the adjusted changes and trends may differ from the observed changes and trends reported in previous sections. If countries and economies observe a more negative change than the adjusted change reported here, that means that concurrent shifts in the student population have had adverse effects on performance. Conversely, if a country's observed change is more positive than the adjusted change reported here, it means that concurrent shifts in the student population contributed to improvements in the mean level of performance. While the observed levels of performance measure the overall quality of education in a school system, the comparison of the observed trends with the hypothetical, adjusted trends can highlight the challenges that countries and economies face in improving students' and schools' performance in mathematics.

Over the most recent period covered by PISA (2012 to 2015), few countries saw large demographic shifts in the population of 15-year-olds; as a result, for most countries/economies, adjusted changes in mean scores for this period closely track observed changes. The largest differences between adjusted and observed changes are found in Switzerland[5] and Qatar. In Switzerland, the reported change is negative, although not significant (-10 points); but had there been no demographic shifts in the PISA sample, the change would have been closer to zero (-5 points). The reverse is found for Qatar, where the observed change is larger (a 26-point increase) than the adjusted change (21 points), indicating that changes in the student population in Qatar contributed to improvements in the mean level of performance.

STUDENTS AT THE DIFFERENT LEVELS OF MATHEMATICS PROFICIENCY

The six proficiency levels used in the PISA 2015 mathematics assessment are the same as those established for the PISA 2003 and 2012 assessments, when mathematics was the major area of assessment. The process used to produce proficiency levels in mathematics is similar to that used to produce proficiency levels in science, as described in Chapter 2. Figure I.5.7 presents a description of the mathematical skills, knowledge and understanding that are required at each level of the mathematics scale.

Since it is necessary to preserve the confidentiality of the test material in order to continue to monitor trends in mathematics beyond 2015, no question used in the PISA 2015 assessment of mathematics was released after the assessment. However, because PISA 2015 used questions from previous mathematics assessments, it is possible to illustrate the proficiency levels with test materials that were released after previous assessments. Sample items that illustrate the different levels of mathematics proficiency can be found in the PISA 2012 initial report (OECD, 2014) and on line at www.oecd.org/pisa.

Figure I.5.8 shows the distribution of students across the six proficiency levels in each participating country and economy. Table I.5.1a shows the percentage of students at each proficiency level on the mathematics scale, with standard errors.

Figure I.5.7 ■ **Summary description of the six levels of mathematics proficiency in PISA 2015**

Level	Lower score limit	Characteristics of tasks
6	669	At Level 6, students can conceptualise, generalise and utilise information based on their investigations and modelling of complex problem situations, and can use their knowledge in relatively non-standard contexts. They can link different information sources and representations and flexibly translate among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for attacking novel situations. Students at this level can reflect on their actions, and can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments, and the appropriateness of these to the original situation.
5	607	At Level 5, students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterisations, and insight pertaining to these situations. They begin to reflect on their work and can formulate and communicate their interpretations and reasoning.
4	545	At Level 4, students can work effectively with explicit models for complex, concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic, linking them directly to aspects of real-world situations. Students at this level can utilise their limited range of skills and can reason with some insight, in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments and actions.
3	482	At Level 3, students can execute clearly described procedures, including those that require sequential decisions. Their interpretations are sufficiently sound to be a base for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships. Their solutions reflect that they have engaged in basic interpretation and reasoning.
2	420	At Level 2, students can interpret and recognise situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures or conventions to solve problems involving whole numbers. They are capable of making literal interpretations of the results.
1	358	At Level 1, students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are almost always obvious and follow immediately from the given stimuli.

Proficiency above the baseline

Proficiency at Level 2 (score higher than 420 but lower than 482 points)

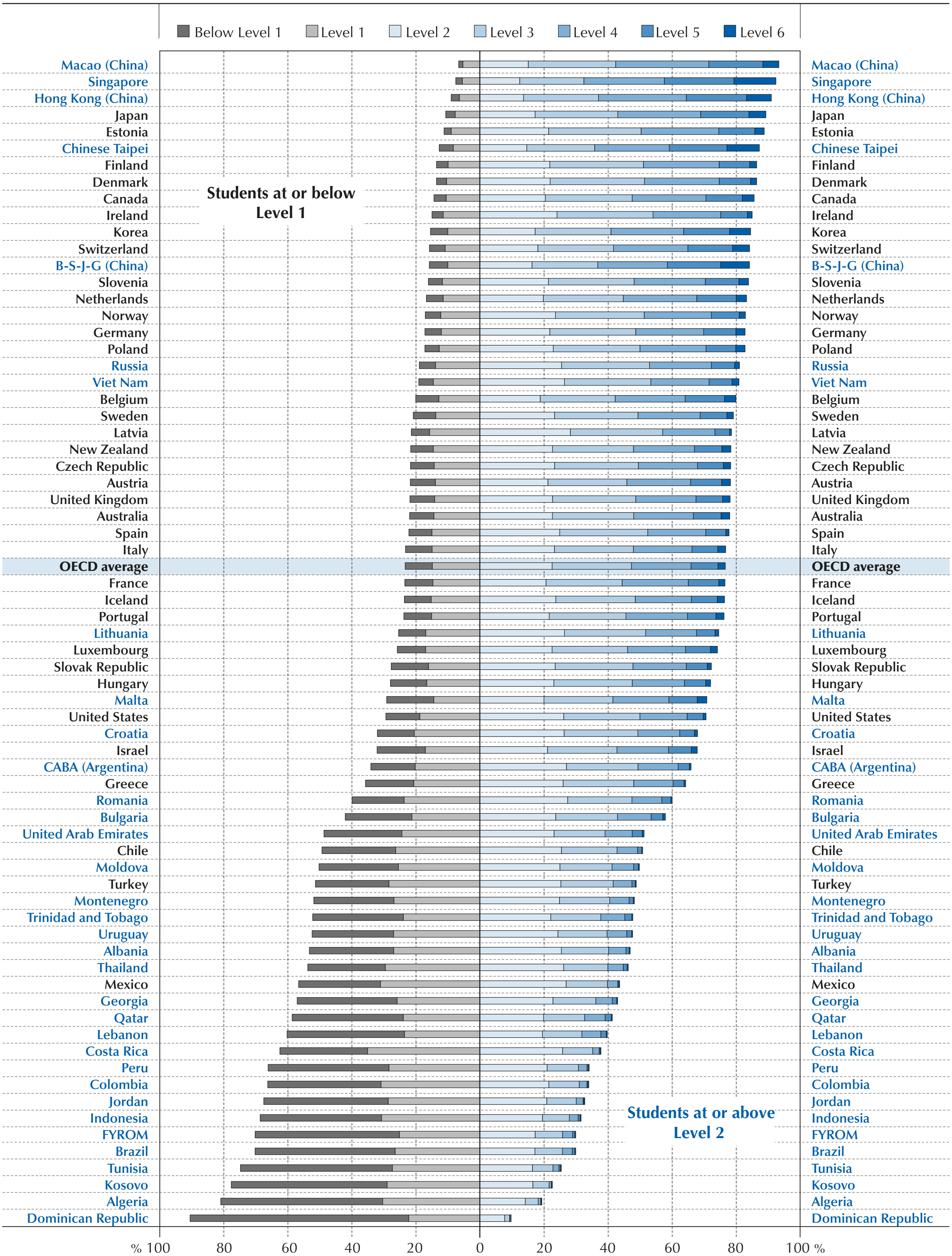
At Level 2, students can use basic algorithms, formulae, procedures or conventions to solve problems involving whole numbers – e.g. to compute the approximate price of an object in a different currency or to compare the total distance across two alternative routes. They can interpret and recognise situations in contexts that require no more than direct inference, extract relevant information from a single source and make use of a single representational mode. Students at this level are capable of making literal interpretations of the results.

Level 2 can be considered a baseline level of proficiency that is required to participate fully in modern society. More than 90% of students in Hong Kong (China), Macao (China) and Singapore meet this benchmark. On average across OECD countries, 77% of students attain Level 2 or higher. More than one in two students perform at these levels in all OECD countries except Turkey (48.6%) and Mexico (43.4%) (Figure I.5.8 and Table I.5.1a). Meanwhile, fewer than one in ten students in the Dominican Republic (9.5%), and only 19.0% of students in Algeria attain this baseline level of mathematics proficiency.

Proficiency at Level 3 (score higher than 482 but lower than 545 points)

At Level 3, students can execute clearly described procedures, including those that require sequential decisions. They typically show some ability to handle percentages, fractions and decimal numbers, and to work with proportional relationships. Their interpretations are sufficiently sound to be the basis for building a simple model or for selecting and applying simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. Their solutions reflect that they have engaged in basic interpretation and reasoning.

Figure I.5.8 ■ **Student proficiency in mathematics**



Countries and economies are ranked in descending order of the percentage of students who perform at or above Level 2.
Source: OECD, PISA 2015 Database, Table I.5.1a.
StatLink http://dx.doi.org/10.1787/888933432665

Across OECD countries, 54% of students are proficient at Level 3 or higher (that is, proficient at Level 3, 4, 5 or 6). In Hong Kong (China), Japan, Macao (China), Singapore and Chinese Taipei, more than 70% of students are proficient at Level 3 or higher, and at least two out of three students in B-S-J-G (China), Estonia and Korea attain this level. In contrast, in 21 countries and economies with comparable data, three out of four students do not attain this level; and in Algeria, the Dominican Republic, Kosovo and Tunisia, more than 90% of students do not attain Level 3 (Figure I.5.8 and Table I.5.1a).

Proficiency at Level 4 (score higher than 545 but lower than 607 points)

At Level 4, students can work effectively with explicit models on complex, concrete situations that may involve constraints or call for making assumptions. They can select and integrate different representations, including symbolic representations, linking them directly to aspects of real-world situations. Students at this level can reason with some insight, in straightforward contexts. They can construct and communicate explanations and arguments based on their interpretations, reasoning and actions.

Across OECD countries, 29.3% of students perform at proficiency Level 4, 5 or 6. More than one in two students in Hong Kong (China), Macao (China), Singapore and Chinese Taipei perform at one of these levels. Between 40% and 50% of students perform at or above Level 4 in B-S-J-G (China) (47.4%), Japan (46.3%), Korea (43.6%) and Switzerland (42.5%). By contrast, in 22 participating countries and economies with comparable data, fewer than one in ten students attains this levels – including OECD countries Chile (7.8%), Turkey (7.0%) and Mexico (3.5%) (Figure I.5.8 and Table I.5.1a).

Proficiency at Level 5 (score higher than 607 but lower than 669 points)

At Level 5, students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterisations, and insights pertaining to these situations. They have begun to develop the ability to reflect on their work and to communicate conclusions and interpretations in written form.

Across OECD countries, 10.7% of students are top performers, meaning that they are proficient at Level 5 or 6. Among all countries and economies that participated in PISA 2015, the partner country Singapore has the largest proportion of top performers (34.8%), followed by Chinese Taipei (28.1%), Hong Kong (China) (26.5%) and B-S-J-G (China) (25.6%). Overall, in 29 countries and economies, more than 10% of students are top performers, in 12 countries/economies, between 5% and 10% of students are top performers, in 17 countries/economies, between 1% and 5% of students perform at these levels, and in 12 countries/economies – including OECD country Mexico – less than 1% of students performs at Level 5 or above.

Countries with similar mean performance may have significantly different shares of students who are able to perform at the highest levels in PISA. This is true, for example, in Switzerland (mean performance: 521 points; 19.2% of students are top performers) and Estonia (mean performance: 520 points; 14.2% of students are top performers); in Latvia (mean performance: 482 points; 5.2% of students are top performers) and Malta (mean performance: 479 score points; 11.8% of students are top performers); and in the United States (mean performance: 470 points; 5.9% top performers) and Israel (mean performance: 470 points; 8.9% of students are top performers) (Figure I.5.8 and Table I.5.1a).

Proficiency at Level 6 (score higher than 669 points)

Students at Level 6 on the PISA mathematics scale can successfully complete the most difficult PISA items. At Level 6, students can conceptualise, generalise and use information based on their investigations and modelling of complex problem situations, and can use their knowledge in relatively non-standard contexts. They can link different information sources and representations and move flexibly among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply this insight and understanding, along with a mastery of symbolic and formal mathematical operations and relationships, to develop new approaches and strategies for addressing novel situations. Students at this level can reflect on their actions, can formulate and precisely communicate their actions and reflections regarding their findings, interpretations and arguments, and can explain why they were applied to the original situation.

On average across OECD countries, only 2.3% of students attain Level 6. More than one in ten students perform at this level in Singapore (13.1%) and Chinese Taipei (10.1%). In B-S-J-G (China), Hong Kong (China), Japan Korea and Switzerland, between 5% and 10% of students attain proficiency Level 6. In 30 participating countries and economies, between 1% and 5% of students perform at this level, in 21 countries/economies, between 0.1% and 1% of students performs at Level 6, and in 12 other countries/economies, fewer than one in one thousand students (0.1%) performs at Level 6 (Figure I.5.8 and Table I.5.1a).

Proficiency below the baseline

Proficiency at Level 1 (score higher than 358 but lower than 420 points) or below

At Level 1 students can answer mathematics questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are almost always obvious and follow immediately from the given stimuli.

Students below Level 1 may be able to perform direct and straightforward mathematical tasks, such as reading a single value from a well-labelled chart or table where the labels on the chart match the words in the stimulus and question, so that the selection criteria are clear and the relationship between the chart and the aspects of the context depicted are evident. They can perform, at best, only simple arithmetic calculations with whole numbers by following clear and well-defined instructions.

On average across OECD countries, 23.4% of students are proficient only at or below Level 1. In Macao (China) (6.6%), Singapore (7.6%) and Hong Kong (China) (9.0%), less than 10% of students perform at or below Level 1 (Figure I.5.8 and Table I.5.1a). By contrast, in the Dominican Republic (68.3%) and Algeria (50.6%), more than one in two students score below Level 1, the lowest level of proficiency in PISA. In 17 participating countries and economies, between 25% and 50% of students do not reach Level 1 on the mathematics scale.

All PISA-participating countries and economies have students who score at or below Level 1; but the largest proportions of students who score at these levels are found in the lowest-performing countries. In some cases, countries with similar mean performance may have significantly different shares of students who score below the baseline level in mathematics. For example, in B-S-J-G (China), whose mean performance is 531 score points, 15.8% of students score at these levels, while in Japan, whose mean performance is 532 points, 10.7% of students perform at these levels. And while mean performance in Chinese Taipei (542 points) is similar to that of Macao (China) (544 points), the percentage of low achievers in Chinese Taipei (12.7%) is about twice that of Macao (China) (6.6%).

Trends in the percentage of low performers and top performers in mathematics

PISA's mathematics assessments gauge the extent to which students towards the end of compulsory schooling have acquired the mathematical skills and knowledge that enable them to engage with problems and situations encountered in daily life, including in professional contexts that require some level of understanding of mathematics, mathematical reasoning and mathematical tools. These range from basic notions of mathematics and the straightforward application of familiar procedures (related to proficiency Level 2) to complex skills that only a few students have mastered, such as the ability to formulate complex situations mathematically, using symbolic representations (proficiency Level 5 and above).

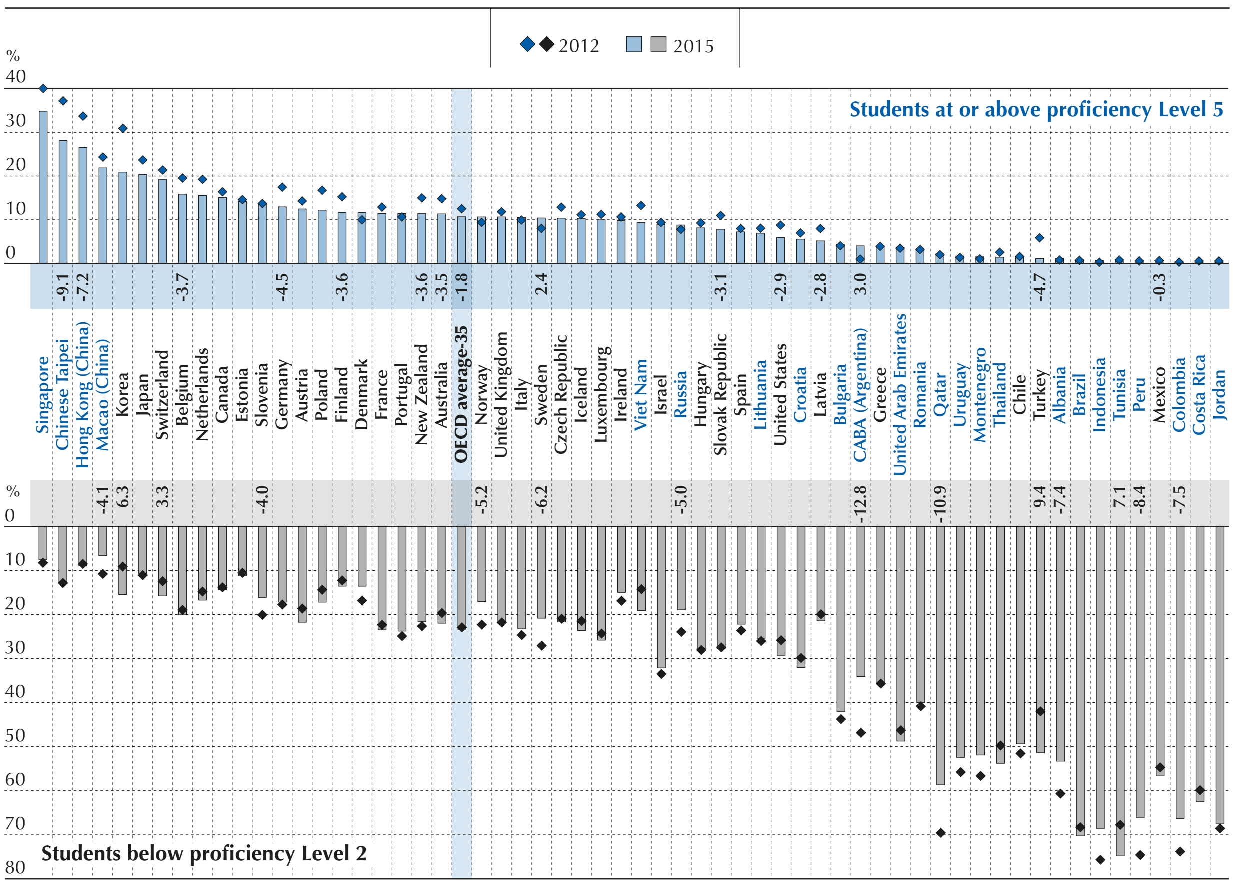
Changes in a country's or economy's average performance can result from changes at different levels of the performance distribution. For example, for some countries and economies, average improvement stems from improvements among low-achieving students, where the share of students scoring below Level 2 is reduced. In other countries and economies, average improvement mostly reflects changes among high-achieving students, where the share of students who perform at or above Level 5 grows. On average across OECD countries with comparable data, between 2012 and 2015 there was no significant change in the share of students who do not attain the baseline level of proficiency in mathematics, but the share of students who score at or above proficiency Level 5 shrank by 1.8 percentage points (Figure I.5.9 and Table I.5.2a).

Countries and economies can be grouped into categories according to whether, between PISA 2012 and PISA 2015, they have: simultaneously reduced the share of low performers and increased the share of top performers in mathematics; reduced the share of low performers but not increased the share of top performers; increased the share of top performers but not reduced the share of low performers; and reduced the share of top performers or increased the share of low performers. The following section categorises countries and economies into these groups.[6] But most countries/economies are not included in any of these groups: they had no significant change in the percentage of top performers or in the percentage of low performers.

Moving everyone up: Reduction in the share of low performers and increase in that of top performers

Between the PISA 2012 and PISA 2015 assessments, CABA (Argentina) and Sweden saw an increase in the share of students who attain the highest levels of proficiency in PISA and a simultaneous decrease in the share of students who do not attain the baseline level of proficiency. In Sweden, for example, the share of students performing below Level 2 shrank by six percentage points (from 27% to 21%) between 2012 and 2015, while the share of students performing at or above proficiency Level 5 grew by more than two percentage points (from 8.0% to 10.4%) (Figure I.5.9 and Table I.5.2a). The system-wide improvements observed in these countries and economies have lifted students out of low performance and others into top performance.

Figure I.5.9 ■ **Percentage of low-achieving students and top performers in mathematics in 2012 and 2015**



Notes: Only countries/economies that participated in both PISA 2012 and 2015 are shown.

The change between PISA 2012 and PISA 2015 in the share of students performing below Level 2 in mathematics is shown below the country/economy name. The change between PISA 2012 and PISA 2015 in the share of students performing at or above Level 5 in mathematics is shown above the country/economy name.

Only statistically significant changes are shown (see Annex A3).

Countries and economies are ranked in descending order of the percentage of students performing at or above Level 5 in 2015.

Source: OECD, PISA 2015 Database, Table I.5.2a.

StatLink http://dx.doi.org/10.1787/888933432672

Another way to assess countries' and economies' success in "moving everyone up" is to compare the change in performance at different percentiles of the performance distribution (Table I.5.4b). Five countries and economies show positive and significant changes in performance at the 10th percentile, i.e. the minimum level achieved by at least 90% of their students, at the median (the minimum level achieved by at least 50% of their students) and at the 90th percentile. Table I.5.4b shows that, consistent with trends in the share of low- and top-performing students, in Sweden and CABA (Argentina), an average improvement in performance between 2012 and 2015 can be observed at all levels of the distribution – among the lowest-achieving students (those whose performance is around the 10th percentile of

performance), among the students who perform around the median, and among the highest-achieving students (those who score around the 90th percentile). Albania, Qatar and Peru also moved towards higher performance across the board during the same period. But in these countries, more than one in two students still perform below Level 2 – a clear sign that much remains to be done to equip all students with the baseline skills needed for full participation in society and the economy. By international benchmarks, these countries belong to the next category ("reducing underperformance").

Reducing underperformance: Reduction in the share of low performers but no change in that of top performers

In Albania, Colombia, Macao (China), Norway, Peru, Qatar, Russia and Slovenia, the change in mathematics performance between 2012 and 2015 was largest among the students who did not attain the baseline level of proficiency. These countries/economies have been successful in reducing underperformance among their students, but without seeing a concurrent increase in the share of students who reach the highest levels of proficiency (Figure I.5.9).

Tables I.5.4b and I.5.4c show that Norway not only saw an improvement in the minimum proficiency achieved by at least 90% of its students (10th percentile), but also significantly reduced the distance between its highest- and lowest-performing students (the interdecile range, or the distance between the 10th and the 90th percentile). Macao (China) also narrowed the gap between the highest and lowest achievers in mathematics, but in this case, the significant improvement in performance at the bottom of the distribution was accompanied by a significant decline among students at the 90th percentile.

Nurturing top performance: Increase in the share of top performers but no change in that of low performers

No country/economy saw growth in the share of its top-performing students in mathematics since PISA 2012 without a concurrent reduction in the share of low-performing students (Figure I.5.9 and Table I.5.2a). When considering changes in percentiles, Table I.5.4b shows that in Indonesia and Montenegro, significant improvements in performance were concentrated among the highest-achieving students. Both countries saw the gap between the two extremes in performance widen because students at the 90th percentile of the performance distribution improved more than students at the 10th percentile did (Table I.5.4c). In these two countries, students at the 90th percentile remain relatively low achieving, by international standards. In Montenegro, the 90th percentile of performance is within the range of Level 3, and in Indonesia, it is even lower, and less than 10% of students perform at Level 3 or above.

Increase in the share of low performers and/or decrease in that of top performers

By contrast, in 16 countries and economies, the percentage of students who do not attain the baseline level of proficiency in mathematics increased since 2012, or the share of students who perform at the highest levels of proficiency shrank (Figure I.5.9 and Table I.5.2a). Both trends are observed in Korea and Turkey.

Korea and Turkey, together with Australia, are also the only three countries in which performance deteriorated significantly between 2012 and 2015, among both the lowest- and highest-achieving students. In Australia and Korea, the magnitude of the change at the top and at the bottom was similar, and the gap between the two extremes did not widen or narrow significantly. By contrast, in Turkey, the decline in performance was larger at the top (90th percentile) than at the bottom (10th percentile) (Table I.5.4c).

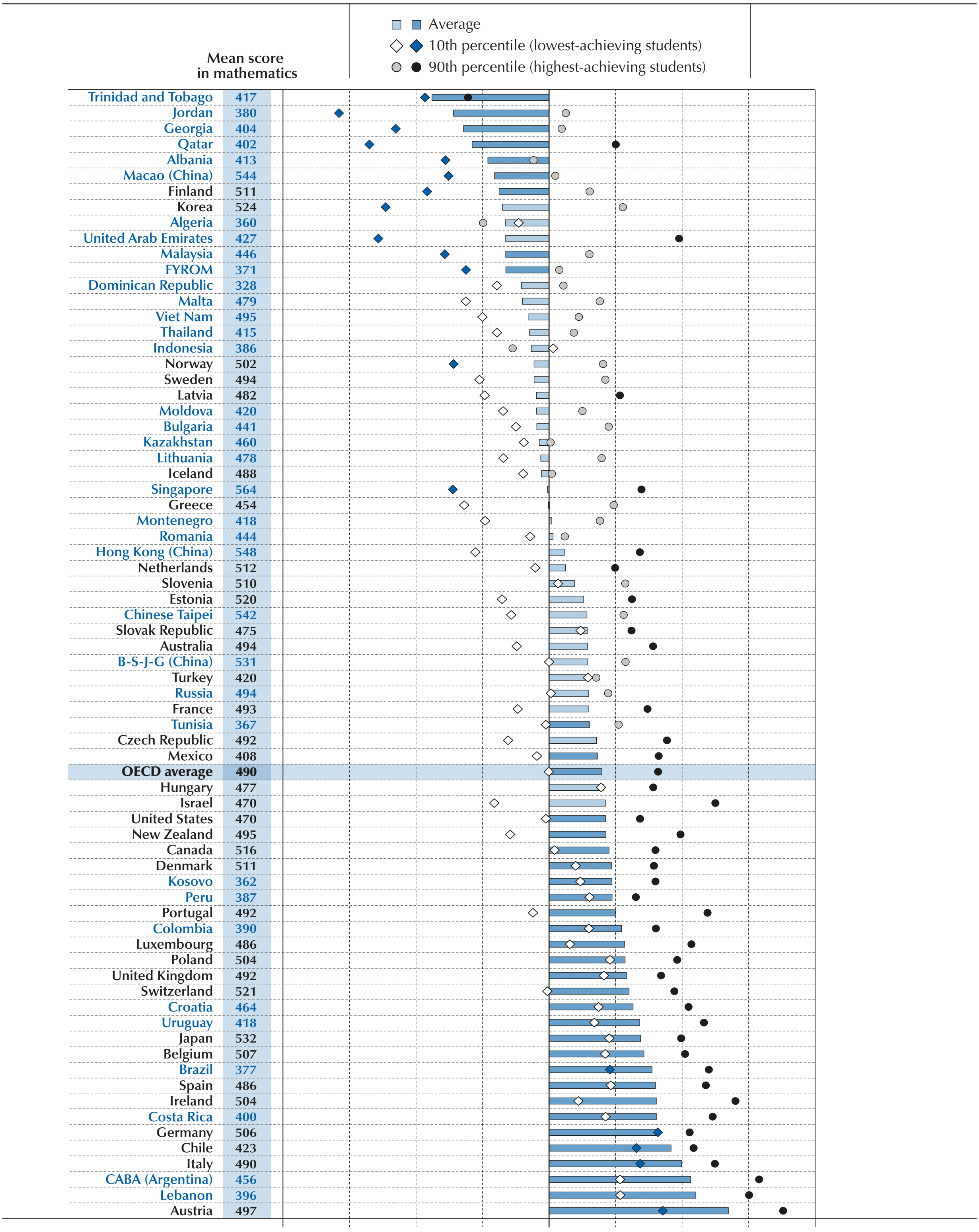
Gender differences in mathematics performance

Figure I.5.10 presents a summary of boys' and girls' performance in the PISA mathematics assessment (Table I.5.7). On average across OECD countries, boys outperform girls in mathematics by eight score points. Boys' advantage at the mean is statistically significant in 28 countries and economies, and is largest in Austria, Brazil, CABA (Argentina), Chile, Costa Rica, Germany, Ireland, Italy, Lebanon and Spain, where boys' average score exceeds girls' by more than 15 points. It is noteworthy that none of the high-performing Asian countries and economies is among this group. In fact, in nine countries and economies, including top performers Finland and Macao (China), as well as Albania, the Former Yugoslav Republic of Macedonia (hereafter "FYROM"), Georgia, Jordan, Malaysia, Qatar and Trinidad and Tobago, girls score higher than boys in mathematics, on average.

PISA has consistently found that boys perform better than girls in mathematics among the highest-achieving students and, as a result, there are more boys than girls who perform at Level 5 or above on the mathematics scale (OECD, 2015a). As noted above, in PISA 2015, boys outperform girls in mathematics by an average of 8 score points (across OECD countries); but the highest-scoring 10% of boys score 16 points higher than the best-performing 10% of girls.

Figure I.5.10 ■ **Gender differences in mathematics performance**

Score-point difference in mathematics (boys minus girls)



Note: Statistically significant differences are marked in a darker tone (see Annex A3).

Countries and economies are ranked in ascending order of the mean score-point difference in mathematics between boys and girls.

Source: OECD, PISA 2015 Database, Tables I.5.3 and I.5.7.

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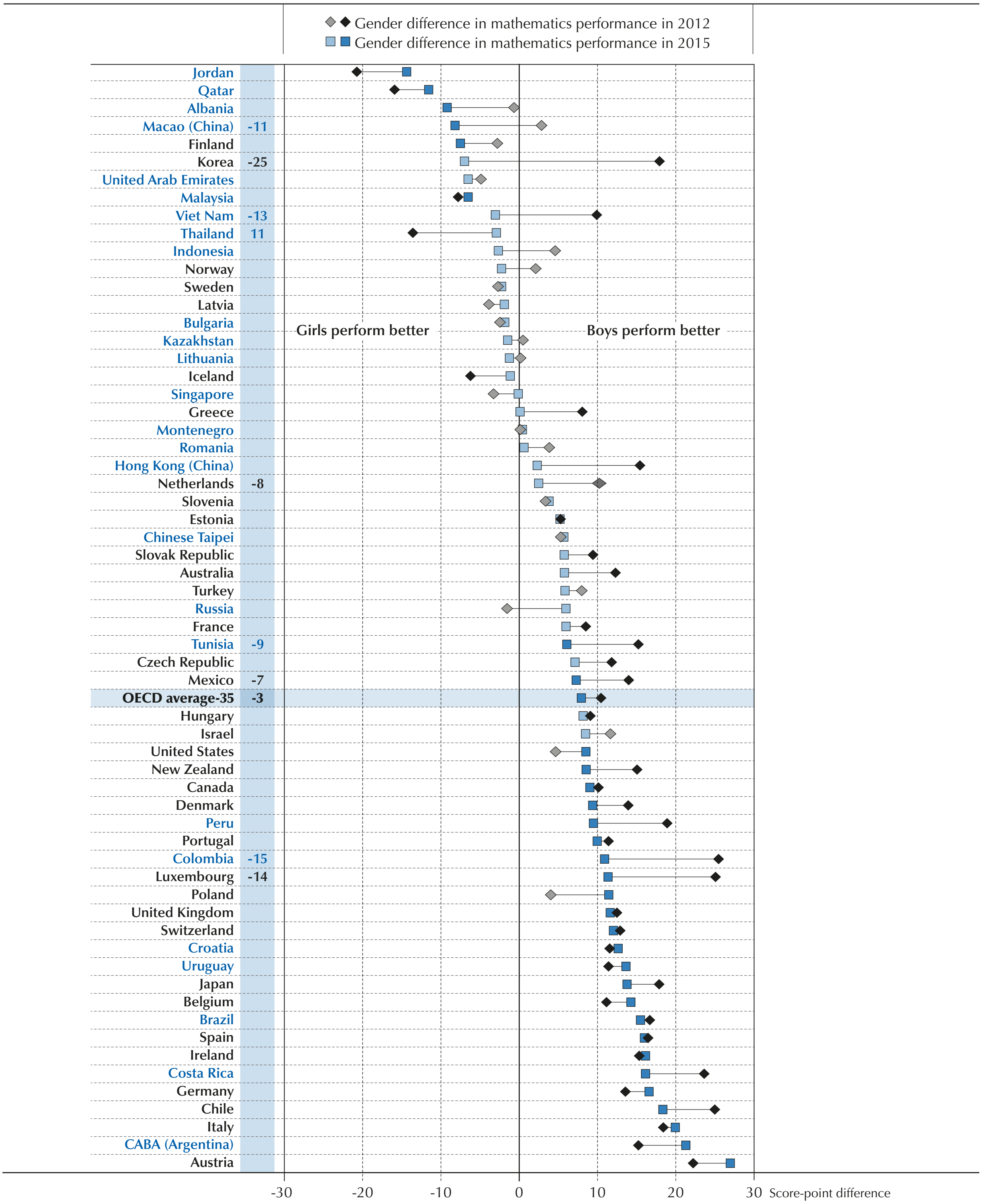
Figure I.5.11 ■ **Change between 2012 and 2015 in gender differences in mathematics performance**

Score-point difference in mathematics (boys minus girls)



Notes: Gender differences in PISA 2012 and in PISA 2015 that are statistically significant are marked in a darker tone (see Annex A3).
Statistically significant changes between PISA 2012 and PISA 2015 are shown next to the country/economy name.
Only countries and economies that participated in both PISA 2012 and 2015 are shown.
Countries and economies are ranked in ascending order of gender differences in 2015.
Source: OECD, PISA 2015 Database, Tables I.5.8a, I.5.8c and I.5.8e.
StatLink http://dx.doi.org/10.1787/888933432693

Meanwhile, there is no gender gap, on average, at the 10th percentile of performance (the minimum level achieved by at least 90% of boys and girls). The gender gap at the top of the performance distribution (90th percentile) is significant in a majority of countries and economies, and exceeds 15 points in 30 of them. Only in Trinidad and Tobago do high-achieving girls perform better than high-achieving boys; and in no PISA-participating country or economy do more girls than boys perform at Level 5 or above in mathematics (Tables I.5.6a and I.5.7).

Between the PISA 2012 and PISA 2015 assessments, the gender gap did not change significantly in a vast majority of countries. The gender gap in mathematics shrank by three points across OECD countries, on average, but this reduction mainly reflects the change in one country (Korea). In Korea, mathematics scores dropped more steeply among boys than among girls between 2012 and 2015. As a result, while Korea had one of the largest gender gaps in favour of boys in 2012, in 2015, girls outperformed boys, although the difference is not statistically significant. Tunisia also saw a significant deterioration in performance among both boys and girls, although boys' scores in mathematics dropped more dramatically. As a result, the gender gap in favour of boys narrowed by nine points. The gender gap narrowed significantly in Colombia as well, where boys' performance remained stable between 2012 and 2015, but girls' performance improved by 20 points, on average, and by 28 points among the highest-achieving girls. Colombia had the largest gender gap in favour of boys of all PISA-participating countries/economies in 2012, and was able to reduce this gap significantly – including among the country's highest-achieving students. In Luxembourg, Mexico, the Netherlands and Viet Nam, boys' advantage shrank because performance deteriorated among boys, but not among girls. In Macao (China), there was no gender gap in 2012; but by 2015, girls had improved their performance, while boys' performance remained stable. The opposite trend is observed in Thailand, where girls scored higher than boys in 2012, but as a result of deteriorating performance among girls, the gap closed between 2012 and 2015 (Figure I.5.11 and Tables I.5.8a, I.5.8d and I.5.8e).

Notes

1. The countries/economies that administered the paper-based test in 2015 are: Albania, Algeria, Argentina, the Former Yugoslav Republic of Macedonia, Georgia, Indonesia, Jordan, Kazakhstan, Kosovo, Lebanon, Malta, Moldova, Romania, Trinidad and Tobago, and Viet Nam.

2. The results of three countries, however, are not fully comparable, because of issues with sample coverage (Argentina), school response rates (Malaysia), or construct coverage (Kazakhstan); see Annex A4. As a consequence, results for these three countries are not included in most figures.

3. Due to rounding, two or more countries can be listed with the same mean score. The order in which countries appear is based on the unrounded results.

4. National differences in mode effects for single items are neutralised by the treatment of differential item functioning in the scaling model. But an overall mode effect related to students' familiarity with ICT devices or to their motivation to take the test in one mode or another, would still affect country mean performance. See Annex A5 and the *PISA 2015 Technical Report* (OECD, forthcoming) for details on the scaling model used in PISA 2015.

5. Note by Switzerland: In Switzerland, the increase in the weighted share of students between previous rounds of PISA and PISA 2015 samples is larger than the corresponding shift in the target population according to official statistics.

6. High- and low-achieving students can be defined using either common, international benchmarks for performance (the PISA proficiency levels) or national benchmarks corresponding to performance quantiles (e.g. the performance achieved by at least 90% of students, or the performance achieved by the top 10%). Because of this, occasionally one country/economy can be listed under two different headings.

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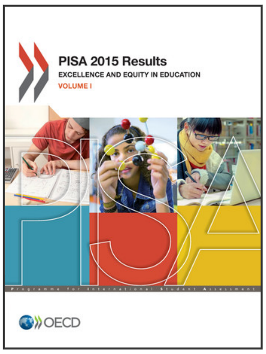

From:
PISA 2015 Results (Volume I)
Excellence and Equity in Education

Access the complete publication at:
https://doi.org/10.1787/9789264266490-en

Please cite this chapter as:

OECD (2016), "Mathematics performance among 15-year-olds", in *PISA 2015 Results (Volume I): Excellence and Equity in Education*, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264266490-9-en

OECD