Annex A.
Data sources and methods

Data sources: overview

This publication reports the results of secondary analyses of data from several sources collected in surveys of students, teachers and principals. These data are drawn from PISA (Programme on International Student Assessment), TIMSS (Trends in International Mathematics and Science Study) and PIRLS (Progress in International Reading Literacy Study). PISA, TIMSS and PIRLS have been created to look at student achievements in maths and science (PISA and TIMSS) and text understanding (PISA and PIRLS). Background questionnaires provide relevant information about classroom or school practices which have been used to identify the extent to which they have changed over time. All these surveys are cross-sectional.

Coverage of the statistics

PISA is designed to assess learning outcomes of 15-year-old students and make comparisons over time. PISA focuses on the extent to which students can apply the knowledge and skills they have learnt and practised at school when confronted with situations and challenges for which that knowledge may be relevant.

PISA uses questionnaires to collect background information from students and data on various aspects of organisation and educational provision in schools from school principals.

The target population of PISA is 15-year-old students in grade 7 or higher who attend educational institutions, including those enrolled part-time and those in vocational training programmes. It is important to note that the sample is not designed to be representative of schools or classrooms and has not been reweighted. Results should be read as "the percentage of 15-year-old students who report ….."

TIMSS and PIRLS are designed to measure student achievement around the world and make comparisons over time. TIMSS has two target populations—all students enrolled at the 4th grade and all students enrolled at the 8th grade, although countries may choose to assess either or both student populations. Fourth and eighth grade represent four and eight years of schooling respectively, counting from the first year of ISCED Level 1, providing the mean age at the time of testing is at least 9.5 years/13.5 years.

The target population for PIRLS is all students enrolled at the 4th grade. All schools of all educational sub-systems that have students learning full-time in the target grade are part of the international target population, including schools that are not under the authority of the national Ministry of Education or its equivalent.

TIMSS and PIRLS are designed to pay particular attention to students' curricular and instructional experiences and therefore sample intact classes of students. However, as with PISA, TIMSS and PIRLS are not designed to be representative of schools or classrooms and data have not been reweighted. Results should be read as "the percentage of 4th /8th grade students who report….."

Country coverage

This publication incorporates information from 47 education systems or countries within the OECD, and 6 partner countries.

- 36 education systems within the OECD participated in PISA 2015, 34 in 2009 and 32 in 2006.

- 29 education systems within the OECD participated in TIMSS 2015, 38 in 2011 and 27 in 2007.
- 31 education systems within the OECD participated in PIRLS 2016, 29 in 2011 and 27 in 2006.

Sample sizes

Table A.1. TIMSS sample sizes: Principals

	4th grade			8th grade		
OECD countries	2007	2011	2015	2007	2011	2015
Australia	229	280	287	228	277	285
Austria	196	158				
Belgium Flemish		142	153			
Canada			441			276
Canada (Alberta)	146	143			145	
Canada (Quebec)	186	190	121	170	189	122
Canada (Ontario)	188	146	151	176	143	138
Chile		200	179		193	171
Colombia	142			148		
Czech Republic	144	177	159	147		
Denmark	137	216	193			
Finland		145	158		145	
France			164			
Germany	246	197	204			
Hungary	144	149	144	144	146	144
Ireland		150	149			149
Israel				146	151	200
Italy	170	202	164	170	197	161
Japan	148	149	148	146	138	147
Korea		150	149	150	150	150
Lithuania	156	154	225	145	141	208
Netherlands	141	128	129			
New Zealand	220	180	174		158	145
Norway	145	119	140	139	134	143
Poland		150	150			
Portugal		147	217			
Slovak Republic	184	197	198			
Slovenia	148	195	148	148	186	148
Spain		151	358			
Sweden	155	152	144	159	153	150
Turkey		257	242	146	239	218
U.K. (England)	143	154	147	137	118	143
U.K. (Northern Ireland)		136	118			
United States	257	369	250	239	501	246
U.S. (Massachusetts)	47			48	56	
U.S. (Minnesota)	50			49	55	
Non OECD countries						
Hong Kong	126	136	132	120	117	133
Indonesia			230	149	153	
Russian Federation	206	202	208	210	210	204
Singapore	177	176	179	164	165	167
South Africa			297		285	292

Table A.2. TIMSS sample sizes: Teachers

	4th grade			8th grade maths			8th grade science		
OECD countries	2007	2011	2015	2007	2011	2015	2007	2011	2015
Australia	360	594	584	251	802	824	496	1049	909
Austria	356	296							
Belgium Flemish		268	295						
Canada			807			384			278
Canada (Alberta)	252	235			222			234	
Canada (Quebec)	308	300	195	226	265	165	192	323	167
Canada (Ontario)	279	362	309	214	244	202	219	245	96
Colombia	214			149			149		
Chile		200	261		194	172		194	191
Czech Republic	253	291	347	212			845		
Denmark	246	341	305						
Finland		310	400		264			827	
France			310						
Germany	373	312	307						
Hungary	255	324	307	289	280	232	987	1005	516
Ireland		220	214			516			352
Israel				394	514	596	270	282	347
Italy	323	314	328	287	205	21	287	205	228
Japan	250	265	292	216	181	231	178	151	169
Korea		168	226	243	376	310	181	202	215
Lithuania	283	282	301	209	222	264	596	617	905
Netherlands	218	210	223						
New Zealand	609	494	499		354	435		265	329
Norway		280	280	270	175	220	264	171	80
Poland		257	390						
Portugal		240	322						
Slovak Republic	343	422	404						
Slovenia	340	245	256	503	523	352	779	901	527
Spain		200	517						
Sweden	396	369	233	491	405	198	680	540	210
Turkey		263	251	146	240	220	146	240	218
U.K. (England)	250	261	238	235	212	210	615	751	775
U.K. (Northern Ireland)		187	154						
United States	904	767	540	532	559	429	687	931	517
U.S. (Massachusetts)	156			103	105		114	107	
U.S. (Minnesota)	168			104	110		116	147	
Non OECD countries									
Hong Kong	282	267	279	145	148	173	123	124	145
Indonesia			378	149	170		276	259	
Russian Federation	268	218	226	273	239	221	1083	916	748
Singapore	508	515	538	357	330	324	429	330	318
South Africa						325			305

Table A.3. TIMSS sample sizes: Students

	4th grade			8th grade		
OECD countries	2007	2011	2015	2007	2011	2015
Australia	4108	6146	10338	4069	7556	10338
Austria	4859	4668				
Belgium Flemish		4849				
Canada			8757			8757
Canada (Alberta)	4037	3645				
Canada (Quebec)	3885	4235	3950	3956	6149	3950
Canada (Ontario)	3496	4570	4520	3448	4756	4520
Chile		5585	4849		5835	4849
Czech Republic	4235	4578		4845		
Denmark	3519	3987				
Finland		4638			4266	
France						
Germany	5200	3995				
Hungary	4048	5204	4893	4111	5178	4893
Ireland		4560	4704			4704
Israel			5512	3294	4699	5512
Italy	4470	4200	4481	4408	3979	4481
Japan	4487	4411	4745	4312	4414	4745
Korea		4334	5309	4240	5166	5309
Lithuania	3980	4688	4347	3991	4747	4347
Netherlands	3349	3229				
New Zealand	4940	5572	8142		5336	8142
Norway	4108	3121	4697	4627	3862	4697
Poland		5027				
Portugal		4042				
Slovak Republic	4963	5616				
Slovenia	4351	4492	4257	4043	4415	4257
Spain		4183				
Sweden	4676	4663	4090	5215	5573	4090
Turkey		7479	6079	4498	6928	6079
U.K. (England)	4316	3397	4814	4025	3842	4814
U.K. (Northern Ireland)		3571				
United States	7896	12569	10221	7377	10477	10221
U.S. (Massachusetts)				1897	2075	
U.S. (Minnesota)				1777	2500	
Non OECD countries						
Colombia	4801			4873		
Hong Kong	3791	3957	4155	3470	4015	4155
Indonesia				4203	5795	
Russian Federation	4464	4467	4780	4472	4893	4780
Singapore	5041	6368	6116	4599	5927	6116
South Africa			12514		11969	12514

Table A.4. PIRLS sample sizes: Principals, teachers and students

	Principals			Teachers			Students		
OECD countries	2006	2011	2016	2006	2011	2016	2006	2011	2016
Australia		280	286		513	531		6126	6341
Austria	158	158	150	263	284	259	5067	4670	4360
Belgium Flemish	137		148	237		277	4479		5198
Belgium French	150	127	158	277	217	254	4552	3727	4623
Canada		1111	926		1393	1119		23206	18245
Canada (Alberta)	150	145		233	218		4243	3789	
Canada (Quebec)	185	190	127	210	217	166	3748	4244	3179
Canada (Ontario)	180	189	188	200	275	251	3988	4561	4270
Colombia		150			151			3966	
Chile			154			154			4294
Czech Republic	0	177	157		235	270		4556	5537
Denmark	145	232	185	216	236	186	4001	4594	3508
Finland	0	145	151		285	295		4640	4896
France	169	174	163	261	276	284	4404	4438	4767
Germany	405	197	208	418	222	227	7899	4000	3959
Hungary	149	149	149	194	245	206	4068	5204	4623
Iceland	128			239			3673		
Ireland	0	151	148		221	219		4524	4607
Israel	149	152	159	149	165	159	3908	4186	4041
Italy	150	202	149	198	239	217	3581	4189	3940
Latvia	145		150	213		216	4162		4157
Lithuania	144	154	195	270	277	243	4701	4661	4317
Luxembourg	178			363			5101		
Netherlands	139	138	132	207	207	226	4156	3995	4206
New Zealand	243	192	188	509	434	411	6256	5644	5646
Norway	135	120	150	227	190	211	3837	3190	4232
Poland	148	150	148	250	257	214	4854	5005	4413
Portugal	0	148	218		242	318		4085	4642
Slovak Republic	167	197	220	263	314	333	5380	5630	5451
Slovenia	145	195	160	315	243	253	5337	4512	4499
Spain	152	312	629	193	402	678	4094	8580	14595
Spain (Andalusia)	0	149		0	197	188	0	4333	
Sweden	147	152	154	255	254	214	4394	4622	4525
U.K. (England)	148	129	170	186	182	210	4036	3927	5095
U.K. (Northern Ireland)		136	134		184	161		3586	3693
United States	183	370	158	253	606	208	5190	12726	4425
Non OECD countries									
Hong Kong	144	132	138	144	138	150	4712	3875	3349
Indonesia	168	158		168	163		4774	4791	
Russian Federation	232	202	206	232	209	213	4720	4461	4577
Singapore	178	176	177	356	355	354	6390	6367	6488
South Africa	397	341	293	403	111		14657	3515	12810

Table A.5. PISA sample sizes: Principals and students

	Principals			Students		
OECD countries	2006	2009	2015	2006	2009	2015
Australia	350	345	758	14170	14251	14530
Austria	197	280	269	4927	6590	7007
Belgium	269	275	288	8857	8501	9651
Canada	861	908	759	22646	23207	20058
Chile	173	199	227	5233	5669	7053
Colombia	165	275	372	4478	7 921	11795
Czech Republic	244	260	344	5932	6064	6894
Denmark	209	285	333	4532	5924	7161
Estonia	169	175	206	4865	4727	5587
Finland	155	203	168	4714	5810	5882
France	179	166	252	4716	4298	6108
Germany	225	226	256	4891	4979	6522
Greece	189	183	211	4873	4969	5532
Hungary	189	187	245	4490	4605	5658
Iceland	135	129	124	3789	3646	3374
Ireland	164	141	167	4585	3937	5741
Israel	149	176	173	4584	5761	6598
Italy	796	1095	474	21773	30905	11583
Japan	181	185	198	5952	6088	6647
Korea	154	157	168	5176	4989	5581
Latvia	176	184	250	4719	4 502	4869
Lithuania	197	196	311	4744	4 528	6525
Luxembourg	31	39	44	4567	4622	5299
Mexico	1128	1531	275	30971	38250	7568
Netherlands	183	185	187	4871	4760	5385
New Zealand	170	161	183	4823	4643	4520
Norway	203	197	229	4692	4660	5456
Poland	221	179	169	5547	4917	4478
Portugal	172	212	246	5109	6298	7325
Slovak Republic	188	189	290	4731	4555	6350
Slovenia	356	337	333	6595	6155	6406
Spain	686	888	201	19604	25887	6736
Sweden	197	189	202	4443	4567	5458
Switzerland	509	425	227	12192	11812	5860
Turkey	160	170	187	4942	4996	5895
United Kingdom	494	481	550	13152	12179	14157
United States	166	160	177	5611	5233	5712
Non OECD						
Brazil	625	947	841	9295	20 127	23141
Hong Kong	146	151	138	4645	4 837	5359
Indonesia	352	183	236	10647	5 136	6513
Russian Federation	209	213	210	5799	5 308	6036
Singapore		171	177		5 283	6115

Year coverage

This publication focuses on change across time and therefore requires data from the same questions asked in different years. There are many such questions in the datasets employed, but it should be noted that the years in which they were answered varies.

Where possible, analysis focuses on change between 2006 and 2016, although data from TIMSS presents change between 2007 and 2015, and PISA data between 2006 and 2015 or 2009 and 2015. The years included in the analyses are indicated in the chapters.

In some cases, data are also available for an additional year between the two end points. In this case, the data from all three data collection exercises are represented in figures but only the end points are discussed in the text.

Calculation of cross-country means and totals

Given the range of education systems covered in each chapter, cross-country means may not always incorporate the same countries or the same number of education systems. Where practical, the average cross-country statistics have been calculated using data for OECD countries (as in PISA, TIMSS, and PIRLS). In each indicator in TIMSS, PIRLS and PISA, the OECD average (unweighted) is computed taking into account the subset of OECD education systems with data available for all years concerned.

Calculation of effect sizes

Effect sizes are presented for all analyses in addition to tests of statistical significance. Tests of significance allow the reader to determine whether the difference between the two percentages reported could have happened by chance if the actual difference is zero and thus consider the quality of the instrument used for measurement. However, statistical significance is dependent on the sample size (the larger the sample and the more confident the reader can be that even small differences wouldn't have happened by chance) and can, in principle, be improved simply by increasing the number of observations. Yet this does not tell the reader anything about how meaningful the observed effects are in real-world terms. For example, a change in classroom practice could be statistically significant but only amount to a few percentage points of relative change with no practical meaning.

The effect size provides important information about the size of the relationship between two statistics. The main difference between effect size and significance is that change is normalized by the standard deviation as opposed to standard error, which means that the result no longer depends on sample size. The precise form of calculation depends on the type of question asked, but is typically calculated as:

$$\mathrm{E} = \frac{\mathrm{X}_2 - \mathrm{X}_1}{\sigma_{21}}$$

i.e. as the change between a treatment and control group (or any two subgroups of a sample; or – as in our case - two different years), divided by a "pooled" standard deviation:

$$\sigma_{21} = \sqrt{\frac{{\sigma_1}^2 - {\sigma_2}^2}{2}}$$

Sometimes, the control group standard deviation or more complicated forms of pooled standard deviations are used instead of the one displayed. This book looks at effect sizes in

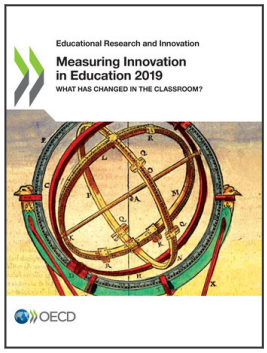
two ways. One approach is to calculate country level effect sizes. Here, means and standard deviations refer to the individual country samples. The effect size calculation provides information about how much, in terms of their own standard deviation, a country has moved up (or down) over time. For country level effect sizes, $\widehat{\sigma_1}$ and $\widehat{\sigma_2}$ are estimated via σ =SE*√n (with n being the sample sizes), which provides a conservative (lower) estimate for the effect size (as n could potentially be overestimated by including invalid observations).

A second way of looking at effect size is required for questions that evaluate proportions, i.e. those that deal with categorical variables and ask, for example, "How often do you do this activity in class? Daily? At least weekly? At least monthly? Rarely or never?". In this case, Cohen h is applied to carry out an arcsin-transformation, whereby h=2(arcsin √P1-arcsin √P2).

In accordance with common practices, effect sizes are assessed at three different levels. Effect sizes of less than 0.2 are considered negligible to very small, between 0.2 and 0.5 are come under small to modest, between 0.5 and 0.8, are large, and effect sizes above 0.8 are considered to be very large. While the usefulness of such cut-offs is debatable, this convention is followed by adding a colour coding in three different shades of blue when displaying effect sizes. The reader should interpret the colour coding with care as there is little practical difference between an effect size of 0.18 and 0.22, even if the colour coding is different.

Further resources

The publication uses the OECD StatLinks service. Below each table and Figure is a URL that leads to a corresponding Excel workbook containing the underlying data for that indicator. These URLs are stable and will remain unchanged over time. In addition, readers of the electronic version of this publication (the e-book) will be able to click directly on the links and the relevant workbook will open in a separate window. The tables in the Excel files contain additional information and computations that could not be presented in the paper version.



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