

Scaling Outcomes

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This chapter describes the application of Item Response Theory (IRT) scaling and plausible value methodology to the PISA 2009 assessment data.

INTERNATIONAL CHARACTERISTICS OF THE ITEM POOL

When main study data were received from each participating country, they were first verified and cleaned using the procedures outlined in Chapter 10. Files containing the achievement data were prepared and national-level Rasch and traditional test analyses were undertaken. The results of these analyses were included in the reports that were returned to each participant (see Chapter 9).

After processing at the national level, a set of international-level analyses was undertaken. Some involved summarising national analyses, while others required an analysis of the international data set.

The final international cognitive data set (that is, the data set of coded achievement booklet responses – available as *INT_cogn09_TD_Dec10.txt*) consisted of 475 460 students from 65 participating countries. Table 12.1 shows the total number of students included in the *PISA 2009 Database*, broken down by participating country and test booklet. Countries that implemented the easier (see Chapter 2) set of booklets are marked with an * in this table.

Nineteen countries participated in PISA 2009 digital reading assessment (DRA). The number of the cases included in DRA cognitive data set is the same as in international cognitive data set for all participating countries except for Colombia and Spain, which have chosen to have schools sub sampled for DRA from their large national school sample (see Chapter 4 for details of DRA sampling).

Proficiency estimates were imputed for the students that were not sampled for DRA. The final international DRA cognitive data file (available as *ERA_cogn09_TD_Jun11.txt*) contains 107 394 students. Table 12.2 shows the total number of students included in the *PISA DRA 2009 Database*, broken down by participating country and DRA test form. For the students that were not sampled for DRA, the test form code is 7.

1	Table 12.1	Numbe	er of sa	mpled	studen	ts by co	ountry a	and boo	oklet							
		Booklets														
		1(21)	2(22)	3(23)	4(24)	5(25)	6(26)	7(27)	8	9	10	11	12	13	UH	Total
Australia	a	1 094	1 107	1 079	1 081	1 096	1 081	1 079	1 1 1 1 4	1 1 3 3	1 094	1 1 1 2	1 092	1 089		14 251
Austria		496	503	499	515	519	506	498	491	489	487	490	498	489	110	6 590
Belgium	ı	646	615	622	644	653	643	647	634	625	611	618	631	621	291	8 501
Canada		1 767	1 788	1 786	1 793	1 793	1 799	1 792	1 746	1 814	1 782	1 758	1 810	1 779		23 207
Chile*		444	422	425	434	468	432	437	440	430	444	417	434	442		5 669
Czech R	Republic	459	462	436	463	443	451	432	430	443	447	455	461	460	222	6 064
Denmar	rk	445	443	465	468	465	463	454	439	459	455	447	460	461		5 924
Estonia		367	354	357	357	352	366	363	360	361	379	369	372	370		4 727
Finland		454	446	453	449	446	447	438	440	438	455	444	454	446		5 810
France		332	320	334	314	319	335	333	312	344	334	339	333	349		4 2 98
German	ıy	382	369	362	362	379	371	360	370	367	379	366	363	370	179	4 979
Greece		389	382	385	381	376	369	381	381	386	385	380	385	389		4 969
Hungary	y	352	354	349	359	349	361	357	350	355	357	349	359	354		4 605
Iceland		280	275	282	279	279	286	278	281	282	280	286	274	284		3 640
Ireland		300	305	300	282	299	294	320	308	308	319	299	296	307		3 937
Israel		810	411	429	406	407	417	417	420	416	408	406	416	398		5 761
Italy		2 366	2 359	2 383	2 386	2 401	2 416	2 389	2 370	2 367	2 356	2 378	2 369	2 365		30 905
Japan		457	468	470	465	466	467	465	470	470	464	472	478	476		6 088
Korea		374	382	377	387	386	399	392	393	394	381	379	371	374		4 989
Luxemb	ourg	352	359	355	357	360	355	357	361	351	349	360	352	354		4 622
Mexico*	*	2 973	2 953	2 959	2 959	2 942	2 973	2 933	2 935	2 908	2 910	2 948	2 917	2 940		38 250
Netherla	ands	359	355	376	357	362	368	362	357	356	355	347	348	361	97	4 760
New Zea	aland	364	357	350	351	350	354	364	361	361	344	355	370	362		4 643
Norway		354	352	355	360	372	369	352	365	355	356	361	361	348		4 660
Poland		381	394	382	368	381	372	370	370	384	375	386	372	382		4 917
Portugal	I	496	451	494	487	482	484	494	490	489	466	500	480	485		6 2 98
Slovak R	Republic	343	320	338	341	339	341	355	353	372	362	358	355	348	30	4 555
Slovenia	1	460	456	459	457	455	460	471	471	462	462	457	469	454	162	6 1 5 5
Spain		1 983	1 952	2 004	2 033	1 995	1 993	1 981	2 008	1 989	2 023	2 002	1 965	1 959		25 882
Sweden		349	360	354	351	349	357	339	344	348	347	351	361	357		4 567
Switzerl	land	917	897	882	936	930	865	915	906	905	922	881	908	948		11 812
Turkey		388	386	378	382	373	385	380	392	390	385	389	383	385		4 996
United I	Kingdom	939	944	932	921	927	933	916	926	957	934	957	951	942		12 179
United S	States	406	400	409	400	402	396	398	402	413	406	407	398	396		5 233

[Part 1/2] e 12.1 Number of sampled students by country and bookle

*These countries opted for the easier booklets.

SCALING OUTCOMES

		[Dout 2.//	1													
		[Part 2/2 Numbe		mpled	studen	ts by co	ountry a	and boo	oklet							
				•		-			klets	-	-					
		1(21)	2(22)	3(23)	4(24)	5(25)	6(26)	7(27)	8	9	10	11	12	13	UH	Total
Alban	nia*	352	348	352	340	351	358	374	367	362	353	345	343	351		4 596
Argen	ntina*	368	374	367	361	344	370	369	362	369	386	358	366	380		4 774
Azerb	oaijan*	354	359	362	367	368	370	375	368	364	359	346	354	345		4 691
Brazil	*	1 547	1 576	1 561	1 614	1 523	1 538	1 548	1 537	1 535	1 527	1 536	1 529	1 556		20 127
Bulga	ria*	350	350	354	357	349	344	351	347	339	338	337	340	351		4 507
Colon	nbia*	613	611	602	625	604	600	597	592	612	608	627	625	605		7 921
Croat	ia	374	368	377	383	386	389	388	387	385	400	397	382	378		4 994
Duba	i (UAE)*	411	443	441	444	431	429	438	441	436	432	430	423	421		5 620
Hong	Kong-China	369	374	376	379	380	372	373	363	364	374	367	373	373		4 837
Indon	iesia	390	387	382	393	394	391	396	401	398	403	399	402	400		5 136
Jorda	n*	505	512	498	493	503	490	491	491	495	491	496	509	512		6 486
Kazak	chstan*	413	409	418	419	415	421	419	427	417	419	406	406	423		5 412
Kyrgy	zstan*	397	390	390	381	377	373	379	382	386	377	386	386	382		4 986
Latvia	1	355	351	354	343	358	342	340	351	340	342	350	333	343		4 502
Liecht	tenstein	23	24	23	33	25	14	28	23	27	23	27	28	31		329
Lithua	ania	363	345	356	338	354	336	352	338	343	344	351	350	358		4 528
Maca	o-China	457	460	456	459	457	459	457	457	459	457	455	457	462		5 952
Monte	enegro	367	369	372	360	373	383	375	376	376	368	371	379	356		4 825
Panan	na*	299	308	312	297	307	303	312	312	302	306	302	302	307		3 969
Peru*		465	472	458	474	459	456	443	449	459	454	465	470	461		5 985
Qatar	*	696	681	699	706	713	707	701	696	697	699	702	688	693		9 078
Roma	nia*	368	359	359	355	358	372	374	378	373	374	372	364	370		4 776
Russia	an Federation	406	414	415	409	409	410	409	402	398	403	412	413	408		5 308
Serbia	a*	417	426	434	434	439	426	429	430	416	422	417	415	418		5 523
Shang	ghai-China	400	398	397	388	386	392	387	391	385	394	398	404	395		5 115
Singa	pore	412	405	402	408	408	416	413	410	404	401	394	406	404		5 283
0.	ese Taipei	445	445	447	452	451	438	452	452	448	441	450	449	461		5 831
Thaila	•	489	486	475	478	476	476	480	483	473	471	473	478	487		6 2 2 5
Trinid	lad and Tobago*	369	351	355	364	359	368	358	366	380	377	379	384	368		4 778
Tunisi	0	381	377	394	370	382	368	376	382	384	384	389	382	386		4 955
Urugi	uav*	464	455	452	454	456	460	467	449	458	453	467	466	456		5 957

Table 12.2 Number of sampled students by country and DRA test form code

				Boo	klets				
		1	2	3	4	5	6	Total sampled students	Total not-sampled students
8	Australia	496	520	505	495	483	494	2 993	11 258
OECD	Austria	454	450	437	417	426	447	2 631	3 959
	Belgium	485	474	448	457	475	469	2 808	5 693
	Chile	297	288	278	274	280	287	1 704	3 965
	Denmark	220	208	198	210	208	226	1 270	4 654
	France	216	203	221	213	228	224	1 305	2 993
	Hungary	311	298	286	302	298	298	1 793	2 812
	Ireland	249	233	239	219	236	233	1 409	2 528
	Israel	155	159	163	165	164	156	962	2 684
	Japan	582	575	570	577	575	550	3 429	2 659
	Korea	255	247	249	239	237	250	1 477	3 512
	New Zealand	296	292	301	286	286	294	1 755	2 888
	Norway	338	329	310	326	340	331	1 974	2 686
	Poland	350	347	321	326	314	330	1 988	2 929
	Spain	283	277	269	291	285	284	1 689	3 059
	Sweden	336	308	313	323	328	313	1 921	2 646
ers	Colombia	496	520	505	495	483	494	2 993	11 258
Partners	Hong Kong-China	454	450	437	417	426	447	2 631	3 959
2	Macao-China	485	474	448	457	475	469	2 808	5 693

Test targeting

Partners

Each of the domains was separately scaled to examine the targeting of the tests. Figures 12.1 to 12.4 show the match between the international (OECD countries only) item difficulty distribution and the distribution of OECD's student achievement for each of reading, mathematics, science and DRA respectively. The figures consist of two panels. The first panel (students) shows the distribution of students' Rasch-scaled achievement estimates. Students at the top end of this distribution have higher proficiency estimates than the students at the lower end of the distribution. The second panel (item difficulties) shows the distribution of Rasch-estimated item difficulties.



Test is well targeted if the average of item difficulties is about the same as the average of the students' abilities and the item difficulties are evenly spread across the ability distribution.

In each of the Figures 12.1 to 12.4, the student proficiency distribution shown by Xs^1 is well matched to the item difficulty distribution. The figures are constructed so that when a student and an item are located at the same location on the scale then the student has a 50% chance of responding correctly to the item.

Stude	nts	Item difficulties
3		1
		19
	1	I
	X	I
		I
	XX	I
	XX	I
2	X	11 21
	XX	I
	XXX	
	XXXX	
	XXXX	
		10 33
1	XXXXXX	
	XXXXX	
	XXXXXX	
	XXXXXX XXXXXXX	
	XXXXXXXX	
0		113 27 28 29
0	XXXXXXXXXX	
	XXXXXXXXXX	
	XXXXXXXXX	
	XXXXXXXX	
	XXXXXXXX	26
-1	XXXXXXXXX	3 20 25
	XXXXXX	18
	XXXXXXX	I
	XXXX	23
	XXXX	
_	XXXXX	
-2	XXX	
	XXX	
	XX	
	XX	
		32
-3	X X	
5	X	
	21	
		1
		I
-4		

■ Figure 12.1 ■ Item plot for mathematics items

Item plot for reading items							
Students	Item difficulties						
4	1						
	I						
3 х							
	76 103						
Х	132						
XX							
	22 87						
XX 							
2 XXXX							
2 XXXXX	91 114						
XXXXXXX							
	17 46 50						
XXXXXXXX	21 59 90 111						
XXXXXXXXX	24 48 54 55 92						
	29 47 68						
	2 12 60 118 126 57 61 85 86 100 120 124						
	6 8 34 35 36 53 119 128						
	3 14 31 58 123						
	30 99 104 108 109 113						
XXXXXXXX	7 11 23 38 39 49 67 69 84						
	33 78 88 121 130						
	71 75 89 96 110						
	4 37 44 51 83 10 15 62 66 70 81 93 98 101						
	43 73 112 125 133						
	9 20 32 107 116 117 122						
	1 13 19 28 63 72 77						
XX	40 41 52 64 74						
XX							
	195						
	5 94 80						
	197						
	42 127						
	82						
-3	1						
Х							
	1115						
	115						
	I						
- 4	1						
Each "X" represe	nts 1636.8 cases						
hach y represe	1105 1050.0 Cases						

■ Figure 12.2 ■



Figure 12.3

Item plot for science items

item plot	Tor science items
Students	Item difficulties
3	
X	
X	
XX	
2 X	
XX	
XXX	
XXXX	
XXXX	2 23
XXXXX	48
XXXXXX	12
1 XXXXX	6
XXXXXXX	30 33 41
XXXXXXX	
	5 15 22 37 40 46
XXXXXXXXX	
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	
XXXXXXXX	
	13 35 38 47 53
XXXXXXXX	
	7 9 11 20 25 32 42 52
XXXXXXXX	
XXXXXXXXX	8 29
XXXXXX	16 24 39
XXXXXXX	
-1 XXXX	19 26 36
XXXX	34
XXXXX	18
XXX	
XXX	
XX	28
XX	
-2 X	43
	3
	50
X	
X	
X	
-3	

Each "X" represents 1834.8 cases

Studen	ts	Item difficu	lties
	I		
	X		
3	Х		
	X		
	XX		
	X		
	XX	29	
	XX		
	XXXX		
2	XXXX		
	XXXXX	9	
	XXXXXXX		
	XXXXXX		
	XXXXXX		
	XXXXXXX		
1	XXXXXXXX		
	XXXXXXXXXX		
		15 19 20 25	
	XXXXXXXXX		
	XXXXXXXXX		
	XXXXXXXX		
	XXXXXXXXXX		
0	XXXXXXXXXX		
		10 17 21 28	
	XXXXXXXX		
	XXXXXXX		
	XXXX		
	XXXXX		
-1	XXX		
1	XX		
	XX		
	XX		
	X		
		24	
	X		
-2	X		
	X		
		1	
-3			

■ Figure 12.4 ■

Each "X" represents 636.4 cases

Test reliability and measurement error design effect

A second test characteristic that is of importance is the test reliability, or equivalently the measurement error design effect (Adams, 2005). Table 12.3 shows the reliability for each of the three overall scales (mathematical literacy, reading literacy and scientific literacy) and for the DRA scale before conditioning and based upon four separate unidimensional scalings, using plausible values (PV) and using Weighted Likelihood Estimates (WLE).

The WLE-based estimates are IRT analogues of traditional estimates of Person separation reliability such as internal consistency. They are estimated for the samples of students that responded to test forms from each of the domains.

The plausible value based estimates, however, use all sampled students and represent the influence of the test design on the uncertainty of estimates of the overall mean. For example the DRA reliability of 0.30 and corresponding design effect of 3.33 means that the error variance of the estimate of the mean would be increased by a factor of 3.33 because of the use of a sub-sample and seven alternative assessment booklets. These estimates take into account the fact that the sample sizes for each domain are markedly different. The consequence is that the WLE reliabilities for the minor domains are higher than the PV reliabilities because students that were not assessed in mathematics, science or DRA were excluded from the calculation of the WLE reliabilities.

The plausible value based estimates in Table 12.2 are based upon unidimensional scaling, and do not reflect the benefit of the conditioning and the multidimensional scaling that is implemented in PISA. The international reliability for each domain after conditioning and multidimensional scaling is reported in Table 12.9.

Domain	Reliability (WLE)	Measurement Error Design Effect (WLE)	Reliability (PV)	Measurement Error Design Effect (PV)
Mathematics	0.74	1.34	0.54	1.84
Reading	0.84	1.19	0.86	1.17
Science	0.80	1.26	0.57	1.75
DRA	0.85	1.18	0.30	3.33

Table 12.3 Reliabilities and Measurement Error Design Effect of each of the three overall scales when scaled separately

Domain inter-correlations

Correlations between the ability estimates for individual students in each of the three domains, the latent correlations, as estimated by *ConQuest*[®] (Wu, Adams and Wilson, 1997) are given in Table 12.4. Correlations between four domains for countries that implemented DRA are given in Table 12.5. It is important to note that these latent correlations are unbiased estimates of the true correlation between the underlying latent variables. As such they are not attenuated by the unreliability of the measures and will generally be higher than the typical product moment correlations that have not been disattenuated for unreliability. The results in Table 12.4 are reported for both OECD countries and for all participating countries. The results in Table 12.5 are reported for 19 DRA countries.

Table 12.4	Latent correlation between the three domains
------------	--

	Reading r	Science r
Mathematics		
OECD	0.82	0.88
All	0.84	0.89
Reading		
OECD		0.87
All		0.87

Table 12.5										
	Reading r	Science r	DRA r							
Mathematics	0.83	0.91	0.80							
Reading		0.87	0.86							
Science			0.82							

Table 12.5 Latent correlation between the four domains

0.94

0.95

Reading scales

OECD

All

As described in Chapter 9, a five-dimensional model consisting of mathematics, science, and the three reading aspect scales: access and retrieve, integrate and interpret, reflect and evaluate was used, Then a four-dimensional model was estimated consisting of mathematics, science, and the two reading text format scales: continuous text and non-continuous text. Responses from the mathematics and science domains were included in the scaling model to improve the estimation of posterior distributions of the reading scales. The plausible values for mathematics and science generated using these two models were not included in the international database. The correlations between reading subscales as estimated from these two models are given in Table 12.6 and Table 12.7.

lable 12.6	6 Latent correlation between the aspect reading scales				
	Integrate and interpret r	Reflect and evaluate r			
Access and retrieve					
OECD	0.93	0.90			
All	0.96	0.93			
Integrate and interpret					

والمحاجب المحاجب فترجيه والمتلا والمتعادية والمحافيات

lable 12./	Latent correlation between text format reading scales
	Non-continuous text r
Continuous text	
OECD	0.93
All	0.95

Table 19.7 I atomt convolution between toyst formest vession of

SCALING OUTCOMES

The procedures for the national and international scaling are outlined in Chapter 9 and are not reiterated here.

National item deletions

The items were first scaled by country and their fit was considered at the national level, as was the consistency of the item parameter estimates across countries. Consortium staff then adjudicated items, considering the items' functioning both within and across countries in detail. Those items considered to be dodgy (see Chapter 9) were then reviewed in consultation with National Project Managers (NPMs). The consultations resulted in the deletion of a number of items at the national level.

At the international level, two reading items (R219Q01E and R219Q01T) and one mathematics item (M305Q01) were deleted from scaling. R219Q01E and R219Q01T were deleted because of data entry errors and M305Q01was deleted because instruction to have a rule was not included in the booklets. The nationally deleted items are listed in Table 12.8. All deleted items were recoded as not applicable and were excluded from both international scaling and generating plausible values.



[Part 1/2] Table 12.8 Items deleted at the national level

Table 12.8	Items deleted at the national level
Item	Country
M033Q01	Hungary (booklet 8), Serbia
M155Q01	Peru, Dubai (UAE) (Arabic-language version)
M305Q01	International Deletion
M406Q01	Israel (booklet 7 of Arabic-language version)
M408Q01T	Denmark
M442Q02	Belgium (booklet 5 of Dutch-language version), Spain (Euskara-language version), Poland (booklet 1), Dubai (UAE) (Arabic-language version), Qatar (Arabic-language version)
M474Q01	Hong Kong-China (Cantonese-language version)
M571Q01	Greece (booklet 10)
M603Q01T	Belgium (Dutch-language version)
M828Q01	Israel (Hebrew-language version), Dubai (UAE) (Arabic-language version)
M828Q03	Indonesia
R055Q01	Hungary, Serbia (Serbian-language version)
R067Q01	Switzerland (booklet 2 of Italian-language version)
R067Q04	Switzerland (booklet 2 of Italian-language version)
R067Q05	Switzerland (booklet 2 of Italian-language version), Chile
R083Q01	Hungary
R101Q05	Iceland (booklet 5)
R102Q04A	Argentina
R102Q05	Argentina, Hong Kong-China (Cantonese-language version), Macao-China (Cantonese-language version), Mexico (booklet 13), Montenegro (Serbian/variant of Montenegrin-language version), Shanghai-China, Serbia (Serbian-language version), Chinese Taipei
R104Q01	Ireland (booklet 11 of English-language version)
R104Q02	Lithuania (Lithuanian-language version), Montenegro (Serbian/variant of Montenegrin, All)
R111Q02B	Qatar (booklet 8 of Arabic-language version)
R111Q06B	Peru (booklet 24)
R219Q01E	International Deletion
R219Q01T	International Deletion
R220Q02B	Brazil, Switzerland (booklet 9 Italian-language version), Indonesia (booklet 9), Japan, Peru
R220Q04	Hungary, Indonesia (booklets 1 and 9)
R220Q05	Bulgaria (booklet 13), Spain (Catalan-language version), Portugal (booklets 2 and 13 of Portuguese-language version)
R220Q06	Estonia (Russian-language version)
R227Q01	Montenegro (Serbian/variant of Montenegrin-language version)
R227Q02	Azerbaijan (booklet 11 of Azerbaijani), Finland, Israel (Arabic-language version), Montenegro (Serbian/variant of Montenegrin-language version)
R227Q03	Israel (Arabic-language version), Montenegro (Serbian/variant of Montenegrin-language version)
R227Q06	Kazakhstan (Russian-language version), Dubai (UAE) (Arabic-language version)
R245Q01	Greece, Israel (booklet 5 of Arabic-language version), Slovak Republic (Hungarian-language version)
R245Q02	Iceland, Israel (booklet 5 of Arabic-language version)
R412Q05	Dubai (UAE) (Arabic-language version)
R412Q06T	Chile
R414Q02	Poland
R414Q09	Switzerland (booklets 4 and 6 of French-language version)
R420Q09	Estonia (Estonian-language version)
R420Q10	Japan (booklet 6)
R424Q02T	Argentina, Montenegro (Serbian/variant of Montenegrin-language version)
R432Q05	Turkey (booklet 2)
R432Q06T	Ireland, Kazakhstan (booklet 12 of Russian-language version), Lithuania, Singapore
R433Q02	Chile

[Part 2/2]

Table 12.8	Items deleted at the national level				
Item	Country				
R437Q01	Brazil				
R437Q06	Hungary				
R437Q07	Chile				
R442Q06	Israel (booklet 7 of Arabic-language version)				
R442Q07	Hungary (booklet 5)				
R445Q03	Romania (all booklets of Hungarian-language version)				
R452Q06	Austria				
R453Q01	Argentina, Qatar				
R453Q04	Argentina				
R453Q05T	Argentina				
R453Q06	Argentina, Iceland				
R455Q03	Greece				
R455Q05T	Austria (German-language version), Belgium (German-language version), Switzerland (German-language version), Germany, Italy (German-language version), Luxembourg (German-language version)				
R462Q02	Serbia (booklets 22 and 24 of Serbian-language version)				
R462Q04	Serbia (booklet 24 of Serbian-language version)				
R462Q05	Serbia (booklet 24 of Serbian-language version)				
R466Q03T	Albania, Poland, Serbia (booklet 26 of Serbian-language version), Trinidad and Tobago (booklet 22), Tunisia				
R466Q06	Argentina (booklets 11 and 12), Qatar (booklet 26 of English-language version), Serbia (Hungarian-language version), Trinidad and Tobago (booklet 22)				
\$326Q03	Croatia				
S413Q04T	Colombia				
\$425Q02	Tunisia (booklet 23 of Arabic-language version)				
\$425Q05	Croatia				
S438Q03D	Israel (Arabic-language version)				
\$465Q01	Spain (Euskara-language version)				
S466Q05	Peru (booklet 24)				
\$478Q01	Dubai (UAE) (Arabic-language version)				
S478Q02T	Dubai (UAE) (Arabic-language version), Uruguay (booklet 12)				
\$498Q04	Peru (booklet 13)				
\$519Q01	Peru				
S519Q03	Israel (Hebrew-language version)				
\$527Q04T	Macao-China (Cantonese-language version)				
E002Q01	Sweden				
E017Q01	Norway				
E017Q07	Iceland				
E021Q05	Sweden				
E021Q08	Iceland				

International scaling

The international scaling for mathematics, science and paper-based reading items were performed using a calibration data set of 15 500 students (500 randomly selected students from each of the 31 OECD countries). For the estimation of non-standard reading international item parameters a calibration sample of 24 500 students was used. This calibration sample included 500 students from all OECD countries and 500 students from 20 countries that administered the non-standard test.

The item parameter estimates from this scaling are reported in Annex A. The item parameters were estimated using three separate one-dimensional models. As in previous cycles, not-reached items were treated as not administered and a booklet facet was used in the item response model.

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The international scaling for DRA items was performed using calibration data set of 4 370 students (230 randomly selected students from each of the 19 participating countries). The item parameter estimates from this scaling are reported in Annex A.

Generating student scale scores and reliability of the PISA scales

Applying the conditioning approach described in Chapter 9 and anchoring all of the item parameters at the values obtained from the international scaling, plausible values were generated for all sampled students. Table 12.9 gives the reliabilities at the international level for the generated scale scores. The increase in reliability of the results reported in Table 12.9 over those presented in Table 12.3 is due to the use of multidimensional scaling and conditioning.

Table 12.10 gives the reliabilities at the national level for the generated scale scores.

Table 12.9 Final reliabilities of the PISA scales

Domain	Reliability
Mathematics	0.882
Reading	0.921
Science	0.896
Access and retrieve	0.907
Integrate and interpret	0.913
Reflect and evaluate	0.909
Continuous text	0.911
Non-continuous text	0.903
DRA	0.900

	Mathematics	Reading	Science	Access and retrieve	Integrate and interpret	Reflect and evaluate	Continuous text	Non-continuous text	DRA
Australia	0.88	0.93	0.91	0.91	0.93	0.92	0.92	0.90	0.91
Austria	0.89	0.93	0.92	0.91	0.92	0.93	0.92	0.91	0.93
Belgium	0.92	0.94	0.93	0.92	0.93	0.92	0.93	0.93	0.93
Canada	0.87	0.91	0.89	0.90	0.91	0.90	0.90	0.89	0.89
Chile	0.87	0.90	0.86	0.87	0.89	0.88	0.88	0.88	
Czech Republic	0.89	0.92	0.89	0.91	0.92	0.91	0.91	0.92	
Denmark	0.86	0.91	0.90	0.90	0.91	0.91	0.90	0.88	0.93
Estonia	0.86	0.91	0.87	0.89	0.90	0.90	0.90	0.89	
Finland	0.83	0.90	0.87	0.88	0.89	0.89	0.89	0.88	
France	0.89	0.94	0.91	0.92	0.93	0.92	0.93	0.91	0.94
Germany	0.91	0.92	0.92	0.92	0.92	0.93	0.91	0.91	
Greece	0.84	0.91	0.86	0.89	0.89	0.89	0.90	0.89	
Hungary	0.91	0.93	0.92	0.91	0.92	0.91	0.92	0.92	0.92
Iceland	0.87	0.92	0.90	0.90	0.91	0.91	0.91	0.90	0.90
Ireland	0.90	0.93	0.91	0.93	0.93	0.92	0.92	0.91	0.89
Israel	0.89	0.93	0.89	0.94	0.92	0.93	0.92	0.91	
Italy	0.89	0.93	0.90	0.91	0.92	0.92	0.92	0.91	
Japan	0.89	0.92	0.91	0.91	0.91	0.89	0.91	0.90	0.84
Korea	0.87	0.91	0.90	0.91	0.90	0.89	0.89	0.90	0.87
Luxembourg	0.87	0.93	0.90	0.90	0.92	0.91	0.92	0.92	
Mexico	0.88	0.91	0.87	0.90	0.90	0.90	0.90	0.90	
Netherlands	0.91	0.93	0.92	0.92	0.93	0.93	0.92	0.92	
New Zealand	0.89	0.94	0.92	0.92	0.93	0.92	0.93	0.92	0.90
Norway	0.86	0.92	0.88	0.90	0.90	0.90	0.91	0.89	0.86
Poland	0.88	0.92	0.88	0.89	0.91	0.90	0.90	0.89	0.90
Portugal	0.88	0.91	0.87	0.89	0.90	0.90	0.90	0.88	
Slovak Republic	0.89	0.93	0.89	0.92	0.91	0.92	0.91	0.92	
Slovenia	0.89	0.93	0.90	0.93	0.93	0.92	0.92	0.92	
Spain	0.89	0.92	0.90	0.90	0.92	0.91	0.91	0.91	0.89
Sweden	0.87	0.92	0.89	0.91	0.91	0.92	0.91	0.90	0.90
Switzerland	0.88	0.92	0.89	0.90	0.91	0.91	0.91	0.90	
Turkey	0.90	0.91	0.87	0.90	0.90	0.88	0.90	0.89	
United Kingdom	0.88	0.92	0.91	0.91	0.92	0.90	0.92	0.89	
United States	0.88	0.92	0.91	0.91	0.92	0.91	0.91	0.91	

	Mathematics	Reading	Science	Access and retrieve	Integrate and interpret	Reflect and evaluate	Continuous text	Non-continuous text	DRA
Albania	0.84	0.92	0.87	0.91	0.90	0.90	0.91	0.90	
Argentina	0.88	0.92	0.89	0.91	0.92	0.91	0.91	0.91	
Azerbaijan	0.77	0.86	0.79	0.87	0.84	0.84	0.86	0.84	
Brazil	0.90	0.91	0.89	0.91	0.91	0.91	0.91	0.92	
Bulgaria	0.88	0.94	0.89	0.92	0.93	0.91	0.93	0.93	
Colombia	0.86	0.90	0.85	0.89	0.89	0.89	0.89	0.90	0.90
Croatia	0.89	0.92	0.89	0.91	0.92	0.91	0.91	0.91	
Dubai (UAE)	0.88	0.93	0.90	0.93	0.92	0.92	0.92	0.92	
Hong Kong-China	0.88	0.91	0.89	0.91	0.90	0.90	0.90	0.90	0.87
Indonesia	0.80	0.86	0.81	0.88	0.84	0.81	0.85	0.82	
Jordan	0.88	0.91	0.86	0.91	0.91	0.90	0.88	0.87	
Kazakhstan	0.85	0.91	0.85	0.90	0.90	0.90	0.87	0.87	
Kyrgyzstan	0.82	0.90	0.82	0.89	0.88	0.88	0.89	0.88	
Latvia	0.86	0.91	0.87	0.91	0.89	0.89	0.89	0.91	
Liechtenstein	0.91	0.93	0.92	0.93	0.92	0.93	0.92	0.92	
Lithuania	0.89	0.92	0.89	0.92	0.91	0.92	0.91	0.90	
Macao-China	0.82	0.89	0.83	0.87	0.87	0.86	0.87	0.84	0.79
Montenegro	0.85	0.91	0.84	0.89	0.90	0.88	0.89	0.88	
Panama	0.89	0.92	0.87	0.91	0.91	0.90	0.91	0.91	
Peru	0.86	0.91	0.83	0.89	0.90	0.90	0.90	0.90	
Qatar	0.87	0.93	0.89	0.93	0.92	0.91	0.92	0.92	
Romania	0.86	0.92	0.87	0.92	0.91	0.91	0.90	0.91	
Russian Federation	0.86	0.91	0.85	0.90	0.90	0.90	0.90	0.89	
Serbia	0.86	0.91	0.87	0.90	0.90	0.89	0.89	0.90	
Shanghai-China	0.86	0.89	0.86	0.88	0.89	0.89	0.89	0.87	
Singapore	0.89	0.93	0.91	0.89	0.92	0.91	0.93	0.91	
Chinese Taipei	0.88	0.91	0.89	0.90	0.91	0.90	0.91	0.89	
Thailand	0.84	0.89	0.84	0.87	0.88	0.88	0.89	0.88	
Trinidad and Tobago	0.89	0.93	0.89	0.92	0.92	0.93	0.92	0.92	
Tunisia	0.82	0.89	0.83	0.89	0.87	0.88	0.88	0.87	

TEST LENGTH ANALYSIS

Numbers of missing and non reached responses are discussed in this section. A response is coded as missing if the student was expected to answer a question, but no response was actually provided. All consecutive missing values clustered at the end of a test session were replaced by the non-reached code, except for the first value of the missing series, which is coded as missing (see Chapter 18). All the tables included in the section include weighted and unweighted numbers of the missing and not-reached responses. Final student weight (see Chapter 8) was used to provide weighted numbers and percents.

Table 12.11 shows the number of missing responses and the number of missing responses recoded as not reached, by booklet. Table 12.12 shows the number of missing and not-reached responses by DRA test form.

Booklet	Mis	ssing	Not rea	ched
DOOKIEL	Weighted	Unweighted	Weighted	Unweighted
1	5.05	5.26	0.76	0.69
2	3.91	3.98	1.39	1.09
3	4.56	4.98	1.26	1.10
4	4.27	4.65	1.81	1.36
5	4.57	4.79	0.82	0.64
6	3.38	3.55	1.21	0.85
7	4.48	4.72	1.38	1.24
8	5.61	6.17	2.73	2.54
9	4.23	4.79	1.45	1.53
10	5.02	5.56	2.21	2.02
11	4.84	5.38	1.47	1.36
12	4.50	4.88	2.34	2.20
13	4.82	5.33	2.64	2.55
21	5.97	6.52	2.01	1.89
22	4.42	5.12	3.51	3.20
23	5.52	6.07	3.30	3.09
24	3.39	3.93	2.38	2.34
25	5.50	5.89	1.73	1.61
26	4.08	4.82	4.07	3.46
27	5.35	6.00	4.22	3.76
UH	3.99	3.78	0.93	1.20
Total	4.64	5.09	1.91	1.79

Average number of missing and not-reached items could be compared between standard booklets 1 to 7 and non-standard booklets 21 to 27. Standard booklets have on average less not-reached items and less missing data.

	Mis	sing	Not reached	
TestID	Weighted	Unweighted	Weighted	Unweighted
1	1.64	1.52	0.48	0.41
2	1.87	1.72	0.45	0.41
3	1.55	1.39	0.36	0.28
4	1.36	1.18	0.36	0.32
5	1.17	0.96	0.37	0.30
6	1.22	1.09	0.30	0.24
Total	1.47	1.31	0.39	0.33

Table 12.12 Average number of not-reached items and missing items by DRA TestID

Table 12.13 shows the number of not-reached items for the paper and pencil assessment, by country. Table 12.14 shows this information by country over all booklets and DRA test form. The average number of not-reached items differs from one country to another. Generally, countries with higher averages of not-reached items also have higher averages of missing data. Tables 12.15 and 12.16 provide the percentage distribution of not-reached items per booklet and DRA test form. The percentage of students who reached the last item (i.e. the percentages of students with zero not-reached items) for paper and pencil assessment ranges from 67% to 91% when using weighted data and 68% to 91% when using unweighted data. The percentage of students who reached the last item for DRA assessment ranges from 89% to 91% when using weighted data and 90% to 93% when using unweighted data.

Table 12.13	Average number of not-reached items and missing items by country

	Mis	sing	Not rea	ched
-	Weighted	Unweighted	Weighted	Unweighted
Australia	3.23	3.58	0.90	1.11
Austria	6.69	6.43	0.54	0.56
Belgium	4.08	4.03	0.93	0.90
Canada	2.68	2.99	0.85	0.85
Chile	5.44	5.28	2.08	2.07
Czech Republic	6.20	5.34	0.70	0.60
Denmark	4.71	5.35	0.88	1.03
Estonia	4.08	4.05	0.61	0.61
Finland	2.83	2.88	0.43	0.49
France	6.58	6.48	1.77	1.72
Germany	5.36	5.44	0.67	0.69
Greece	6.42	6.14	1.56	1.56
Hungary	4.95	4.70	0.50	0.45
Iceland	3.80	3.81	1.19	1.18
Ireland	4.09	4.01	1.07	1.04
Israel	6.84	6.78	2.33	2.24
Italy	5.84	5.58	1.53	1.28
Japan	5.01	4.94	0.71	0.68
Korea	2.42	2.32	0.19	0.16
Luxembourg	6.55	6.33	1.41	1.31
Mexico	3.00	2.92	3.46	3.38
Netherlands	1.44	1.31	0.19	0.18
New Zealand	3.27	3.21	1.03	1.01
Norway	4.79	4.79	1.09	1.10
Poland	4.35	4.15	0.54	0.55
Portugal	4.52	4.63	1.39	1.41
Slovak Republic	5.66	5.62	0.62	0.61
Slovenia	5.49	6.62	0.32	0.48
Spain	5.22	5.00	1.58	1.45
Sweden	5.04	5.00	1.51	1.49
Switzerland	4.66	4.68	0.59	0.66
Turkey	4.61	4.57	0.95	0.89
United Kingdom	3.98	4.24	0.70	0.63
United States	1.68	1.71	0.56	0.57
Albania	12.58	12.68	2.79	2.68
Argentina	9.33	9.29	5.87	5.50
Azerbaijan	13.66	13.41	1.43	1.35
Brazil	4.69	4.92	2.66	3.01
Bulgaria	8.97	8.96	1.92	2.11
Colombia	4.58	4.42	6.21	5.36
Croatia	5.52	5.56	0.43	0.43
Dubai (UAE)	4.16	4.60	1.29	1.40
Hong Kong-China	2.48	2.44	0.40	0.39
Indonesia	6.44	6.42	2.98	3.00
Jordan	5.46	5.02	2.13	1.98
Kazakhstan				
	7.40	7.23	3.77	3.61
Kyrgyzstan				
	12.44	12.23	8.89	8.74
Latvia	12.44 3.70	12.23 3.55	8.89 0.93	8.74 0.87
Latvia Liechtenstein	12.44 3.70 4.32	12.23 3.55 4.37	8.89 0.93 0.83	8.74 0.87 0.82
Latvia Liechtenstein Lithuania	12.44 3.70 4.32 4.73	12.23 3.55 4.37 4.71	8.89 0.93 0.83 0.63	8.74 0.87 0.82 0.61
Latvia Liechtenstein Lithuania Macao-China	12.44 3.70 4.32 4.73 3.30	12.23 3.55 4.37 4.71 3.29	8.89 0.93 0.83 0.63 1.20	8.74 0.87 0.82 0.61 1.20
Latvia Liechtenstein Lithuania Macao-China Montenegro	12.44 3.70 4.32 4.73 3.30 11.48	12.23 3.55 4.37 4.71 3.29 11.63	8.89 0.93 0.83 0.63 1.20 1.50	8.74 0.87 0.82 0.61 1.20 1.48
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama	12.44 3.70 4.32 4.73 3.30 11.48 7.36	12.23 3.55 4.37 4.71 3.29 11.63 7.03	8.89 0.93 0.83 0.63 1.20 1.50 4.18	8.74 0.87 0.82 0.61 1.20 1.48 4.50
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28	8.74 0.87 0.82 0.61 1.20 1.48 4.50 6.26
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru Qatar	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00	8.74 0.87 0.61 1.20 1.48 4.50 6.26 1.95
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru Qatar Romania	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57 4.36	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76	8.74 0.87 0.61 1.20 1.48 4.50 6.26 1.95 0.78
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru Qatar Romania Russian Federation	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57 4.36 6.09	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44 6.11	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76 2.62	8.74 0.87 0.61 1.20 1.48 4.50 6.26 1.95 0.78 2.56
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru Qatar Romania Russian Federation Serbia	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57 4.36 6.09 7.96	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44 6.11 7.94	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76 2.62 1.00	8.74 0.87 0.61 1.20 1.48 4.50 6.26 1.95 0.78 2.56 1.05
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru Qatar Qatar Romania Russian Federation Serbia Shanghai-China	12.44 3.70 4.32 4.73 3.30 111.48 7.36 7.84 7.57 4.36 6.09 7.96 1.29	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44 6.11 7.94 1.30	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76 2.62 1.00 0.10	8.74 0.87 0.82 0.61 1.20 1.48 4.50 6.26 1.95 0.78 2.56 1.05 0.11
Latvia Litchtenstein Litchuania Macao-China Montenegro Panama Peru Qatar Romania Russian Federation Serbia Shanghai-China Singapore	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57 4.36 6.09 7.96 1.29 2.49	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44 6.11 7.94 1.30 2.55	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76 2.62 1.00 0.10 0.67	8.74 0.87 0.82 0.61 1.20 1.48 4.50 6.26 1.95 0.78 2.56 1.05 0.11 0.69
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru Qatar Qatar Qatar Russian Federation Serbia Shanghai-China Singapore Chinese Taipei	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57 4.36 6.09 7.96 1.29 2.49 3.34	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44 6.11 7.94 1.30 2.55 3.27	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76 2.62 1.00 0.10 0.67 0.45	8.74 0.87 0.82 0.61 1.20 1.48 4.50 6.26 1.95 0.78 2.56 1.05 0.11 0.69 0.46
Kyrgyzstan Kyrgyzstan Latvia Lichtenstein Lithuania Macao-China Macao-China Montenegro Panama Peru Qatar Romaina Serbia Shanghai-China Singapore Chinese Taipei Thailand Trinidad and	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57 4.36 6.09 7.96 1.29 2.49 3.34 3.86	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44 6.11 7.94 1.30 2.55 3.27 3.25	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76 2.62 1.00 0.10 0.67 0.45 1.22	8.74 0.87 0.82 0.61 1.20 1.48 4.50 6.26 1.95 0.78 2.56 1.05 0.11 0.69 0.46 1.19
Latvia Liechtenstein Lithuania Macao-China Montenegro Panama Peru Qatar Qatar Qatar Romania Russian Federation Serbia Singapore Chinese Taipei Thailand	12.44 3.70 4.32 4.73 3.30 11.48 7.36 7.84 7.57 4.36 6.09 7.96 1.29 2.49 3.34	12.23 3.55 4.37 4.71 3.29 11.63 7.03 7.67 7.52 4.44 6.11 7.94 1.30 2.55 3.27	8.89 0.93 0.83 0.63 1.20 1.50 4.18 6.28 2.00 0.76 2.62 1.00 0.10 0.67 0.45	8.74 0.87 0.82 0.61 1.20 1.48 4.50 6.26 1.95 0.78 2.56 1.05 0.11 0.69 0.46



Table 12.14 Average number of DRA not-reached items and missing items by country

		Mis	sing	Not re	eached
		Weighted	Unweighted	Weighted	Unweighted
B	Australia	0.77	0.86	0.11	0.14
OECD	Austria	1.87	1.89	0.16	0.23
	Belgium	1.11	1.08	0.13	0.14
	Chile	2.38	2.29	1.19	1.16
	Denmark	0.97	1.19	0.13	0.15
	France	1.29	1.24	0.43	0.43
	Hungary	1.89	1.65	0.16	0.15
	Iceland	0.85	0.84	0.14	0.14
	Ireland	1.08	1.06	0.19	0.17
	Japan	1.32	1.31	0.27	0.28
	Korea	0.53	0.50	0.08	0.08
	New Zealand	0.85	0.83	0.22	0.23
	Norway	1.01	1.02	0.19	0.18
	Poland	2.05	1.93	0.11	0.11
	Spain	1.47	1.45	0.18	0.17
	Sweden	1.07	1.07	0.19	0.19
ers	Colombia	2.87	2.74	1.62	1.64
Partners	Hong Kong-China	1.00	1.01	0.34	0.35
Pe	Macao-China	1.01	1.01	0.60	0.60

Table 12.15 Distribution of not-reached items by booklet

					Number of nor	-reached items				
Booklet	0	1	2	3	4	5	6	7	8	>8
					Weighted p	ercentages				
1	91.20	0.28	1.03	1.54	0.21	0.73	0.90	0.67	0.13	3.44
2	86.86	0.85	1.79	1.07	0.83	0.84	0.33	0.48	1.09	6.94
3	86.94	1.08	1.42	1.64	1.01	0.60	0.65	0.71	0.17	5.95
4	79.48	1.28	3.62	1.19	0.84	3.69	0.81	0.92	0.59	8.18
5	86.87	2.06	2.83	2.21	0.64	1.41	0.10	0.27	0.15	3.60
6	88.76	0.81	0.73	1.06	0.23	0.67	0.38	1.87	0.30	5.50
7	87.90	0.27	0.82	0.21	1.48	0.38	1.35	0.14	0.42	7.44
8	78.70	1.22	3.09	0.33	1.11	0.63	0.94	1.36	0.40	12.62
9	85.40	0.42	0.57	1.04	2.40	0.40	0.79	1.41	0.89	7.58
10	81.83	1.29	0.68	0.94	1.91	0.71	0.91	0.76	0.75	10.97
11	87.26	0.57	0.52	0.55	1.28	0.30	0.67	1.03	0.56	7.82
12	82.72	0.76	1.27	0.58	0.68	0.61	1.01	0.46	1.49	11.90
13	80.58	0.64	0.63	0.88	1.03	0.90	1.13	0.29	1.53	13.92
21	79.82	1.21	1.18	2.77	0.65	0.95	2.32	1.94	0.47	9.15
22	72.58	1.52	2.71	2.11	1.10	1.78	0.67	0.82	1.92	16.71
23	72.43	1.11	1.90	4.03	1.73	1.29	1.09	1.20	0.86	15.21
24	72.43	1.83	3.75	1.72	1.34	4.51	1.51	1.19	1.36	11.74
25	76.52	2.58	4.01	2.67	1.27	2.33	0.21	0.95	1.03	9.46
26	74.86	0.87	0.88	0.90	0.39	0.48	0.63	1.42	0.36	19.58
27	67.64	2.92	1.99	3.40	1.35	1.67	0.42	1.76	0.55	18.86
UH	85.42	2.80	0.31	1.74	0.68	2.67	0.33	0.50	1.38	5.55
					Unweighted	percentages				
1	91.05	0.41	1.24	1.71	0.39	0.66	1.11	0.73	0.22	2.49
2	88.79	0.79	1.98	1.10	0.69	0.94	0.25	0.36	0.68	4.42
3	87.53	1.06	1.58	2.09	0.82	0.54	0.64	0.62	0.27	4.85
4	82.26	1.71	3.12	1.43	0.76	3.39	0.76	0.69	0.55	5.33
5	88.50	2.38	2.35	1.93	0.67	1.01	0.13	0.32	0.18	2.53
6	91.01	0.95	0.72	1.01	0.18	0.58	0.30	1.52	0.16	3.57
7	88.61	0.35	0.80	0.20	1.64	0.53	1.36	0.14	0.36	6.01
8	79.62	1.44	2.89	0.32	1.33	0.60	0.97	1.26	0.32	11.24
9	84.38	0.53	0.35	0.87	3.54	0.19	0.60	1.66	0.89	7.00
10	82.84	1.31	0.56	0.76	1.99	0.61	0.86	0.70	0.75	9.62
11	88.15	0.44	0.57	0.46	1.30	0.37	0.54	1.13	0.56	6.49
12	83.45	0.77	1.16	0.58	0.64	0.84	1.04	0.49	1.38	9.64
13	81.15	0.63	0.63	0.98	0.99	0.71	1.24	0.32	1.90	11.45
21	80.94	0.97	1.38	2.94	0.53	1.03	2.19	1.57	0.52	7.94
22	74.32	1.54	2.79	2.19	1.22	1.52	0.68	0.73	1.71	13.29
23	73.55	1.20	2.07	3.50	1.57	1.29	1.14	1.22	0.63	13.83
24	72.67	1.53	3.99	1.76	1.00	4.89	1.40	1.33	1.18	10.25
25	77.25	2.99	4.20	2.90	1.15	1.97	0.18	0.83	0.80	7.73
26	77.15	1.05	0.82	0.95	0.36	0.41	0.77	1.54	0.45	16.49
27	68.22	3.17	2.46	4.65	1.51	1.39	0.31	1.82	0.43	16.04
UH	83.39	2.02	0.83	2.20	1.47	2.57	0.46	0.28	0.83	5.96

Table 12.16	Distribution of not	t-reached items by	/ DRA TestID

Booklet	0	1	2	3	4	5	6	7	8	>8
					Weighted _I	percentages				
1	89.08	1.95	1.14	1.66	2.29	1.13	0.86	0.44	0.47	0.97
2	89.29	2.62	2.11	1.08	1.10	0.73	1.01	0.56	0.07	1.43
3	90.74	1.89	2.36	0.92	1.29	0.96	0.62	0.17	0.08	0.95
4	89.97	2.83	1.14	1.09	2.17	0.97	0.66	0.57	0.28	0.32
5	90.31	2.17	2.23	1.18	0.84	0.96	1.10	0.25	0.17	0.78
6	91.33	1.96	2.53	1.45	0.79	0.68	0.20	0.17	0.24	0.64
					Unweighted	percentages				
1	90.14	1.87	1.02	1.53	2.13	0.85	0.98	0.46	0.30	0.72
2	90.12	2.22	2.04	1.21	0.91	0.78	1.06	0.55	0.11	0.99
3	92.01	2.03	2.17	0.75	1.00	0.80	0.42	0.12	0.10	0.60
4	91.45	2.18	1.05	0.91	1.93	0.81	0.60	0.38	0.28	0.40
5	91.63	2.10	1.85	1.07	0.91	0.81	0.79	0.21	0.10	0.53
6	92.74	1.76	1.92	1.10	0.82	0.79	0.18	0.11	0.18	0.39

BOOKLET EFFECTS

The booklet parameters for the paper and pencil test that are described in Chapter 9 are reported in Table 12.17. The booklet effects are the amount that must be added to the proficiencies of students who responded to each booklet. That is, a positive value indicates a booklet that was harder than the average while a negative value indicates a booklet that was easier than the average. Since the booklet effects are deviations from an average they sum to zero for each domain. Table 12.18 shows the booklet effects after transformation to the PISA scales.

Table 12.17 Estimated booklet effects in logits

Table 12.17	Estimated bookiet effects in logits	·	
Booklet		Domains	
Standard set	Mathematics	Reading	Science
1	0.045	-0.04	
2		0.068	-0.1
3	0.069	-0.045	0.008
4		0.027	0.097
5	0.064	-0.181	
6		-0.056	
7	-0.058	0.101	-0.027
8	-0.071	0.122	0.071
9	-0.13	0.251	-0.032
10	0.045	-0.091	0.107
11	0.024	-0.026	
12	0.011	-0.387	0.068
13		0.258	-0.193
Easy set			
8	0.037	0.276	0.38
9	-0.248	0.387	-0.18
10	0.033	-0.238	0.228
11	0.092	0.132	
12	0.204	-0.289	0.105
13		0.406	-0.336
21	0.022	-0.173	
22		0.127	-0.026
23	0.006	-0.299	-0.016
24		-0.196	-0.12
25	0.014	-0.348	
26		0.060	
27	-0.16	0.156	-0.035

	Estimated booklet effects on the PISA		
Booklet		Domains	
Standard set	Mathematics	Reading	Science
1	3.5	-3.2	
2		5.5	-9.3
3	5.4	-3.6	0.7
4		2.2	9.0
5	5.0	-14.5	
6		-4.5	
7	-4.5	8.1	-2.5
8	-5.5	9.8	6.6
9	-10.1	20.1	-3.0
10	3.5	-7.3	10.0
11	1.9	-2.1	
12	0.9	-31.1	6.3
13		20.7	-18.0
Easy set			
8	2.9	22.1	35.4
9	-19.3	31.1	-16.8
10	2.6	-19.1	21.3
11	7.2	10.6	
12	15.9	-23.2	9.8
13		32.6	-31.3
21	1.7	-13.9	
22		10.2	-2.4
23	0.5	-24.0	-1.5
24		-15.7	-11.2
25	1.1	-27.9	
26		4.8	
27	-12.5	12.5	-3.3

Booklets that include a single domain cluster at the beginning of the booklet (mathematics in booklet 9, reading in booklet 12 and science in booklet 13) have the largest negative parameters. Booklets with the domain at the end of the booklet have the highest positive parameters. The reading booklet effects for the non-standard easier set of booklets are bigger than for the standard set of booklets.

After scaling the PISA 2009 data for each country separately, the booklet parameters were added to the students' achievement scores for mathematics, reading and science. The mean performance scores could be compared across countries and across booklets. Tables 12.19 to 12.21 present the results of testing the variance in booklet means by country (UH booklet excluded), in each domain. The table rows represent countries and the columns booklets, the cells contain the mean performance by booklet and the square root of the squared difference between the observed and expected mean, divided by the error variance by booklet (a z-score). The expected mean is the average of the booklet means, each weighted by the reciprocal of their error variance. The sum of the squared differences divided by their error variance is chi-square distributed with 13–1=12 degrees of freedom (where 13 represent the number of booklets). Significant values are in bold.

A z-score is an indication of the magnitude of the difference between the observed booklet mean and the expected booklet mean. Significantly easier or harder than expected booklets are those with z-score >1.96. Booklets numbers shaded in grey are booklets without items in the domain.

Table 10.10 Fatimated backlet offerste on th



		variane	ce in m	atnema	tics bo	oklet m	eans									
		Expected	Bookle	et 1(21)	Bookle	et 2(22)	Bookle	et 3(23)	Bookle	et 4(24)	Bookle	et 5(25)	Bookle	et 6(26)	Bookle	et 7(27)
		mean	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score
OECD	Australia	514	516	0.43	516	0.47	525	2.40	514	0.16	514	0.03	512	0.56	512	0.54
Ö	Austria	499	499	0.01	495	0.87	497	0.50	502	0.46	495	0.93	503	0.83	504	0.86
	Belgium Canada	521 527	524 524	0.91	524 529	0.71 0.49	514 528	1.81 0.46	521 527	0.01	527 529	1.51 0.60	525 527	1.23 0.18	526 530	1.35 0.88
	Chile*	421	422	0.28	419	0.39	428	1.31	418	0.68	422	0.21	421	0.02	404	3.83
	Czech Republic	496	496	0.07	492	0.69	500	0.81	495	0.18	501	1.16	492	0.87	497	0.15
	Denmark	503	495	1.40	505	0.51	517	2.38	507	0.73	507	0.84	504	0.22	493	1.95
	Estonia Finland	512 540	521 531	1.83 2.03	509 537	0.45 0.56	512 547	0.02	511 539	0.26	510 544	0.51 0.76	509 547	0.63	513 540	0.09
	France	497	505	1.61	498	0.18	498	0.14	496	0.17	491	1.05	492	0.78	491	1.04
	Germany	518	522	0.98	517	0.10	516	0.36	520	0.49	522	1.02	518	0.09	527	1.83
	Greece	466	475	1.53	463	0.48	475	1.38	468	0.28	456	1.96	463	0.47	468	0.24
	Hungary	491	486	0.71	479	1.83	492	0.23	487	0.59	489	0.32	493	0.40	488	0.52
	Iceland Ireland	507 487	509 493	0.35	506 480	0.13	503 486	0.65	506 482	0.13	508 494	0.22	505 487	0.25	491 479	2.57 1.54
	Israel	447	444	0.43	444	0.53	450	0.52	448	0.17	447	0.09	449	0.25	457	1.74
	Italy	483	482	0.32	480	0.79	479	1.47	482	0.21	481	0.47	484	0.20	494	3.69
	Japan	529	540	2.47	531	0.34	520	2.16	524	1.09	522	1.47	530	0.21	532	0.62
	Korea	547	557	2.08	545	0.28	538	1.56	543	0.63	548	0.19	547	0.09	546	0.03
	Luxembourg Mexico*	489 418	492 410	0.47 3.08	485 419	0.61 0.33	473 420	2.73 0.65	484 420	0.86	483 417	0.94 0.67	492 418	0.48	510 422	3.59
	Netherlands	529	535	1.28	534	0.33	420 520	1.54	524	0.52	524	0.67	533	0.01	422 524	0.80
	New Zealand	519	517	0.45	516	0.63	532	2.34	512	1.25	524	0.83	528	1.76	512	1.41
	Norway	499	493	1.20	500	0.18	496	0.53	500	0.29	503	0.83	497	0.32	487	2.18
	Poland	495	490	0.95	495	0.07	506	2.31	496	0.18	501	1.51	494	0.19	483	2.40
	Portugal	487	484	0.78	487	0.00	493	1.25	487	0.00	482	1.02	489	0.33	494	1.61
	Slovak Republic Slovenia	498 502	500 499	0.41 0.50	504 503	0.92 0.03	492 503	1.01 0.02	496 507	0.29 0.62	500 496	0.38	504 501	1.12 0.17	502 512	0.88
	Spain	484	477	1.74	481	0.58	486	0.70	484	0.02	487	0.99	485	0.36	487	0.83
	Sweden	494	492	0.46	493	0.23	486	1.26	495	0.24	499	0.91	495	0.10	507	2.19
	Switzerland	534	540	1.11	532	0.32	531	0.59	531	0.52	527	1.35	531	0.43	544	1.84
	Turkey	446	438	1.31	440	0.86	456	1.70	446	0.07	448	0.37	446	0.12	447	0.22
	United Kingdom United States	493 487	492 484	0.12 0.63	487 487	1.07 0.07	497 488	0.99 0.08	496 489	0.74 0.31	495 492	0.38 0.89	497 492	0.94 0.68	488 476	0.91 2.06
	onneu suites			0.05	-107	0.07	100	0.00	-105	0.51		0.05	172	0.00	47.0	1 2.00
ners	Albania*	378	381	0.42	383	0.76	383	0.71	376	0.38	380	0.31	377	0.15	370	1.34
Partners	Argentina*	388	386	0.22	396	1.19	378	1.56	386	0.30	396	1.33	387	0.18	393	0.84
_	Azerbaijan*	432	461	7.73	431	0.35	422	2.36	436	0.85	428	1.07	436	1.01	394	8.82
	Brazil*	386	390	0.88	384	0.66	374	3.56	389	0.65	376	3.21	387	0.23	405	6.56
	Bulgaria*	428	435	1.16	429	0.16	425	0.53	423	0.59	429	0.17	436	0.83	420	1.22
	Colombia*	381	380	0.32	383	0.27	373	1.37	386	0.86	366	3.10	381	0.08	399	4.30
	Croatia	460	475	3.01	459	0.17	456	0.79	455	1.04	459	0.35	456	0.76	473	2.59
	Dubai (UAE)*	453	447	0.96	449	0.61	457	0.55	453	0.06	464	2.43	455	0.38	442	1.99
	Hong Kong-China	554	557	0.72	553	0.22	566	2.59	552	0.49	551	0.61	555	0.24	546	1.66
	Indonesia	371	368	0.65	371	0.13	369	0.45	371	0.07	372	0.20	371	0.09	369	0.37
	Jordan*	387	388	0.23	379	1.34	388	0.21	386	0.21	391	0.92	390	0.54	376	2.15
	Kazakhstan*	405	410	1.04	404	0.17	401	0.74	402	0.67	405	0.00	403	0.31	406	0.21
	Kyrgyzstan*	330	323	1.44	331	0.05	337	1.30	330	0.02	335	1.04	331	0.21	334	0.81
	Latvia	482	484	0.43	480	0.28	485	0.53	484	0.29	488	1.19	487	0.92	482	0.07
	Liechtenstein	536	549	0.73	538	0.15	546	0.56	530	0.35	541	0.30	541	0.19	526	0.66
	Lithuania	477	480	0.86	479	0.53	481	0.94	476	0.18	477	0.11	479	0.33	474	0.55
	Macao-China	525	525	0.08	526	0.19	533	1.71	526	0.09	529	0.87	525	0.02	524	0.27
	Montenegro	403	401	0.29	405	0.49	407	0.62	404	0.28	394	1.72	402	0.15	415	2.61
	Panama*	361	338	2.75	350	1.25	363	0.31	359	0.30	353	1.22	367	0.89	372	1.81
	Peru*	365	364	0.22	360	0.92	363	0.28	364	0.09	360	0.90	372	1.20	382	3.18
	Qatar*	368	367	0.24	369	0.30	364	0.88	370	0.46	374	1.48	369	0.23	356	3.13
	Romania*	427	414	2.49	427	0.06	433	1.02	427	0.03	429	0.30	425	0.33	428	0.25
	Russian Federation	468	462	1.05	470	0.51	466	0.23	472	1.02	467	0.17	470	0.50	468	0.16
	Serbia*	442	444	0.19	439	0.65	437	1.21	439	0.59	438	0.95	442	0.04	448	0.96
	Shanghai-China	600	601	0.37	600	0.04	599	0.07	598	0.30	601	0.23	598	0.42	607	1.14
	Singapore	562	565	0.55	560	0.24	556	0.95	562	0.11	567	0.25	559	0.54	570	1.49
	Chinese Taipei	544	536	1.63	547	0.49	553	1.47	540	0.69	543	0.18	545	0.09	543	0.16
	Thailand	419	411	1.88	420	0.26	436	3.31	416	0.57	419	0.03	421	0.41	407	2.33
	Trinidad and Tobago*	413	413	0.00	414	0.10	428	2.00	415	0.26	414	0.03	414	0.14	411	0.44
	Tunisia*	371	371	0.00	374	0.10	373	0.34	374	0.20	368	0.00	371	0.14	384	2.57
	Uruguay*	427	428	0.34	428	0.37	422	0.92	429	0.33	432	1.09	426	0.15	429	0.56

[Part 1/2]

[Part 2/2]

Table 12.19 Variance in mathematics booklet means

		klet 8		s bookle klet 9		det 10	Book	let 11	Book	det 12	Book	det 13	Chi-s
	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	(df=12
Australia	509	1.17	521	1.79	507	2.01	516	0.45	515	0.19	509	1.33	11.5
Austria	495	1.02	486	2.70	512	3.05	505	1.07	499	0.14	494	0.88	13.3
Belgium	516	1.19	508	3.06	526	1.30	521	0.11	519	0.31	519	0.46	14.0
Canada	526	0.31	522	1.60	526	0.05	524	0.67	530	0.97	527	0.04	6.9
Chile*	427	1.47	413	1.92	426	1.28	424	0.55	427	1.49	422	0.23	13.3
Czech Republic	498	0.42	500	0.80	496	0.00	498	0.47	487	1.82	494	0.29	7.7
Denmark Estonia	506 516	0.62	514 504	1.89 1.57	493 512	1.98 0.18	507 518	0.79	498 511	1.01 0.30	498 511	0.80	15.
Finland	534	1.34	544	0.72	530	2.20	545	1.06	546	1.22	543	0.22	13.4
France	508	2.08	489	1.65	492	0.92	495	0.33	505	1.33	499	0.55	11.
Germany	515	0.52	500	3.62	529	2.34	513	0.92	515	0.59	516	0.47	13.
Greece	470	0.50	480	2.29	461	0.90	462	0.53	455	1.70	464	0.33	12.
Hungary	490	0.04	494	0.75	496	0.88	496	1.11	491	0.09	491	0.10	7.0
Iceland	506	0.13	503	0.78	513	0.96	505	0.37	526	3.37	506	0.23	10.
Ireland	499	2.35	484	0.55	478	1.69	492	0.75	493	1.06	484	0.56	13.
Israel	443	0.76	447	0.03	449	0.38	444	0.53	444	0.48	445	0.44	6.4
Italy	483 525	0.14	482 529	0.32 0.07	484 530	0.37	483	0.16	478	1.84 1.70	486 530	1.09	11.
Japan Korea	525	0.67	529	1.35	530	0.22	527 544	0.51 0.45	537 547	0.15	530	0.22	11.
Luxembourg	499	1.81	474	2.80	502	2.31	489	0.43	482	1.14	492	0.58	18.
Mexico*	423	1.68	420	0.78	418	0.05	417	0.58	419	0.21	417	0.76	10.
Netherlands	530	0.17	520	1.68	533	0.62	538	1.22	535	0.83	533	0.52	12.
New Zealand	511	1.63	522	0.55	520	0.18	518	0.21	518	0.17	520	0.14	11.
Norway	503	0.87	517	4.29	490	1.58	495	0.65	500	0.22	492	1.31	14.
Poland	502	1.41	491	0.79	488	1.14	487	1.64	505	1.58	495	0.15	14.
Portugal	483	0.88	487	0.09	491	0.69	477	1.92	486	0.23	491	0.72	9.
Slovak Republic	495	0.58	492	1.26	501	0.56	499	0.32	493	0.96	497	0.22	8.9
Slovenia	500	0.32	498	1.00	511	1.40	503	0.12	500	0.49	503	0.06	7.9
Spain Sweden	483 500	0.19	488 493	1.25 0.10	485 488	0.36	479 485	1.11	481 497	0.90	481 495	0.65	9.7
Switzerland	528	1.07	529	1.28	545	1.14	540	1.49	525	1.82	538	0.27	14.
Turkey	425	3.60	464	3.38	448	0.37	455	1.61	430	2.63	447	0.21	16.
United Kingdom	498	1.08	502	2.51	481	2.84	487	1.23	491	0.37	490	0.41	13.
United States	485	0.41	496	1.53	483	0.59	487	0.16	495	1.27	482	0.95	9.6
Albania*	356	3.26	393	2.44	379	0.05	388	1.72	360	2.47	381	0.51	14.
Argentina*	396	1.22	377	1.99	392	0.65	386	0.28	383	0.69	390	0.33	10.
Azerbaijan*	406	5.89	422	2.49	403	6.02	440	1.96	493	13.28	434	0.49	52.
Brazil*	389	0.69	377	2.45	395	2.51	381	1.31	381	1.77	387	0.09	24.
Bulgaria*	419	1.15	431	0.46	431	0.35	428	0.01	433	0.66	426	0.23	7.5
Colombia*	383	0.42	379	0.41	393	2.00	374	1.63	377	0.84	378	0.88	16.
													13.
Croatia	451	1.72	458	0.50	464	0.89	459	0.29	454	1.14	460	0.11	
Dubai (UAE)*	461	1.49	445	1.52	436	3.09	459	1.18	463	1.90	451	0.28	16.
Hong Kong-China	539	3.26	565	2.08	563	1.67	562	1.32	547	1.36	551	0.70	16.
Indonesia	375	0.73	382	2.09	367	0.89	368	0.74	371	0.05	374	0.53	7.0
Jordan*	385	0.29	385	0.31	395	1.68	385	0.30	390	0.55	389	0.52	9.3
Kazakhstan*	410	1.01	407	0.61	410	1.07	404	0.19	396	1.93	406	0.16	8.
Kyrgyzstan*	329	0.31	348	3.13	338	1.26	316	3.37	323	1.49	330	0.01	14.
Latvia	489	1.16	456	4.43	486	0.66	478	0.69	486	0.58	479	0.54	11.
Liechtenstein	509	1.42	547	0.55	549	0.76	528	0.39	545	0.47	526	0.53	7.0
Lithuania	471	1.06	476	0.07	474	0.62	488	2.39	468	1.98	473	0.69	10.
Macao-China	519	1.50	527	0.36	520	1.01	530	1.09	522	0.84	523	0.58	8.0
Montenegro	387	2.84	403	0.06	415	2.22	402	0.00	396	1.35	403	0.09	12
Panama*	358	0.27	359	0.17	382	3.00	372	1.37	345	2.15	362	0.19	15.
Peru*	364	0.17	370	1.09	368	0.54	356	2.02	355	1.95	370	0.86	13.
Qatar*	381	3.41	370	0.50	364	1.30	369	0.30	366	0.44	366	0.54	13.
Romania*	429	0.49	428	0.15	434	1.54	434	1.39	416	2.32	427	0.10	10.
Russian Federation	475	1.17	467	0.18	465	0.43	463	0.97	464	0.74	472	0.73	7.9
Serbia*	439	0.75	431	2.58	453	2.16	453	2.72	444	0.37	444	0.22	13.
Shanghai-China	593	1.49	595	1.02	602	0.45	614	2.58	593	1.40	601	0.24	9.
Singapore	548	2.62	560	0.31	570	1.38	567	0.81	555	0.86	565	0.49	11.
Chinese Taipei	514	5.36	560	3.28	570	2.06	557	2.42	532	2.12	540	0.83	20.
•													
Thailand	410	1.83	443	5.14	416	0.65	420	0.32	406	2.36	420	0.25	19.
Trinidad and Tobago*	430	2.72	424	2.14	389	4.85	401	1.94	417	0.70	414	0.18	15.
Tunisia*	358	3.18	376	1.18	373	0.40	367	1.00	370	0.23	372	0.23	11.
Uruguay*	436	1.87	430	0.71	427	0.13	416	2.70	428	0.23	418	1.55	10.

Note: Values that are statistically significant are indicated in bold. * These countries opted for the easier booklets.



	Table 12.20	Variand	ce in re	ading b	ooklet	means										
		Expected	Bookle	et 1(21)	Bookle	et 2(22)	Bookle	t 3(23)	Bookle	et 4(24)	Bookle	et 5(25)	Bookle	t 6(26)	Bookle	et 7(27)
		mean	Mean	Z-Score												
8	Australia	515	518	0.98	518	0.69	523	1.99	512	0.84	507	2.09	516	0.38	508	1.82
OECD	Austria	475	477	0.58	472	0.44	460	2.65	474	0.13	471	0.85	478	0.83	478	0.82
	Belgium	511	512	0.15	511	0.02	509	0.64	507	1.12	520	2.19	514	0.79	508	0.90
	Canada Chile*	524 450	514 454	3.18 1.04	522 447	0.55	536 451	3.29 0.35	524 445	0.01 0.99	519 443	1.50 1.62	528 447	1.25 0.49	522 449	0.53
	Czech Republic	430	434	0.38	447	0.98	473	1.88	483	0.33	443	0.91	447	0.49	449	1.75
	Denmark	495	492	0.55	493	0.43	498	0.57	499	0.79	491	0.76	499	0.85	493	0.63
	Estonia	501	501	0.04	505	0.60	486	2.68	498	0.63	493	1.62	500	0.17	510	1.98
	Finland	537	540	0.72	532	0.71	549	2.42	535	0.36	521	3.05	550	2.77	534	0.59
	France	495	505	1.80	499	0.57	504	1.54	498	0.47	499	0.59	491	0.79	496	0.16
	Germany	503	494	2.03	505	0.42	489	2.58	499	0.92	503	0.04	495	1.79	508	1.09
	Greece Hungary	483 494	498 490	2.82 0.84	477 488	0.85	482 493	0.12 0.33	473 486	1.60 1.66	484 493	0.24 0.29	487 495	0.50 0.15	485 499	0.30
	Iceland	500	500	0.04	499	0.09	504	0.33	495	0.82	490	1.81	508	1.21	499	1.37
	Ireland	496	500	0.66	493	0.48	492	0.74	485	1.74	494	0.47	492	0.67	505	1.72
	Israel	473	477	0.44	453	3.32	477	0.61	468	0.96	482	1.61	488	2.10	474	0.12
	Italy	486	491	2.05	491	1.57	484	0.62	486	0.21	495	3.41	484	0.67	483	1.22
	Japan	519	504	3.26	524	0.90	515	0.86	508	2.41	517	0.39	531	2.49	517	0.53
	Korea	538	530	1.91	543	0.77	534	0.73	536	0.35	533	1.08	537	0.16	541	0.53
	Luxembourg	472	474	0.36	471	0.18	462	1.58	458	2.59	478	1.02	476	0.61	483	1.69
	Mexico* Netherlands	425 511	424 509	0.17 0.37	430 520	1.50 1.54	429 511	1.32 0.02	423 499	0.96	416 499	3.98 1.67	424 513	0.40 0.37	414 507	3.36
	Netherlands New Zealand	511	509	0.37	520 516	0.79	511	0.02	499 509	2.24	499 516	0.91	513	2.48	507	0.57
	Norway	503	521	1.50	509	0.79	507	0.50	513	1.85	507	0.91	505	0.35	498	1.01
	Poland	501	504	0.65	499	0.33	498	0.52	492	1.59	506	1.09	498	0.68	496	0.98
	Portugal	489	491	0.49	499	1.63	501	2.55	497	1.65	497	1.74	492	0.73	481	1.86
	Slovak Republic	478	473	0.85	485	1.27	470	1.60	482	0.86	484	1.39	480	0.44	482	0.91
	Slovenia	485	473	2.15	499	2.61	473	2.10	489	0.65	488	0.53	479	1.11	491	1.11
	Spain	482	480	0.39	479	0.77	492	2.90	483	0.35	492	3.17	485	0.94	481	0.16
	Sweden	497	503	1.18	497	0.06	495	0.44	497	0.10	509	1.89	499	0.30	503	0.92
	Switzerland Turkey	501 465	499 475	0.44 2.25	495 454	1.30 1.98	483 475	3.79 1.89	495 464	1.07 0.17	496 467	1.00 0.30	502 461	0.06 0.85	511 466	2.20 0.17
	United Kingdom	465	495	0.16	493	0.28	492	0.47	404	0.17	487	1.25	502	1.51	400	0.17
	United States	500	503	0.55	492	1.01	508	1.43	502	0.40	490	1.84	502	0.31	496	0.65
s	All	200	267		200	2.02	272	1 70	204	0.22	397	1.01	207	0.16	207	0.26
Partners	Albania*	386	367	2.81	399	2.03	373	1.70	384	0.23		1.81	387	0.16	387	0.26
Part	Argentina*	398	411	1.85	412	1.68	400	0.18	401	0.34	410	2.07	379	2.60	387	2.03
	Azerbaijan*	362	386	5.07	359	0.75	359	0.58	352	1.88	356	1.58	355	1.68	378	3.29
	Brazil*	412	420	1.68	415	0.64	414	0.48	409	0.80	406	1.66	413	0.29	410	0.47
	Bulgaria*	428	420	1.14	434	0.63	418	1.36	415	1.64	438	1.17	444	1.49	438	1.04
	Colombia*	412	428	3.05	427	2.44	419	1.09	414	0.43	408	0.56	408	0.64	387	5.22
	Croatia	477	472	0.84	488	2.32	467	1.99	467	2.07	483	1.55	476	0.05	489	2.73
	Dubai (UAE)*	459	442	2.64	452	1.18	462	0.51	452	1.42	450	1.71	473	2.30	466	1.28
	Hong Kong-China	532	519	3.52	538	1.25	518	3.63	529	1.04	521	2.75	532	0.17	528	0.96
	Indonesia	401	398	0.77	394	1.40	398	0.69	394	1.87	407	1.06	394	1.76	400	0.30
	Jordan*	405	399	1.10	379	4.38	408	0.57	388	3.12	382	4.95	420	2.49	396	1.69
	Kazakhstan*	391	377	2.51	388	0.38	380	2.07	377	2.81	393	0.58	390	0.10	390	0.15
	Kyrgyzstan*	314	313	0.22	310	0.55	305	1.42	311	0.64	328	2.83	309	0.87	310	0.79
	Latvia	485	468	3.18	480	0.85	470	2.37	491	1.34	486	0.20	495	1.97	490	0.87
	Liechtenstein	499	498	0.00	503	0.28	504	0.31	492	0.48	508	0.64	517	0.86	496	0.14
	Lithuania	468	458	2.32	495	5.45	447	3.99	462	1.40	474	1.28	458	2.04	471	0.56
	Macao-China	487	472	3.72	489	0.50	466	5.94	475	3.11	490	0.66	489	0.36	478	2.15
	Montenegro	408	410	0.27	411	0.52	395	2.34	408	0.03	426	3.28	412	0.55	419	1.96
	Panama*	373	349	2.09	355	1.65	348	2.47	372	0.14	376	0.34	372	0.19	378	0.63
	Peru*	369	387	2.97	367	0.45	366	0.58	366	0.62	368	0.23	370	0.19	357	2.51
	Qatar*	372	356	3.70	365	1.35	365	1.29	367	1.17	363	1.82	384	2.74	371	0.25
	Romania*	425	410	2.81	440	2.46	400	3.84	413	1.97	423	0.41	426	0.13	432	1.28
	Russian Federation	459	455	0.66	468	1.50	453	1.26	451	1.72	469	1.76	461	0.43	457	0.53
	Serbia*	442	430	2.38	445	0.57	428	3.69	430	3.01	428	3.03	462	5.03	459	3.62
	Shanghai-China	555	543	2.86	562	1.32	546	2.32	556	0.30	549	1.45	549	1.46	573	3.61
	Singapore	525	520	1.04	516	1.65	522	0.51	521	0.93	522	0.58	524	0.36	521	0.96
	Chinese Taipei	496	483	2.72	504	2.08	480	3.25	485	2.24	501	1.33	493	0.55	498	0.59
	Thailand	421	420	0.27	420	0.33	411	2.60	408	3.51	421	0.04	420	0.19	424	0.64
	Trinidad and Tobago*	416	416	0.12	418	0.39	420	0.57	417	0.19	420	0.67	412	0.45	419	0.43
				1		1										
	Tunisia*	404	404	0.01	409	1.01	385	3.41	404	0.15	403	0.27	401	0.78	401	0.68

[Part 1/2]

[Part 2/2]	

Table 12.20 Variance in reading booklet means

Table 12.20		klet 8		det 9		let 10	Book	let 11	Book	let 12	Book	let 13	Chi-sq
-	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	(df=12)
Australia	510	1.14	509	1.43	514	0.30	526	2.88	528	3.62	504	2.75	20.9
Austria	487	2.51	476	0.29	469	1.27	480	1.08	464	1.82	477	0.37	13.7
Belgium	506	1.33	504	1.62	521	2.54	510	0.27	511	0.06	511	0.06	11.7
Canada	521	1.02	518	1.84	526	0.74	527	0.97	530	1.83	527	0.94	17.7
Chile*	452	0.54	455	1.31	444	1.18	455	1.04	440	1.91	459	2.13	13.1
Czech Republic Denmark	487 509	0.99 3.04	479 492	0.57 0.66	473 490	1.80 1.08	481 503	0.09	476 486	1.01 2.08	489 490	1.57 1.14	13.0 14.5
Estonia	506	1.01	505	0.72	496	1.10	508	1.26	498	0.41	506	0.94	13.2
Finland	536	0.12	534	0.59	523	2.44	542	1.20	524	2.39	546	1.97	19.3
France	493	0.42	481	2.65	494	0.34	493	0.47	505	1.57	487	1.57	12.9
Germany	513	2.28	509	1.31	505	0.44	512	2.27	495	1.65	505	0.45	17.3
Greece	477	0.92	493	1.55	479	0.57	470	1.88	500	2.45	471	1.94	15.7
Hungary	492	0.52	505	2.06	498	0.81	494	0.11	500	1.06	493	0.39	10.2
Iceland	492	1.22	498	0.38	505	0.86	504	0.68	520	3.38	495	0.89	13.5
Ireland Israel	513 462	3.09 2.07	491 461	0.89	492 497	0.75 4.07	499 469	0.36	485 485	1.84 1.76	501 465	0.90	14.3 21.1
Italy	481	1.65	482	1.59	497	2.08	479	1.89	483	0.97	485	0.17	18.1
Japan	520	0.21	509	2.16	520	0.11	523	0.64	557	7.59	512	1.70	23.3
Korea	555	3.30	534	1.04	518	4.52	554	2.88	553	3.09	541	0.59	21.0
Luxembourg	478	1.04	483	2.06	466	0.99	477	0.65	467	0.81	464	1.34	14.9
Mexico*	428	1.07	434	3.41	426	0.68	431	2.05	417	2.94	432	2.69	24.5
Netherlands	511	0.12	504	1.12	518	1.00	517	0.88	518	0.95	520	1.24	11.8
New Zealand	507	2.25	528	1.35	519	0.25	524	0.59	526	0.91	530	1.49	14.7
Norway Poland	507 509	0.72	496 507	1.36 1.03	501 498	0.33 0.49	496 491	1.34 1.84	500 494	0.60	492 515	2.08 2.73	13.5 14.7
Portugal	476	2.89	479	2.14	498	0.49	491	1.84	494	0.92	486	0.75	14./
Slovak Republic	469	1.82	479	0.01	489	2.39	472	1.30	493	1.61	478	0.09	14.5
Slovenia	492	1.59	477	1.63	483	0.33	487	0.39	478	1.30	492	1.37	16.9
Spain	476	1.29	477	1.32	487	1.43	472	2.27	476	1.44	473	2.14	18.6
Sweden	505	1.38	491	0.98	494	0.55	488	1.68	486	2.16	501	0.68	12.3
Switzerland	504	0.74	500	0.30	503	0.46	509	1.79	500	0.40	509	1.95	15.5
Turkey	460	1.08	475	2.03	482	3.44	454	2.13	432	6.03	469	0.76	23.1
United Kingdom United States	496 494	0.27	494 514	0.09 2.55	503 497	1.77 0.41	488 502	1.28 0.46	497 507	0.65	488 490	1.21 1.71	9.3 13.7
Onited States	494	1.07	514	2.35	497	0.41	302	0.40	307	1.54	490	1.71	13.7
Albania*	374	1.49	397	1.69	370	2.32	395	1.56	382	0.51	391	0.94	17.5
Argentina*	408	1.32	386	1.80	396	0.34	392	0.80	402	0.52	395	0.50	16.0
Azerbaijan*	385	4.76	345	3.13	388	4.28	352	1.92	339	3.75	344	3.45	36.1
Brazil*	404	1.56	414	0.45	409	0.77	399	2.76	424	2.90	417	1.34	15.8
Bulgaria*	427	0.17	432	0.48	432	0.41	421	0.71	428	0.01	432	0.59	10.8
Colombia*	407	0.87	413	0.22	415	0.63	418	1.08	419	1.23	405	1.34	18.8
Croatia	472	0.99	490	3.08	474	0.63	457	3.58	477	0.10	473	0.75	20.6
Dubai (UAE)*	460	0.15	465	1.11	448	2.08	469	1.80	465	0.99	468	1.23	18.4
Hong Kong-China	543	2.80	539	1.80	535	0.59	550	3.60	550	3.71	530	0.49	26.3
Indonesia	399	0.54	413	2.38	413	2.56	406	1.07	396	0.86	410	1.69	17.0
Jordan*	414	1.92	420	3.07	412	1.41	418	2.41	408	0.66	423	3.41	31.2
Kazakhstan*	401	1.97	384	1.38	408	3.60	407	3.53	380	2.02	398	1.54	22.6
Kyrgyzstan*	305	1.53	317	0.56	334	2.95	308	1.21	320	1.03	314	0.06	14.7
Latvia	492	1.31	490	0.88	486	0.28	490	1.08	476	1.43	479	0.88	16.6
Liechtenstein	486	0.73	487	0.77	483	0.75	514	0.67	506	0.46	500	0.12	6.2
Lithuania	475	1.41	481	2.62	456	3.15	473	0.84	468	0.13	473	1.06	26.3
Macao-China	491	1.09	481	1.54	487	0.03	512	6.88	513	6.80	484	0.90	33.7
Montenegro	399	1.43	415	1.42	411	0.44	394	2.62	398	1.67	401	1.16	17.7
Panama*	379	0.52	382	0.95	391	1.90	386	1.44	354	1.84	382	1.10	15.3
Peru*	364	1.02	383	2.57	374	0.80	364	0.99	364	0.87	376	1.26	15.1
Qatar*	385	3.17	388	3.58	372	0.04	362	2.36	371	0.19	383	2.37	24.0
Romania*	429	0.83	431	1.05	416	1.91	426	0.18	443	3.43	431	1.12	21.4
Russian Federation	444	2.86	455	0.57	476	3.19	456	0.55	472	2.27	455	0.80	18.1
Serbia*	443	0.20	461	4.93	431	2.86	443	0.16	447	1.25	439	0.69	31.4
Shanghai-China	568	3.35	557	0.42	538	4.63	572	3.72	557	0.55	558	0.62	26.6
	520	1.01	524	0.19	524	0.32	535	1.74	553	4.97	535	1.58	15.8
Singapore		2.26	496	0.10	511	3.58	504	1.73	505	1.92	493	0.75	23.1
0.	485					2.00							19.5
Chinese Taipei	485 421		437	3 70	432	2 70	422	0.13	410	1 7 4 4		977	
Chinese Taipei Thailand	421	0.04	437	3.79	432	2.70	422	0.13	410	2.43	432	2.77	
Chinese Taipei			437 412 410	3.79 0.63 1.34	432 408 411	2.70 1.22 1.50	422 413 406	0.13 0.31 0.51	410 447 401	2.43 4.45 0.56	432 400 415	2.77 2.37 2.43	13.5 12.9 14.5



	Table 12.21	Varian	<u>e in sc</u>	ience bo	oklet r	means										
		Expected	Bookle	et 1(21)	Bookle	et 2(22)	Bookle	et 3(23)	Bookle	et 4(24)	Bookle	et 5(25)	Bookle	et 6(26)	Bookle	et 7(27)
		mean	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score
	Australia	527	532	1.29	538	2.23	534	1.57	525	0.37	528	0.29	525	0.46	525	0.48
	Austria	499	499	0.10	490	1.54	491	1.44	513	2.57	501	0.30	502	0.46	495	0.85
	Belgium	513	514	0.24	521	1.71	515	0.58	504	2.27	522	1.95	516	0.79	523	2.37
	Canada	528	529	0.26	540	2.98	535	1.85	525	0.91	529	0.34	529	0.22	525	0.79
	Chile* Czech Republic	448 505	446 510	0.26 0.97	455 501	1.26 0.79	452 498	0.85 1.48	433 515	3.25 1.96	446 507	0.44 0.38	447 503	0.08 0.40	439 511	1.60
	Denmark	499	499	0.97	499	0.79	498	0.89	513	2.61	507	0.38	500	0.40	485	3.14
	Estonia	528	531	0.62	535	1.08	529	0.03	530	0.44	524	0.67	524	0.67	522	1.28
	Finland	554	549	0.98	550	0.72	557	0.45	552	0.49	548	1.20	559	0.91	567	2.30
	France	499	502	0.49	503	0.60	501	0.35	495	0.65	495	0.61	494	0.75	491	1.37
	Germany	527	526	0.20	521	1.45	531	0.87	541	3.40	527	0.01	526	0.12	526	0.09
	Greece	471	471	0.07	481	1.40	471	0.06	465	1.02	470	0.19	470	0.21	467	0.54
	Hungary	503	500	0.52	484	3.11	500	0.55	505	0.26	497	1.28	506	0.52	503	0.05
	Iceland	496	492	0.61	491	0.72	493	0.39	497	0.30	495	0.18	495	0.07	496	0.13
	Ireland	508	515	1.20	498	1.41	500	1.32	502	0.80	506	0.22	507	0.12	520	2.19
	Israel	456	453 489	0.42	454 488	0.20	457	0.30	451	0.85	453 490	0.36	458	0.35	454 482	0.34
	Italy Japan	489 540	543	0.20 0.75	539	0.41	484 538	2.07 0.28	495 543	1.93 0.76	537	0.38 0.50	489 541	0.03 0.25	402 522	2.70
	Korea	538	539	0.73	542	0.61	548	1.90	517	3.84	537	0.08	537	0.25	536	0.36
	Luxembourg	484	484	0.05	481	0.45	486	0.45	476	1.24	483	0.13	488	0.71	491	1.00
	Mexico*	414	413	0.39	434	6.38	418	1.17	410	1.91	417	1.25	416	0.69	410	1.59
	Netherlands	527	532	0.86	536	1.55	533	0.95	504	3.50	520	1.05	531	0.56	536	1.18
	New Zealand	532	529	0.45	527	0.74	540	1.30	525	1.32	535	0.52	543	1.71	524	1.43
	Norway	500	498	0.42	495	0.82	481	3.17	525	4.53	503	0.52	499	0.26	483	3.44
	Poland	508	508	0.03	509	0.23	512	0.90	507	0.08	509	0.29	507	0.17	495	2.66
	Portugal	493	490	0.63	493	0.01	489	0.98	508	3.26	492	0.33	495	0.44	492	0.26
	Slovak Republic	491	491	0.09	517	3.88	497	1.13	496	1.14	490	0.19	496	0.87	478	2.40
	Slovenia	513	511	0.38	524	1.94	517	0.71	526	2.02	508	0.85	515	0.34	507	1.18
	Spain Sweden	488 495	488 501	0.09	494 493	1.53 0.33	486 492	0.51 0.49	492 505	1.10 1.70	492 500	1.43 0.82	489 497	0.41 0.39	483 494	1.51 0.25
	Switzerland	516	523	1.28	516	0.33	515	0.49	517	0.12	514	0.82	513	0.59	519	0.23
	Turkey	454	451	0.73	443	1.98	450	0.89	453	0.12	452	0.38	456	0.40	461	1.34
	United Kingdom	514	515	0.20	499	2.99	506	1.66	529	2.73	515	0.26	517	0.71	519	1.03
	United States	502	502	0.03	494	1.18	500	0.37	510	1.52	502	0.05	505	0.41	497	0.73
.		204	204	0.45	200	1.00	200	0.22	205	0.47	207	0.05	200	0.40	201	1.50
	Albania*	394	394	0.45	380	1.83	389	0.33	395	0.47	397	0.85	388	0.49	381	1.50
	Argentina*	403	403	0.28	418	2.58	398	0.50	403	0.31	405	0.65	397	0.59	386	2.36
	Azerbaijan*	373	373	0.57	436	10.49	387	3.53	360	1.90	376	1.04	373	0.67	345	6.57
	Brazil*	407	407	0.08	396	2.60	410	0.94	403	1.04	406	0.05	406	0.15	415	2.84
	Bulgaria*	445	445	0.88	439	0.04	436	0.41	444	0.58	441	0.29	444	0.52	431	1.08
	Colombia*	406	406	0.83	431	4.53	396	0.96	409	1.26	394	1.08	404	0.57	398	0.69
	Croatia	491	491	0.82	492	1.17	486	0.20	489	0.52	485	0.41	485	0.36	483	0.73
	Dubai (UAE)*	468	468	0.20	451	2.52	471	0.74	465	0.42	468	0.13	470	0.43	481	2.54
	Hong Kong-China	552	552	0.78	550	0.26	554	1.08	544	1.27	543	1.17	550	0.28	546	0.61
	Indonesia	381	381	0.31	365	3.32	385	0.48	378	0.90	383	0.06	381	0.34	398	3.16
	Jordan*	415	415	0.15	393	3.65	409	1.11	415	0.18	416	0.03	418	0.25	422	1.30
	Kazakhstan*	397	397	0.80	395	0.87	389	2.35	414	2.86	402	0.20	400	0.19	397	0.81
	Kyrgyzstan*	332	332	0.32	322	1.42	321	1.82	335	1.04	329	0.30	328	0.37	324	1.35
	Latvia	486	486	1.45	492	0.39	494	0.04	514	3.66	499	0.96	499	0.86	490	0.82
	Liechtenstein	528	528	0.51	520	0.06	552	1.64	519	0.04	537	1.04	532	0.53	499	1.32
	Lithuania	493	493	0.54	505	2.70	489	0.36	493	0.46	491	0.06	493	0.36	485	1.13
	Macao-China	512	512	0.23	509	0.51	511	0.07	516	1.26	510	0.18	511	0.12	504	1.76
	Montenegro	403	403	0.25	391	2.22	399	0.50	415	2.82	401	0.18	403	0.12	396	1.10
	U															
	Panama*	369	369	0.66	347	3.51	368	1.10	388	1.54	378	0.18	385	1.13	382	0.74
	Peru*	370	370	0.16	368	0.09	361	1.52	380	1.97	367	0.35	373	0.84	364	1.10
	Qatar*	380	380	0.11	363	3.40	377	0.61	382	0.64	381	0.27	380	0.06	383	0.79
	Romania*	429	429	0.02	407	3.96	419	1.69	437	1.77	430	0.20	427	0.30	440	2.18
	Russian Federation	469	469	1.46	476	0.44	470	1.61	493	2.95	480	0.19	480	0.35	472	1.18
	Serbia*	440	440	0.57	442	0.24	439	1.12	437	1.20	442	0.22	445	0.47	443	0.08
	Shanghai-China	574	574	0.22	568	1.41	577	0.48	575	0.11	576	0.25	573	0.54	582	1.40
	Singapore	543	543	0.22	527	2.63	547	0.46	535	1.26	544	0.48	537	0.93	559	3.01
	01															
	Chinese Taipei	519	519	0.55	514	1.56	519	0.36	520	0.19	524	0.57	521	0.06	520	0.36
	Thailand	423	423	0.65	401	5.15	415	2.34	437	2.85	425	0.28	428	0.38	431	0.90
	Trinidad and	414	414	0.64	405	0.65	424	2.01	409	0.12	410	0.02	410	0.06	405	0.74
	Tobago*															
	Tunisia*	396	396	1.07	386	3.31	393	1.64	413	2.28	400	0.37	402	0.00	421	4.05
	Uruguay*	429	429	0.37	431	0.85	426	0.23	430	0.56	431	0.79	425	0.39	422	0.91

[Part 1/2]



[Part 2/2] Table 12.21 Variance in science booklet means

		Bool	klet 8	Bool	klet 9	Book	let 10	Book	let 11	Book	let 12	Book	let 13	Chi-sq
		Mean	Z-Score	Mean	Z-Score	(df=12)								
Q	Australia	529	0.51	520	1.78	530	0.87	528	0.35	529	0.49	513	3.66	14.3
OECD	Austria	487	2.41	511	2.06	506	1.47	503	0.70	502	0.50	488	1.80	16.2
Ŭ	Belgium	521	1.87	494	4.73	511	0.44	515	0.53	506	1.85	514	0.26	19.6
	Canada	528	0.04	522	2.24	527	0.43	529	0.29	526	0.54	528	0.02	10.9
	Chile* Czech Republic	477 510	7.35 0.80	439 503	2.01 0.54	449 509	0.34 0.77	450 502	0.40	445 503	0.70 0.48	438 497	2.23	20.8 11.9
	Denmark	502	0.58	513	2.76	508	1.55	499	0.00	496	0.40	497	3.23	16.4
	Estonia	548	3.77	523	0.79	536	1.66	531	0.49	521	1.06	508	3.56	16.3
	Finland	556	0.34	543	2.27	554	0.16	558	0.82	560	1.30	551	0.56	12.5
	France	494	0.73	493	1.10	492	1.25	502	0.60	498	0.08	516	3.70	12.3
	Germany	516	2.25	526	0.10	534	1.53	527	0.01	528	0.18	519	1.79	12.0
	Greece	449	3.05	477	1.06	460	1.78	472	0.08	471	0.06	487	3.18	12.7
	Hungary	508	0.82	517	3.25	507	0.74	506	0.55	506	0.61	495	1.96	14.2
	Iceland Ireland	489 521	1.02	495 508	0.03	492 506	0.51	505 512	1.48 0.66	505 506	1.52 0.26	497 500	0.18	7.1 12.1
	Israel	438	2.99	458	0.08	457	0.24	457	0.88	451	0.26	473	3.61	11.2
	Italy	481	2.22	500	4.24	486	0.87	489	0.07	489	0.24	492	1.10	16.4
	Japan	527	2.19	549	2.28	552	2.22	536	0.70	544	0.96	540	0.00	14.7
	Korea	567	5.57	524	2.99	540	0.53	538	0.13	538	0.08	531	1.36	17.9
	Luxembourg	477	1.22	488	0.78	479	0.81	487	0.46	480	0.65	491	1.20	9.2
	Mexico*	436	6.84	411	1.53	413	0.81	417	1.20	410	2.22	402	5.61	31.6
	Netherlands	535	1.07	510	2.82	526	0.17	529	0.26	522	0.70	540	1.78	16.4
	New Zealand Norway	527 497	0.76	542 524	1.58 4.92	533 497	0.06 0.49	531 500	0.17 0.09	526 503	0.97 0.54	535 492	0.52	11.5 21.5
	Poland	526	3.62	500	1.49	507	0.09	504	0.82	516	1.38	504	0.72	12.5
	Portugal	484	1.81	501	1.74	485	1.68	490	0.61	497	0.93	491	0.51	13.2
	Slovak Republic	492	0.29	492	0.17	497	1.26	491	0.07	478	2.61	476	2.66	16.7
	Slovenia	519	0.91	514	0.11	524	1.80	515	0.29	508	0.93	488	4.32	15.8
	Spain	497	2.04	488	0.04	489	0.44	487	0.10	483	1.49	478	2.52	13.2
	Sweden	490	0.80	497 516	0.40	485 525	1.78	489	1.06	499	0.73 0.85	494	0.26	10.0 7.2
	Switzerland Turkey	512 454	0.94 0.05	462	0.10	456	1.71 0.45	516 460	0.17	513 451	0.83	516 452	0.15 0.46	10.1
	United Kingdom	500	2.65	527	2.96	515	0.22	509	0.90	514	0.12	513	0.13	16.5
	United States	494	1.47	513	1.80	506	0.67	503	0.14	505	0.54	496	1.04	9.9
s	Albania*	379	1.72	412	3.69	392	0.00	391	0.12	396	0.64	386	0.91	13.0
Partners				405										
Par	Argentina*	397	0.55		0.65	396	0.79	402	0.10	397	0.55	405	0.58	10.5
	Azerbaijan*	372	0.43	349	4.94	419	9.61	377	1.34	354	3.11	332	7.25	51.5
	Brazil*	400	1.20	397	2.76	401	1.59	403	0.84	412	1.59	417	3.12	18.8
	Bulgaria*	442	0.39	438	0.12	444	0.59	440	0.16	441	0.24	427	1.73	7.0
	Colombia*	406	0.83	403	0.31	390	2.11	400	0.24	387	2.40	401	0.10	15.9
	Croatia	493	1.21	493	1.44	491	1.14	481	1.12	483	0.68	471	3.17	13.0
	Dubai (UAE)*	480	2.46	452	2.60	465	0.34	467	0.02	465	0.27	461	0.83	13.5
	Hong Kong-China	556	1.62	546	0.67	561	2.70	550	0.24	548	0.28	537	2.72	13.7
	Indonesia	368	2.78	390	1.59	369	2.71	383	0.08	387	0.88	406	4.20	20.8
	Jordan*	408	1.58	416	0.04	415	0.11	420	0.73	422	1.21	431	2.68	13.0
	Kazakhstan*	398	0.40	420	4.11	409	1.65	400	0.22	395	1.14	389	2.43	18.0
	Kyrgyzstan*	314	2.73	353	4.48	329	0.23	328	0.41	326	0.76	342	2.49	17.7
	Latvia	508	2.38	485	1.65	497	0.40	493	0.17	486	1.26	476	2.92	17.0
	Liechtenstein	501	1.19	516	0.18	525	0.33	507	0.49	539	1.12	497	1.24	9.7
	Lithuania	510	3.42	481	1.69	485	1.26	495	0.74	488	0.61	480	2.37	15.7
	Macao-China	519	2.00	518	1.92	506	1.16	513	0.51	510	0.20	504	1.96	11.9
	Montenegro	383	2.79	418	2.90	405	0.51	403	0.22	403	0.12	396	0.93	14.6
	Panama*	388	1.15	379	0.30	377	0.31	383	0.22	374	0.12	371	0.93	12.2
	Peru*			384		357		367						
		362	1.41		3.23		2.74		0.38	366	0.65	382	2.49	16.9
	Qatar*	375	1.18	377	0.75	376	0.97	381	0.21	390	2.81	387	1.60	13.4
	Romania*	427	0.35	432	0.68	434	1.02	429	0.15	433	1.07	421	1.53	14.9
	Russian Federation	467	1.97	503	4.20	476	0.51	475	0.66	474	0.96	484	0.87	17.4
	Serbia*	468	5.80	445	0.68	449	1.63	447	1.12	439	0.83	420	5.52	19.5
	Shanghai-China	576	0.31	574	0.21	580	1.23	576	0.32	577	0.55	564	2.52	9.6
	Singapore	538	0.67	530	2.11	533	1.38	545	0.58	543	0.19	563	3.73	18.1
	Chinese Taipei	510	2.23	529	2.39	530	2.04	523	0.42	527	1.26	511	2.41	14.4
	Thailand	394	5.92	447	4.44	425	0.26	430	0.78	438	2.40	437	2.27	28.6
	Trinidad and Tobago*	416	0.97	412	0.31	402	1.43	403	0.87	405	0.89	418	1.08	9.8
	Tunisia*	367	7.26	410	2.20	389	2.85	398	0.82	415	3.03	418	3.97	32.8
	Uruguay*	432	0.86	429	0.46	428	0.13	428	0.20	418	2.01	425	0.29	8.1

Note: Values that are statistically significant are indicated in bold. * These countries opted for the easier booklets.



There is no significant booklet effect at the OECD and international level, because the booklet corrections controlled for this effect.

The booklets means for domains that are not included in the booklet (shaded booklets numbers for mathematics and science) do not significantly differ from the expected booklet means for all countries, which is to be expected using the deviation contrast codes for booklets in the conditioning model.

Estimation of the booklet effect for the DRA was not necessary as there were no minor domains included. Table 12.22 presents the results of testing the variance in test form means by country. The TestID 7 column represents imputed scores for the students who did not take the DRA assessment. The chi-square statistics distributed with 7–1=6 degrees of freedom. There was no significant booklet effect at the international and country level for DRA.

ustralia	Expected mean	Test	ID 1	Test	ID 0											
ustralia				iest		Test	ID 3	Test	ID 4	Test	ID 5	Test	ID 6	Test	ID 7	Chi-sq
ustralia		Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	Mean	Z-Score	(df=6)
ustralla	540.2	545.0	0.9	544.4	1.0	539.3	0.2	551.2	2.1	533.9	1.1	543.0	0.6	535.0	1.9	7.5
ustria	457.4	458.1	0.1	451.5	1.0	447.8	1.4	455.2	0.4	467.6	1.8	457.2	0.0	460.2	0.6	5.2
elgium	509.9	515.9	1.4	505.9	0.9	515.1	1.1	510.7	0.2	515.1	1.3	516.1	1.6	504.3	2.4	8.9
hile	432.0	421.3	1.7	431.1	0.1	425.7	1.0	432.5	0.1	437.0	1.0	428.8	0.5	436.8	1.2	5.7
Denmark	489.6	493.0	0.6	484.5	0.8	486.5	0.4	488.0	0.2	492.6	0.4	501.7	1.8	488.2	0.6	4.8
rance	478.7	482.5	0.6	473.4	0.8	476.7	0.3	488.6	1.5	482.7	0.6	483.6	0.8	472.0	1.6	6.3
lungary	496.9	497.4	0.1	496.9	0.0	498.0	0.2	507.4	1.6	496.9	0.0	490.7	0.8	492.7	0.8	3.4
celand	460.8	456.6	0.6	454.5	0.9	438.8	2.4	450.1	1.3	451.3	1.4	457.6	0.5	480.5	4.3	11.4
reland	508.7	508.1	0.1	501.5	1.2	505.2	0.5	510.8	0.4	513.7	0.8	509.0	0.0	509.4	0.2	3.2
apan	511.7	514.9	0.4	507.5	0.6	515.0	0.4	520.4	1.0	514.6	0.4	514.3	0.4	510.9	0.5	3.7
orea	521.7	528.9	1.5	524.3	0.5	519.1	0.5	519.0	0.6	528.4	1.4	532.9	2.2	511.2	3.1	9.9
lew Zealand	567.2	573.6	1.3	569.1	0.4	561.4	1.3	560.0	1.3	565.2	0.3	570.2	0.7	568.0	0.3	5.3
lorway	500.6	504.1	0.7	490.3	2.2	513.8	2.6	511.8	2.0	500.9	0.1	495.1	1.2	498.0	0.8	9.5
oland	539.8	541.2	0.2	542.6	0.5	537.6	0.4	548.1	1.2	554.5	2.9	547.0	1.3	532.5	2.8	9.2
pain	462.5	453.8	1.6	454.7	1.5	459.1	0.6	469.5	1.3	467.5	0.8	465.1	0.5	464.9	0.7	7.0
weden	513.5	507.3	1.1	519.9	1.3	512.8	0.1	519.9	1.0	516.7	0.6	519.4	1.1	506.3	2.0	7.2
Colombia	369.2	372.1	0.5	359.4	1.4	362.4	0.9	373.6	0.7	377.8	1.3	370.7	0.2	368.2	0.3	5.3
long Kong-China	514.2	515.4	0.3	517.0	0.7	507.5	1.4	505.3	1.8	514.6	0.1	520.5	1.3	515.4	0.4	5.8
Aacao-China	492.0	488.7	0.9	488.2	1.0	483.1	2.7	489.2	0.9	494.6	0.8	488.3	1.1	494.3	2.0	9.5
	ance ungary eland eland orea ew Zealand orway land ain veeden olombia ong Kong-China	ance 478.7 ungary 496.9 eland 508.7 sland 508.7 pan 511.7 yrea 521.7 we Zealand 567.2 porway 500.6 land 539.8 ain 462.5 yrea 513.5 ong Kong-China 514.2	ance 478.7 482.5 ungary 496.9 497.4 eland 460.8 456.6 eland 508.1 508.1 pan 511.7 514.9 wea 521.7 528.9 wex Zealand 567.2 573.6 porway 500.6 504.1 land 539.8 541.2 ain 462.5 507.3 pombia 513.5 507.3	ance 478.7 482.5 0.6 ungary 496.9 497.4 0.1 eland 460.8 456.6 0.6 sland 508.7 508.1 0.1 pan 511.7 514.9 0.4 wrea 521.7 528.9 1.5 wrea 567.2 573.6 1.3 porway 500.6 504.1 0.7 land 539.8 541.2 0.2 ain 462.5 453.8 1.6 wrea 513.5 507.3 1.1 blombia 369.2 372.1 0.5	ance 478.7 482.5 0.6 473.4 ungary 496.9 497.4 0.1 496.9 eland 460.8 456.6 0.6 454.5 eland 508.7 508.1 0.1 501.5 pan 511.7 514.9 0.1 507.5 prea 521.7 528.9 1.5 524.3 park Zealand 567.2 573.6 1.3 569.1 proway 500.6 504.1 0.7 490.3 land 539.8 541.2 0.2 542.6 ain 462.5 453.8 1.6 454.7 pandend 513.5 507.3 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31.9	ance478.7482.50.6473.40.8476.70.3ungary496.9497.40.1496.90.0498.00.2eland460.8456.60.6454.50.0498.02.4sland508.7508.7501.6501.51.2505.20.5pan511.7514.90.4507.526.0151.90.4orea521.7528.7524.30.5513.42.4orway500.6507.40.7490.32.2513.82.6land539.8513.5617.4519.7513.5617.4519.7617.4ormay513.5507.31.1519.91.3512.80.1ormay369.2372.10.5359.41.4362.40.1ormay513.5507.30.1519.91.3512.80.1ormay513.5507.3513.5513.5359.41.4362.40.1ormay513.5515.40.3517.00.7507.51.4	ance478.7482.50.6473.40.8476.70.3488.6ungary496.9497.40.1496.90.0498.00.2507.4eland460.8456.60.6454.50.0438.82.4450.1eland508.7508.10.1501.51.2505.20.0510.8pan511.7514.90.4507.50.6515.0510.4520.4prea521.7528.91.3569.10.4561.41.3560.0prea500.6504.10.7490.32.2513.82.6511.8pand507.2573.61.3569.10.4513.82.6511.8pand503.5504.10.7490.32.2513.82.6511.8pand507.5504.6514.20.2542.60.5537.60.4548.1pand509.5504.6504.71.5459.10.6469.5pand513.5507.31.1519.91.3512.80.1519.9pand369.2372.10.5359.41.4362.40.9373.6pand369.2372.10.5359.41.4362.40.9373.6pand369.2372.10.5359.41.4362.40.9373.6pand514.2515.40.3517.00.7507.51.4 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Table 12.22 Variance in DRA booklet means

Overview of the PISA cognitive reporting scales

PISA 2009 is the fourth PISA assessment and also the fourth occasion on which reading, mathematics and science literacy scores have been reported. A central aim of PISA is to monitor trends over time in indicators based upon reading, mathematics and science literacy. In this section we review the stability of the PISA scales over time, with a view to:

- setting out the range of scales that have been prepared over the past four PISA assessments;
- describing their special features and appropriate use; and
- asking recommendations regarding future design elements of PISA.

Table 12.23 provides a listing of the 19 distinct cognitive scales that have been produced as part of PISA 2000, PISA 2003, PISA 2006 and PISA 2009. For the purpose of this overview, the cognitive scales are classified into three types: PISA literacy scales, PISA literacy subscales and special purpose scales. The PISA literacy scales are the key reporting scales that have been established for each domain, when that domain has been the major domain. The PISA literacy subscales are additional scales that were provided when a domain was the major domain. The special purpose scales are additional scales that can be used as interim and trend scales prior to the establishment of the related PISA overall literacy scales.

In the table each scale is named, the database upon which it was established is given, the datasets for which it is provided are indicated (a "P" indicates that the dataset exists); and comments are made about the scale's appropriate use. In the text following, further details are provided on these scales.

Table 12.23	Summary	of PISA co	gnitive rep	orting sca	les	
Name	Established	2000	2003	2006	2009	Comment
	PISA literacy	scale				
Print reading	2000	Р	Р	Р	Р	Trends can be reported between any of the three cycles, by country or by subgroups within countries.
Print mathematics	2003		Р	Р	Р	Trends can be reported between 2003, 2006 and 2009 by country or by subgroups within countries.
Print science	2006			Р	Р	Trends can be reported between 2006 and 2009 by country or by subgroups within countries.
	PISA literacy	subscales				
Reading subscale: Retrieving Information	2000	Р			Р	
Reading subscale: Interpreting Texts	2000	Р			Р	
Reading subscale: Reflection and Evaluation	2000	Р			Р	
Reading subscale: Continuous Texts	2009				Р	
Reading subscale: Non-Continuous Texts	2009				Р	
Mathematics subscale: Quantity	2003		Р			
Mathematics subscale: Uncertainty	2003		Р			
Mathematics subscale: Space and Shape	2003	Р	Р			Established in 2003 and then applied to 2000 with a rescaling (no conditioning). Trends can be reported for countries, but are not optimal for subgroups within countries.
Mathematics subscale: Change and Relationships	2003	Р	Р			Established in 2003 and then applied to 2000 with a rescaling (no conditioning). Trends can be reported for countries, but are not optimal for subgroups within countries.
Science subscale: Explaining Phenomena Scientifically	2006			Р		
Science subscale: Identifying Scientific Issues	2006			Р		
Science subscale: Using Scientific Evidence	2006			Р		
Science subscale: Physical Systems	2006			Р		Limited conditioning implemented permitting unbiased estimation by country and by gender. Results for other subgroups are not optimal.
Science subscale: Earth and Space Systems	2006			Р		Limited conditioning implemented permitting unbiased estimation by country and by gender. Results for other subgroups are not optimal.
Science subscale: Living Systems	2006			Р		Limited conditioning implemented permitting unbiased estimation by country and by gender. Results for other subgroups are not optimal.
	Special purpo	se scales				
Interim mathematics	2000	Р				
Interim science	2000	Р	Р			
Science trend 2003-2006	2006		Р	Р		Uses items that were common to PISA 2003 and 2006.
Electronic reading	2009				Р	

PISA literacy scales

The primary PISA reporting scales are reading, mathematics and science. These scales were established in the year in which the respective domain was the major domain, since in that year the framework for the domain was fully developed and the domain was comprehensively assessed. When the overall literacy scale is established the mean of the scale is set at 500 and the standard deviation is set at 100 (for the pooled, equally weighted OECD countries) – for example, 500 on the PISA mathematics scale is the mean achievement of assessed students in OECD countries in 2003.

The intention is that these overall literacy scales will stay in place until the specification of the domain is changed or updated.

PISA literacy subscales

Across the four PISA assessments a total of 19 subscales have been prepared and reported. In PISA 2000, three reading aspect-based scales were prepared; in PISA 2003, four mathematics content-based scales were prepared, in 2006 a total of six science scales were prepared; and in PISA 2009 two text format scales were prepared.

The subscales are typically prepared only in the year in which a domain is a major domain, since when a domain is a major domain there are sufficient items in each sub-area to support the reporting of the scales. The one exception to this general practice is mathematics, for which the *space and shape* and *change and relationships* scales were reported for the PISA 2000 data as well as the PISA 2003 data. These scales, which were established in 2003 when mathematics was the major domain, could be applied to the 2000 data because only these two areas of mathematics had been assessed in PISA 2000 and sufficient common items were available to support the scaling.

For the 2000 data the mathematics scales where prepared using a methodology that permits trend analysis at the national level (or at the level of adjudicated regions), but the scales are not optimal for analysis at the level of student sub-groups.³

For science in PISA 2006, two alternative sets of scales were prepared. The first was a set of three process-based scales and the second was a set of three content-based scales. It is important to note that these are alternative scalings that each rely on the same test items. As such, it is inappropriate to jointly analyse scales that are selected from the alternative scalings. For example, it would not be meaningful or defensible to correlate or otherwise compare performance on the "Physical systems" scale, with performance on the *using scientific evidence* scale. Furthermore the content-based scales can be analysed at the national level (or at the level of adjudicated regions), and can be analysed by gender, but they are not optimal for use at the level of any other student sub-groups, whereas the process-based scales are suitable in addition for sub-group analyses.⁴

The metric of all of the PISA subscales is set so that scales within a domain can be compared to each other and with the matching overall PISA reporting scale.⁵

Special purpose scales

There are three special purpose scales.

An interim mathematics scale was established and reported in PISA 2000. This scale was prepared to provide an overall mathematics score, and it used all of the mathematics items that were included in the PISA 2000 assessment. This scale was discontinued in 2003 when mathematics was the major domain and the alternative and more comprehensive PISA overall mathematics literacy scale was established.

An interim science scale was established and reported in PISA 2000. This scale was prepared to provide an overall science score, and it used all of the science items that were included in the PISA 2000 assessment. The PISA 2003 science data were linked to this scale so that the PISA 2003 science results were also reported on this interim science scale. For PISA 2006 this scale was not provided since science was the major domain and the alternative and more comprehensive overall PISA science scale was established.

To allow comparisons between science outcomes in 2003 and 2006 a science trend 2003-2006 scale was prepared. This scale is based upon the science items that are common to PISA 2003 and 2006 and can be used to examine trends (on those common items) between 2003 and 2006. The PISA 2003 abilities that are based on the common items can be analysed at the national level (or at the level of adjudicated regions), and can be analysed by gender, but they are not optimal for use at the level of any other student sub-groups. The PISA 2006 abilities, associated with the fully developed overall PISA science scale, can be analysed by national subgroups as well.

OBSERVATIONS CONCERNING THE CONSTRUCTION OF THE PISA OVERALL LITERACY SCALES

A number of the PISA scales have been established to permit trend analyses. A review of the various links available and necessary to establish these scales is given below. Table 12.24 illustrates the nine linkages of the PISA domains that are examined and discussed below. Links (1), (2) and (3) are for reading 2000 to 2003, 2003 to 2006 and 2006 to 2009 respectively, links (4), (5) and (6) are for mathematics 2000 to 2003, 2003 to 2006 and 2006 to 2009 respectively, links (7), (8) and (9) are for science 2000 to 2003, 2003 to 2006 and 2006 to 2009 respectively.

Table 12.24 also indicates in which data collections the domain was a major domain and on which occasions it was a minor domain. As a consequence one can note that on three occasions the links are major to minor (links (1), (5) and (9)), on three occasions they are minor to minor (links (2), (6) and (7)), and on three occasions they are minor to major (links (3), (4) and (8)).

	2000		2003		2006		2009
Reading	Major	(1) →	Minor	(2) →	Minor	(3) →	Major
Mathematics	Minor	$(4) \rightarrow$	Major	(5) →	Minor	$(6) \rightarrow$	Minor
Science	Minor	(7) →	Minor	(8) →	Major	(9) →	Minor

Table 12.24 Linkage types among PISA domains 2000 - 2009



When a proficiency area is assessed as a major domain there are two key characteristics that distinguish it from a minor domain. First the framework for the area is fully developed and elaborated. Second the framework is comprehensively assessed since more assessment time is allocated to the major domain than is allocated to each of the minor domains.

Framework development

For PISA 2000 a full and comprehensive framework was developed for reading to guide the assessment of reading as a major domain. Less fully articulated frameworks were developed to support the assessment of mathematics and science as minor domains.⁶

For PISA 2003, the mathematics framework was updated and fully developed to support a comprehensive assessment of mathematics. The science frameworks were retained largely as they had been for PISA 2000.⁷

The key changes to the mathematics framework between 2000 and 2003 were:

- addition of a theoretical underpinning of the mathematics assessment, expanding the rationale for the PISA emphasis on using mathematical knowledge and skills to solve problems encountered in life;
- restructuring and expansion of domain content: expansion from two broad content areas (overarching ideas) to four; removal of all reference to mathematics curricular strands as a separate content categorisation (instead, definitions of the overarching ideas were expanded to include the kinds of school mathematics topics associated with each);
- a more elaborated rational for the existing balance between realistic mathematics and more traditional context-free items, in line with the literacy for life notion underlying OECD/PISA assessments;
- a redeveloped discussion of the relevant mathematical processes: a clearer and much enhanced link between the
 process referred to as mathematisation, the underlying mathematical competencies, and the competency clusters;
 and a better operationalisation of the competency classes through a more detailed description of the underlying
 proficiency demands they place on students; and
- considerable elaboration through addition of examples, including items from previous test administrations.

Clearly, the framework change involving an effective doubling of the mathematical content base of the study was of such significance that trend measures would be very seriously affected. Hence, only scale links to 2000 were possible, and the new framework provided the first comprehensive basis for the calculation of future trend estimates.

For PISA 2006, science was the major domain so the science framework was updated and fully developed to support a comprehensive assessment of science. The reading framework was retained largely as it had been for PISA 2000, and the mathematics framework as it had been for PISA 2003.⁸ The key changes to the science framework between 2003 and 2006 as they relate to comparison in the science scales over time were:

- A clearer separation of knowledge about science as a form of human enquiry from knowledge of science, meaning knowledge of the natural world as articulated in the different scientific disciplines. In particular, PISA 2006 gives greater emphasis to knowledge about science as an aspect of science performance, through the addition of elements that underscore students' knowledge about the characteristic features of science and scientific endeavour.
- The addition of new components on the relationship between science and technology.

Both of these changes carry the potential to disrupt links with the previous special purpose science scales: the interim science and trend science scales.

With regard to reading, much of the substance of the PISA 2000 framework was retained in the PISA 2009 framework, respecting one of the central purposes of the PISA project: to collect and report trend information about performance in reading, mathematics and science. However, the PISA domain frameworks are also aimed to be evolving documents that will adapt to and integrate new developments in theory and practice over time. There was therefore some evolution, reflecting both an expansion in our understanding of the nature of reading and changes in the world. At the same time there was no need to develop a new scale for reading, so that performance from 2009 could be compared to 2000.

There were two major modifications in the reading framework:

- incorporating the reading of electronic texts; and
- elaborating the constructs of reading engagement and metacognition.

Testing time and item characteristics

In each of PISA 2000, PISA 2003 and PISA 2006 a total of 390 minutes of testing material was used.⁹ In this case there were thirteen 30 minutes clusters of items (390 minutes all together). These 13 clusters were included in 13 two-hour booklets (4 clusters in each booklet). In PISA 2009, due to the addition of the easy booklets, a total of 450 minutes of testing material was used.¹⁰

The distribution of the testing minutes is given in Table 12.25. When a domain is assessed as a major domain then more minutes are devoted to it than for minor domains. For example 270 minutes were assigned to reading material in PISA 2000 and PISA 2009 to allow full coverage of the framework. Similarly, PISA 2003 included 210 minutes of mathematics material and PISA 2006 included 210 minutes of science material. When a domain is assessed as a minor domain the assessment is less comprehensive and does not provide an in-depth assessment of the full framework that is developed when a domain is a major domain.

It is also important to recognise that given the PISA test design (see Chapter 2) the change of major domains over time means that the testing experience for the majority of students will be different in each cycle because it becomes dominated by the new major domain. For example, the design for PISA 2009 used 13 booklets per country. Ten of them comprised at least 50% of reading material. For three of these the other 50% comprised only mathematics material, three were completed with a mixture of science and mathematics material, other three were completed with the mixture of reading material. Remaining three booklets contained one reading, one mathematics and two science clusters.

This could be compared to the design for PISA 2006 that also used 13 booklets. Eleven of them comprised at least 50% of science material. For four of these the other 50% comprised only mathematics material, four were completed with a mixture of reading and mathematics material, and for one booklet the other 50% comprised only reading material. Two booklets contained only science material.

The links in terms of numbers of items in common for successive pairs of assessments are shown in Table 12.26.

	Reading	Mathematics	Science	Total
2000	270	60	60	390
2003	60	210	60	330 ¹
2006	60	120	210	390
2009	270	90	90	450 ²

 Table 12.25
 Number of unique item minutes for each domain for each PISA assessments

1. 60 minutes were devoted to problem solving.

2. 390 minutes unique item minutes per country

Characteristics of each of the links

To allow a comparison between PISA cycles a set of the same items (link items) included for each domain in each PISA assessment. The number of link items in each domains included in Table 12.26.

Table 12.20	able 12.20 Numbers of link items between successive FISA assessments					
	Reading	Mathematics	Science			
Link 2000-2003	28	20	25			
Link 2003-2006	28	48	22			
Link 2000-2009	26	8	5			
Link 2003-2009	26	35	9			
Link 2006-2009	26	35	53			

Table 12.26 Numbers of link items between successive PISA assessments*

* Total number of items included in major domains Reading 2000, Mathematics 2003, Science 2006 and Reading 2009 are 129, 84, 108 and 131 respectively.

Reading 2000 to 2003

The PISA reading scale was established in 2000 on the basis of a fully developed and articulated framework and a comprehensive assessment of that framework. The PISA 2000 included 129 reading items. In PISA 2003 a subset of 28 of the 2000 reading items was selected and used. Equating procedures reported in OECD (2005) were then used to report the PISA 2003 data on the established PISA reading scale.



The trend results for the OECD countries that participated in both PISA 2000 and PISA 2003 showed that of 32 countries, 10 had a significant decline in mean score and 5 had a significant rise in mean score (OECD, 2004).

When reviewing the potential causes for this possible instability a number of relevant issues where observed. First, there was a substantial test design change between PISA 2000 and PISA 2003. The PISA 2003 design was fully balanced whereas the PISA 2000 design systematically placed minor domain items and some reading items at the end of the student booklets (see Adams and Wu, 2002). The complexity of the PISA 2000 design is such that the impact of this on the item parameter estimation and hence the equating is unclear. Second, the units that were selected from PISA 2000 for use in PISA 2003 were edited in minor ways. While none of the individual link items was edited, some items in the units were removed. As with the test design change, the impact of this change on the item parameter estimation and hence the equating is unclear of this change on the item parameter estimation and hence the clusters of items that were used were not pre-existing clusters. In particular, units from PISA 2000 clusters one to seven were selected and reconstituted as two new clusters. Intact clusters of items could not be used from PISA 2000 since none of the individual pre-existing clusters provided an adequate coverage of the framework.

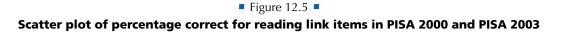
The percentage correct on reading items that link PISA 2000 and PISA 2003 are given in Table 12.27, with the corresponding scatter plot in Figure 12.5. To compute the percentage correct, all students were included from countries that were included in trend analysis between PISA 2000 and PISA 2003. For this analysis 25 OECD countries were included. Those excluded were the United Kingdom (who did not meet school response rate in 2003), the Netherlands (who did not meet school response rate in 2000), Luxembourg (who used multilingual booklets in 2000), and the Slovak Republic and Turkey (who did not participate in the PISA 2000 study). In addition, recent OECD members such as Chile, Estonia, Israel and Slovenia were not included.

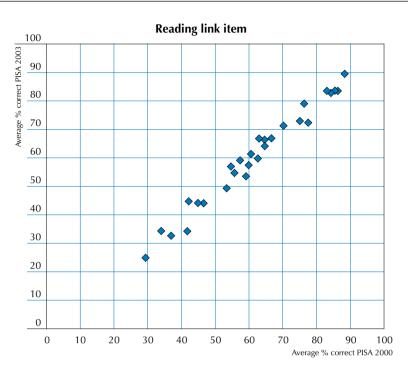
The mean of the differences between PISA 2003 and PISA 2000 is -1.11, and the standard deviation of the differences is 2.82.

	% correct		
Item	2000	2003	
R055Q01	84.4	82.9	
R055Q02	53.4	49.1	
R055Q03	62.7	59.8	
R055Q05	77.7	72.5	
R067Q01	88.5	89.7	
R067Q04	54.7	57	
R067Q05	62.9	67.1	
R102Q04A	37.1	32.4	
R102Q05	42.2	44.9	
R102Q07	86.2	83.5	
R104Q01	83	83.2	
R104Q02	41.6	34.5	
R104Q05	29.2	24.9	
R111Q01	64.8	66.3	
R111Q02B	34.2	34	
R111Q06B	44.8	44.5	
R219Q01	70.2	71.2	
R219Q01E	57.4	59.3	
R219Q02	76.5	78.8	
R220Q01	46.8	44.4	
R220Q02B	64.8	64	
R220Q04	60.8	61.3	
R220Q05	85.5	83.2	
R220Q06	66.6	67.1	
R227Q01	59	53.8	
R227Q02	59.8	57.7	
R227Q03	56	54.9	
R227Q06	75.2	72.9	

Table 12.27 International percent correct for reading link items in PISA 2000 and PISA 2003







Reading 2003 to 2006

To link the PISA 2006 data to the PISA reading scale the same 28 items (units and clusters) as were used in PISA 2003 were again used. The trend results for the OECD countries that participated in both PISA 2003 and PISA 2006 showed that of the 38 countries which could be compared, five had a significant decline in mean score and two had a significant rise in mean score (OECD, 2007). The number of significant changes was less than reported for the 2000-2003 link.

A number of reasons might be conjectured as possible explanations of this lack of consistency. First, presenting a large number of reading items with a small number of mathematics and science items interspersed, provides for a very different test-taking experience for students compared to a test with a majority of mathematics items, and a few reading, general problem solving and science items interspersed. This may have impacted on the trend estimates. Second, the mix of reading items by aspect type was somewhat different between the two test administrations. In 2003 there was a larger proportion of score points in the reflection and evaluation aspect than had been the case for 2006.

The percentage correct on reading items that link PISA 2003 and PISA 2006 are given in Table 12.28, with the corresponding scatter plot in Figure 12.6. To compute the percentage correct, all students were included from countries that were included in these trend analyses. For percentage correct, 28 OECD countries were included. Excluded were the United Kingdom (because of low response rate) and the United States (reading scores are not available for PISA 2006 because of a printing error).

The mean of the differences between PISA 2003 and PISA 2006 is -1.17 (PISA 2006 minus PISA 2003), and the standard deviation of the differences is 1.07. The standard deviation of this difference is much less than that for 2000 to 2003 and most likely due to the use of identical items in identical clusters for the two assessments.

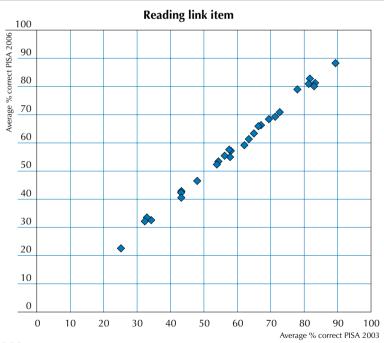


Table 12.28 International percent correct for reading link items in PISA 2003 and PISA 2006

	% correct				
Item	2003	2006			
R055Q01	81.4	80.9			
R055Q02	47.9	46.8			
R055Q03	58.2	57.2			
R055Q05	72.6	71			
R067Q01	89.5	88.2			
R067Q04	56.1	55.6			
R067Q05	66.4	65.9			
R102Q04A	32.4	32.2			
R102Q05	43.1	42.8			
R102Q07	81.8	82.9			
R104Q01	83	80.3			
R104Q02	34.3	32.9			
R104Q05	25.3	22.8			
R111Q01	64.9	63.4			
R111Q02B	32.9	33.4			
R111Q06B	43.3	40.9			
R219Q01	69.6	68.4			
R219Q01E	57.5	57.4			
R219Q02	78.1	78.8			
R220Q01	43.2	42.5			
R220Q02B	63.5	61.2			
R220Q04	62.1	59.2			
R220Q05	83.2	81			
R220Q06	67.1	66.4			
R227Q01	53.7	52.3			
R227Q02	57.9	55			
R227Q03	54.4	53.3			
R227Q06	71.3	69.3			

■ Figure 12.6 ■

Scatter plot of percentage correct for reading link items in PISA 2003 and PISA 2006



Reading 2000 to 2009

To link the PISA 2009 data to the PISA reading scale the same 28 items (units and clusters) used in both PISA 2003 and PISA 2006 were again used. Two link items were deleted from the link item set because of data entry errors. The trend results for the OECD countries that participated in both PISA 2000 and PISA 2009 showed that of the 38 countries which could be compared, 5 had a significant decline in mean score and 13 had a significant rise in mean score (OECD, 2010b).

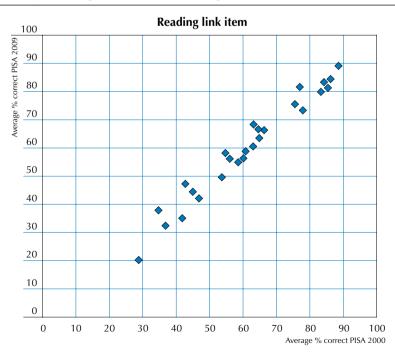
The percentage correct on reading items that link PISA 2000 and PISA 2009 are given in Table 12.29, with the corresponding scatter plot in Figure 12.7. To compute the percentage correct, all students were included from countries that were included in these trend analyses. For percentage correct, 26 OECD countries were included. Excluded were the Netherlands, Luxembourg, the Slovak Republic and Turkey. The mean of the differences (PISA 2000 minus PISA 2009) is 1.30, and the standard deviation of the differences is 3.53. The standard deviation of this difference is greater than that for 2003 to 2006 but comparable to the 2000 to 2003 difference and most likely due to the inclusion of the new item clusters.

	% correct				
Item	2000	2009			
R055Q01	84.4	82.9			
R055Q02	53.5	49.7			
R055Q03	63.0	60.7			
R055Q05	77.8	73.5			
R067Q01	88.5	89.2			
R067Q04	55.0	57.9			
R067Q05	63.2	68.3			
R102Q04A	36.9	32.5			
R102Q05	42.9	47.2			
R102Q07	86.3	84.5			
R104Q01	83.2	80.2			
R104Q02	41.8	34.9			
R104Q05	29.1	20.3			
R111Q01	64.7	66.7			
R111Q02B	34.8	37.9			
R111Q06B	45.1	44.4			
R219Q02	77.1	81.6			
R220Q01	46.7	41.9			
R220Q02B	64.9	63.6			
R220Q04	60.6	58.6			
R220Q05	85.4	81.4			
R220Q06	66.2	66.6			
R227Q01	58.6	55.1			
R227Q02	59.9	56.3			
R227Q03	56.2	56.1			
R227Q06	75.4	75.5			

Table 12.29 International percent correct for reading link items in PISA 2000 and PISA 2009



Scatter plot of percentage correct for reading link items in PISA 2000 and PISA 2009



Mathematics 2000 to 2003

The mathematics framework that was prepared for PISA 2000 was preliminary and the assessment was restricted to two of the so-called big ideas – *space and shape*, and *change and relationships*. For the PISA 2003 assessment, when mathematics was a major domain, the framework was fully developed and the assessment was broadened to cover the four overarching ideas – *quantity, uncertainty, space and shape*, and *change and relationships*.

Given that the mathematics framework was fully developed for PISA 2003, the PISA mathematics scale was developed at that point. As PISA 2000 had covered two of the four 2003 mathematic scales, only two trend scales could be developed. These were for comparison of performance between 2000 and 2003 for space and shape, and change and relationships.

PISA 2000 and PISA 2003 percentages correct for mathematics *space and shape* and *change and relationships* link items are given in Table 12.28, with the corresponding scatter plot in Figure 12.8. Similar to the reading 2000 to 2003 item analysis student responses from only 25 OECD countries were included in computation of the percentage correct.

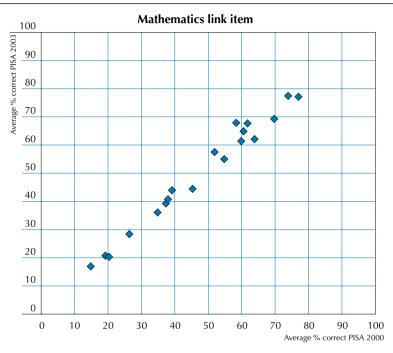
The mean of the differences between PISA 2003 and PISA 2000 is 2.39, and the standard deviation of the differences is 2.79.

	% ca	rrect
Item	2000	2003
M033Q01	74.2	77.8
M034Q01	39.3	44.2
M124Q01	35.0	36.3
M124Q03	19.3	20.9
M144Q01	64.1	62.4
M144Q02	26.5	28.6
M144Q03	77.3	77.5
M144Q04	37.5	39.5
M145Q01	58.6	68.2
M150Q01	62.0	68.0
M150Q02	70.0	69.6
M150Q03	45.5	44.7
M155Q01	60.8	65.2
M155Q02	60.1	61.7
M155Q03	14.9	17.1
M155Q04	52.1	57.8
M192Q01	38.1	41.0
M266Q01	20.4	20.5
M273Q01	55.0	55.3

Table 12.30 International percent correct for mathematics link items in PISA 2000 and PISA 2003



Scatter plot of percentage correct for mathematics space and shape and change and relationships link items in PISA 2000 and PISA 2003



Mathematics 2003 to 2006

A set of 48 mathematics items was selected from PISA 2003 and used again in PISA 2006.¹¹ Hence the change from 2003 to 2006 involved reducing the number of items by almost half, and as was the case when reading changed from a major to a minor domain, it was not possible to make such a reduction whilst retaining intact clusters. Four new clusters were formed for PISA 2006 from the units retained from PISA 2003. The trend results for the OECD countries that participated in both PISA 2003 and 2006 showed that of the 39 countries which could be compared 4 had a significant decline in mean score and 4 had a significant rise in mean score (OECD, 2007). The magnitude and number of these changes is consistent with the figures for reading from 2003 to 2006 and with figures observed in other international studies such as TIMSS (Mullis, Martin, and Foy [with Olson, Preuschoff, Erberber, Arora, and Galia], 2008).

The percentage correct on mathematics items that link PISA 2003 and PISA 2006 are given in Table 12.31, with the corresponding scatter plot in Figure 12.9. To compute the percentage correct, all students were included from countries that were included in these trend analyses. For percentage correct, 29 OECD countries were included. The United Kingdom was excluded because it was excluded from PISA 2003.

It is interesting to contrast these results with those observed for reading. At the item level the consistency seems somewhat less for mathematics than for reading, whereas at the scale level the consistency is comparable. It is possible that the item-level inconsistency is caused by the change from mathematics as a major domain to mathematics as a minor domain. Two specific aspects of the change are likely to have contributed to this inconsistency. One is the fact that it was necessary to select a subset of items and form new trend clusters. The rearrangement of items into new clusters appears to have a small impact on relative item difficulty. The second is the fact that the items were presented to students in a different context from before; specifically that the items were no longer from the dominant domain, rather they represented a smaller set of items presented amongst a much larger number of science items.

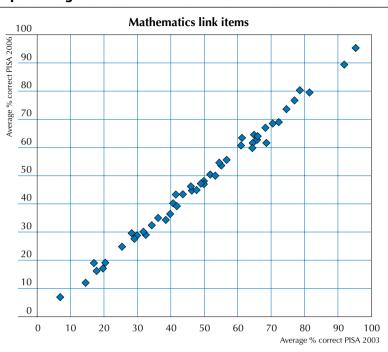
The mean of the differences (PISA 2003 minus PISA 2006) is 1.40, and the standard deviation of the differences is 1.77. This standard deviation is less than that for reading between 2000 and 2003 but greater than that for reading between 2003 and 2006. This is consistent with the fact that 2003 and 2006 designs where both balanced but, unlike the reading items, the mathematics link items between 2003 and 2006 where not presented in the same clusters.

Table 12.31 International percent correct for mathematics link items in PISA 2003 and PISA 2006

Table 12	2.31 International percent correct for mathematics link ite	ems in PISA 2003 and PISA 2006
	% correct	
Item	2003	2006
M033Q01	77.0	76.8
M034Q01	43.6	43.5
M155Q01	64.9	64.6
M155Q02	61.0	60.8
M155Q03	17.0	19.1
M155Q04	56.7	55.7
M192Q01	40.7	40.3
M273Q01	55.1	53.7
M302Q01	95.3	95.4
M302Q02	78.6	80.4
M302Q03	29.9	28.9
M305Q01	64.5	61.7
M406Q01	29.1	27.7
M406Q02	19.7	17.2
M408Q01	41.5	43.4
M411Q01	51.8	50.5
M411Q02	46.3	44.8
M420Q01	49.9	48.2
M421Q01	65.8	62.8
M421Q02	17.8	16.3
M421Q03	38.5	34.4
M423Q01	81.5	79.6
M442Q02	41.8	39.3
M446Q01	68.3	67.1
M446Q02	6.9	7.0
M447Q01	70.5	68.6
M462Q01	14.5	12.1
M464Q01	25.4	24.9
M474Q01	74.6	73.7
M496Q01	53.3	50.1
M496Q02	66.0	64.1
M559Q01	61.3	63.5
M564Q01	49.9	47.1
M564Q02	46.0	46.3
M571Q01	49.0	47.3
M598Q01	64.4	59.9
M603Q01	47.7	45.0
M603Q02	36.2	35.1
M710Q01	34.3	32.5
M800Q01	91.9	89.5
M803Q01	28.3	29.7
M810Q01	68.6	61.7
M810Q02	72.3	69.1
M810Q03	20.4	19.2
M828Q01	39.8	36.5
M828Q02	54.5	54.7
M828Q03	32.5	29.1
M833Q01	31.8	30.2







Mathematics 2006 to 2009

A set of 35 mathematics items (three out of four PISA 2006 mathematics clusters) was selected from PISA 2006 and used again in PISA 2009.¹² The trend results for the OECD countries that participated in both PISA 2006 and PISA 2009 showed that of the 55 countries which could be compared 9 had a significant decline in mean score and 11 had a significant rise in mean score (OECD, 2010b).

The percentage correct on mathematics items that link PISA 2006 and PISA 2009 are given in Table 12.32, with the corresponding scatter plot in Figure 12.10. To compute the percentage correct, all students were included from countries that were included in these trend analyses. For percentage correct, 34 OECD countries were included.

The mean of the differences (PISA 2009 minus PISA 2006) is 0.22, and the standard deviation of the differences is 1.36. The standard deviation of this difference is less than that for 2003 to 2006 and most likely due to the use of identical clusters for the two assessments as it was a case for the reading for 2003 to 2006.

	[Part 1/2]	
Table 12.32	International percent correct for mathematics li	ink items in PISA 2006 and PISA 2009
	% co	orrect
Item	2006	2009
M033Q01	76.1	75.3
M034Q01T	42.6	42.4
M155Q01	64.3	66.3
M155Q02D	59.8	61.5
M155Q03D	18.3	18.5
M155Q04T	55.0	54.9
M192Q01T	39.4	41.1
M273Q01T	52.9	52.7
M406Q01	26.6	26.7
M406Q02	16.3	16.7
M408Q01T	42.2	40.2
M411Q01	49.0	47.9
M411Q02	44.3	44.8
M420Q01T	47.4	50.6
M423Q01	79.3	79.1
M442Q02	38.4	38.4
M446Q01	66.8	69.0
M446Q02	6.7	7.1

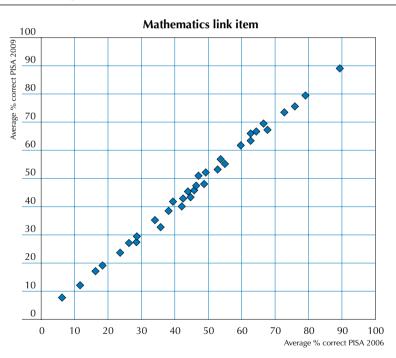


[Part 2/2] Table 12.32 International percent correct for mathematics link items in PISA 2006 and PISA 2009

	% correct		
Item	2006	2009	
M447Q01	67.6	67.4	
M462Q01D	12.0	11.4	
M464Q01T	23.8	23.2	
M474Q01	72.9	73.1	
M496Q01T	49.4	51.5	
M496Q02	63.1	65.7	
M559Q01	62.8	63.3	
M564Q01	46.5	46.4	
M564Q02	45.9	45.8	
M571Q01	46.5	46.6	
M603Q01T	44.5	43.5	
M603Q02T	34.3	34.8	
M800Q01	89.3	89.0	
M803Q01T	28.7	27.3	
M828Q01	35.9	32.3	
M828Q02	53.9	56.0	
M828Q03	28.8	28.5	

■ Figure 12.10 ■

Scatter plot of percentage correct for mathematics link items in PISA 2006 and PISA 2009



Science 2000 to 2003

Science was a minor domain in both PISA 2000 and 2003. As such the assessment on both of these occasions was less comprehensive than it was in 2006, when a more fully articulated framework and more testing time was available. There were 25 items that were common to both PISA 2000 and PISA 2003. The trend results for the OECD countries that had participated in both PISA 2000 and PISA 2003 showed that of 32 countries, 5 had a significant decline in mean score and 13 a significant rise in mean score (OECD, 2004).

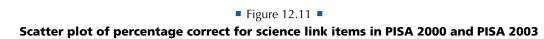
The number of inconsistencies between 2000 and 2003 was greater than expected at both the item-level and at the scale level. When reviewing the potential causes for this possible instability a number of relevant issues were observed. First, as mentioned above for reading, there was a substantial test design change between PISA 2000 and PISA 2003. The complexity of the PISA 2000 design is such that impact of this on the item parameter estimation and hence the equating is unclear. Second, the units that were selected from PISA 2000 for use in PISA 2003 were edited in minor ways. As with reading, while none of the link items were edited, some items in the units were removed. And as with the test design change, the impact of this on the item parameter estimation and hence the equating is unclear. Third, the clusters of items that were used were not pre-existing clusters. The material retained from the two PISA 2000 clusters was supplemented with a small number of new units, and reconstituted as two new clusters. Fourth, there were just 25 link items between these two assessments, and unlike mathematics these items were spread across all aspects of the framework. This number was less than desirable and was a result of choices made concerning the release of items following the 2000 assessment to illustrate the nature of the PISA assessment to the public.

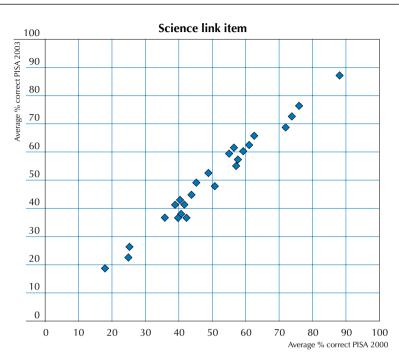
The percentage correct on science items that link PISA 2000 and PISA 2003 are given in Table 12.33, with the corresponding scatter plot in Figure 12.11. To compute the percentage correct, all students were included from countries that were included in these trend analyses. For percentage correct 25 OECD countries were included. The United Kingdom, the Netherlands, Luxembourg, the Slovak Republic and Turkey where excluded because they did not participate in either PISA 2000 or PISA 2003 or because they excluded for guality assurance reasons from either PISA 2000 or PISA 2003. In addition, recent OECD members, such as Chile, Estonia, Israel and Slovenia were not included.

The mean of the differences (PISA 2000 minus PISA 2003) is -0.28, and the standard deviation of the differences is 2.79. This standard deviation is consistent with that observed for reading between 2000 and 2003.

Table 12	.33 International percent correct for science link item	ns in PISA 2000 and PISA 2003	
	% corr	% correct	
Item	2000	2003	
S114Q03	57.3	55	
S114Q04	39.8	36.8	
S114Q05	24.9	22.7	
S128Q01	62.6	65.7	
S128Q02	45.2	49	
S128Q03	61.2	62.5	
\$129Q01	38.8	41.6	
S129Q02	17.9	19	
\$131Q02	50.9	47.9	
S131Q04	25.2	26.5	
\$133Q01	56.7	61.6	
\$133Q03	42.3	36.6	
S133Q04	43.8	44.7	
S213Q01	40.3	43.2	
S213Q02	76.1	76.6	
S252Q01	48.8	52.8	
S252Q02	72.2	68.6	
\$252Q03	55	59.2	
S256Q01	88.3	87.3	
S268Q01	73.7	72.4	
\$268Q02	40.8	38.1	
\$268Q06	57.9	57.4	
\$269Q01	59.2	60.2	
\$269Q03	41.8	41.6	
S269Q04	35.9	36.5	

Table 12.33 International percent correct for science link items in PISA 2000 and PISA 2003





Science 2003 to 2006

In PISA 2006, science was the major domain and as such it was comprehensively assessed on the basis of a newly developed and elaborated framework. As noted above there were quite substantial changes between the preliminary framework that had underpinned PISA 2000 and PISA 2003 assessments and the more fully developed framework used for PISA 2006. Note that in addition to the framework changes mentioned above, there was an important change in the way science was assessed in PISA 2006, when compared with PISA 2003 and PISA 2000. First, to more clearly distinguish scientific literacy from reading literacy, the PISA 2006 science test items required on average less reading than the science items used in earlier PISA surveys. Second, as with each domain when it goes from a minor to a major domain the item pool, the testing experience for the majority of students becomes dominated by the new major domain. For example, there were 108 science items used in PISA 2006, compared with 35 in PISA 2003; of these, just 22 items were common to PISA 2006 and PISA 2003 and 14 were common to PISA 2006 and PISA 2000.

Therefore, as the first major assessment of science, the PISA 2006 assessment was used to establish the basis for the PISA science scale.

The percentage correct on science items that link PISA 2003 and PISA 2006 are given in Table 12.34, with the corresponding scatter plot Figure 12.12. To compute the percentage correct, all students were included from countries that were included in these trend analyses. For percentage correct, 29 OECD countries were included. The United Kingdom was excluded because it was excluded from the *PISA 2003 Database*.

The mean of the differences (PISA 2006 minus PISA 2003) is 0.01, and the standard deviation of the differences is 1.89. This standard deviation is less than for science from 2000 to 2003 but greater than that for reading from 2003 to 2006. As with the previous observations regarding the standard deviations of the differences, this is consistent with PISA test design changes.

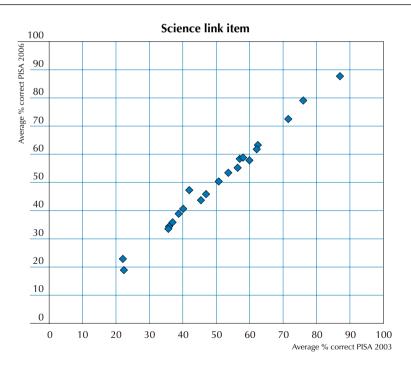


	% correct	
Item	2003	2006
S114Q03	53.6	53.6
S114Q04	35.9	34.4
S114Q05	22.4	18.8
\$131Q02	46.9	46.2
S213Q01	41.9	47.4
S213Q02	76.2	79.2
S256Q01	87	87.5
S268Q01	71.7	72.5
S268Q02	36.9	36.1
S268Q06	56.6	55.4
S269Q01	60	57.9
S269Q03	40.1	40.7
S269Q04	35.6	33.8
S304Q01	45.5	43.8
\$304Q02	62	62.1
\$304Q03a	38.7	39.1
S304Q03b	50.7	50.6
\$326Q01	58.2	58.7
\$326Q02	62.6	63.4
\$326Q03	57.2	58.3
\$326Q04	22.2	22.8

Table 12.34 International percent correct for science link items in PISA 2003 and PISA 2006

■ Figure 12.12 ■

Scatter plot of percentage correct for science link items in PISA 2003 and PISA 2006



For the purposes of trend analysis an additional trend scale has been established that is based upon those items that were common to both PISA 2003 and 2006. Details on the construction of this trend scale are given below and international results are provided in the initial report (OECD, 2007; pp. 369-370).

On the science trend scale that was produced from these 39 countries that participated in both PISA 2003 and PISA 2006, one had a significant decline in mean score and 5 had a significant rise in mean score (OECD, 2007).

Science 2006 to 2009

Fifty-three science items were selected from PISA 2006 and used again in PISA 2009.¹³ Hence the change from 2006 to 2009 involved reducing the number of items by almost half, and as it was the case when reading and mathematics changed from major to minor domain, it was not possible to make such a reduction whilst retaining intact clusters. Three new clusters were formed for PISA 2009 from the units retained from PISA 2006.

The trend results for the OECD countries that participated in both PISA 2006 and PISA 2009 showed that of the 57 countries which could be compared 6 had a significant decline in mean score and eleven had a significant rise in mean score (OECD, 2010b).

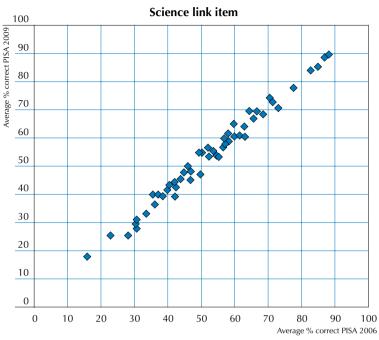
The percentage correct on science items that link PISA 2006 and PISA 2009 are given in Table 12.35, with the corresponding scatter plot and Figure 12.13. For percentage correct, 34 OECD countries were included.

The mean of the differences (PISA 2006 minus PISA 2009) is -0.79, and the standard deviation of the differences is 2.04.

Iem20062009S1100D46.349.5S1100D63.928.0S126Q0167.488.6S260Q1367.783.0S260Q1433.833.0S260Q1560.963.9S260Q1462.963.9S260Q1560.260.3S260Q1423.163.3S260Q1560.860.3S260Q1462.860.3S260Q1564.660.3S260Q1662.860.3S260Q1763.660.3S260Q1860.660.3S260Q1963.860.3S260Q1963.860.3S260Q1963.860.3S260Q1963.860.3S260Q1963.860.3S408Q0163.863.1S408Q0163.863.1S408Q0163.863.1S413Q0564.564.1S413Q0577.877.6S413Q0777.472.7S413Q0777.472.7S413Q0771.472.7S413Q0764.564.3S422Q161.960.5S422Q263.773.0S422Q364.564.3S422Q364.733.0S422Q564.364.2S43Q0165.966.7S43Q0165.966.7S43Q0265.966.7S43Q0265.966.7S43Q0265.965.9S43Q02	\$131Q02D		
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S269QHT 33.8 33.0 S326Q01 58.3 58.6 S326Q03 57.9 60.6 S326Q04T 23.1 25.3 S408Q01 62.8 60.3 S408Q03 30.8 30.7 S408Q04T 50.8 54.4 S408Q05 42.3 42.8 S413Q047 40.8 43.0 S413Q047 40.8 43.0 S413Q05 64.6 69.1 S413Q05 64.6 69.1 S413Q047 77.6 77.6 S415Q07 77.4 72.7 S415Q07 77.4 72.7 S415Q07 77.4 72.7 S415Q07 77.8 77.6 S415Q04 30.6 29.4 S425Q03 42.2 43.8 S425Q04 30.6 29.4 S425Q05 68.5 68.3 S425Q05 43.7 45.2 S426Q05 43.7 45.2	\$269Q01	57.7	58.0
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S413Q05 64.6 69.1 S413Q06 37.4 39.7 S415Q02 77.8 77.6 S415Q07T 71.4 72.7 S415Q08T 57.3 59.7 S425Q02 45.2 47.4 S425Q03 42.2 43.8 S425Q04 30.6 29.4 S425Q05 68.5 68.3 S428Q01 61.9 60.5 S428Q03 71.3 73.0 S428Q04 63.9 66.7 S428Q05 43.7 45.2 S428Q05 43.7 45.2 S428Q05 43.7 45.2 S428Q05 43.7 45.2 S438Q020 65.9 66.7 S438Q03D 38.6 39.3 S456Q04 36.3 36.2 S456Q04 36.3 36.2 S466Q05 54.8 53.2 S466Q07T 73.3 70.3 S478Q01 42.5 43.6	\$408Q05	42.3	42.8
S413Q06 37.4 39.7 S415Q02 77.8 77.6 S415Q07T 71.4 72.7 S415Q06T 57.3 59.7 S425Q02 45.2 47.4 S425Q03 42.2 43.8 S425Q04 30.6 29.4 S425Q05 68.5 66.3 S428Q01 61.9 60.5 S428Q03 71.3 73.0 S428Q04 61.9 60.5 S428Q05 43.7 45.2 S438Q017 82.8 83.7 S438Q019 65.9 66.7 S438Q02 65.9 66.7 S438Q03D 38.6 39.3 S465Q04 49.8 46.8 S455Q02 60.1 60.4 S456Q04 36.3 36.2 S466Q05 54.8 53.2 S466Q05 54.8 53.2 S466Q05 54.8 53.2 S466Q05 54.8 53.2	S413Q04T	40.8	43.0
S415QQ2 77.8 77.6 S415QQ7T 71.4 72.7 S415QQ6T 57.3 95.77 S425QQ2 45.2 47.4 S425QQ3 42.2 43.8 S425Q04 30.6 29.4 S425Q05 66.5 66.3 S428Q01 61.9 60.5 S428Q03 71.3 73.0 S428Q05 43.7 45.2 S438Q01T 82.8 83.7 S438Q02 65.9 66.7 S438Q03D 38.6 39.3 S456Q01 49.8 46.8 S456Q01 60.1 60.4 S466Q05 54.8 33.2 S466Q01T 70.6 73.5 S466Q05 54.8 33.2 S466Q07T 73.3 70.3 S478Q01 42.5 43.0 S478Q01 42.5 43.0 S478Q01 42.4 38.9 S478Q01 66.9 69.1	S413Q05	64.6	69.1
S415QQ2 77.8 77.6 S415QQ7T 71.4 72.7 S415QQ6T 57.3 95.77 S425QQ2 45.2 47.4 S425QQ3 42.2 43.8 S425Q04 30.6 29.4 S425Q05 66.5 66.3 S428Q01 61.9 60.5 S428Q03 71.3 73.0 S428Q05 43.7 45.2 S438Q01T 82.8 83.7 S438Q02 65.9 66.7 S438Q03D 38.6 39.3 S456Q01 49.8 46.8 S456Q01 60.1 60.4 S466Q05 54.8 33.2 S466Q01T 70.6 73.5 S466Q05 54.8 33.2 S466Q07T 73.3 70.3 S478Q01 42.5 43.0 S478Q01 42.5 43.0 S478Q01 42.4 38.9 S478Q01 66.9 69.1	S413Q06	37.4	39.7
S415Q08T 57.3 59.7 S425Q02 45.2 47.4 S425Q03 42.2 43.8 S425Q04 30.6 29.4 S425Q05 68.5 68.3 S426Q01 61.9 60.5 S428Q03 71.3 73.0 S428Q05 43.7 45.2 S438Q01T 82.8 83.7 S438Q02 65.9 66.7 S438Q03D 38.6 39.3 S465Q01 49.8 46.8 S465Q02 60.1 60.4 S466Q05 54.8 33.2 S466Q05 54.8 33.2 S478Q01 42.5 43.0 S478Q01 42.5 43.0 S478Q01 42.5 43.0 S478Q03 44.8 45.0 S478Q04 50.4 45.0 S478Q03 42.4 38.9 S478Q04 50.4 45.0 S478Q03 42.4 38.9		77.8	77.6
S425Q02 45.2 47.4 S425Q03 42.2 43.8 S425Q04 30.6 29.4 S425Q05 68.5 68.3 S428Q01 61.9 60.5 S428Q03 71.3 73.0 S428Q05 43.7 45.2 S438Q01T 82.8 83.7 S438Q01T 82.8 83.7 S438Q02 65.9 66.7 S438Q03D 38.6 39.3 S465Q01 49.8 46.8 S455Q02 60.1 60.4 S465Q04 36.3 36.2 S466Q01T 73.3 70.3 S466Q01T 73.3 70.3 S466Q01T 73.3 70.3 S466Q01T 50.4 54.6 S478Q02T 50.4 54.6 S466Q01T 73.3 70.3 S466Q01T 50.4 54.6 S466Q01T 50.4 54.6 S466Q01T 50.4 54.6	S415Q07T	71.4	72.7
\$425Q03 42.2 43.8 \$425Q04 30.6 29.4 \$425Q05 68.5 68.3 \$425Q05 68.5 68.3 \$428Q01 61.9 60.5 \$428Q05 43.7 45.2 \$438Q01T 82.8 83.7 \$438Q02 65.9 66.7 \$438Q03D 38.6 39.3 \$465Q01 49.8 46.8 \$465Q02 60.1 60.4 \$465Q04 36.3 36.2 \$465Q04 36.3 36.2 \$466Q05T 54.8 33.2 \$466Q05T 54.8 35.2 \$466Q05T 54.8 35.2 \$466Q05T 54.8 45.0 \$478Q01 42.5 43.0 \$478Q02T 66.9 69.1 \$	S415Q08T	57.3	59.7
\$425Q04 30.6 29.4 \$425Q05 66.5 66.3 \$428Q01 61.9 60.5 \$428Q03 71.3 73.0 \$428Q05 43.7 45.2 \$438Q01T 82.8 83.7 \$438Q02 65.9 66.7 \$438Q03D 38.6 39.3 \$465Q01 49.8 46.8 \$465Q02 60.1 60.4 \$465Q04 36.3 36.2 \$465Q04 36.3 36.2 \$465Q04 36.3 36.2 \$466Q01T 70.6 73.5 \$466Q01T 70.3 70.3 \$466Q01T 70.3 70.3 \$466Q01T 70.4 51.4 \$466Q01T 70.3 70.3 \$466Q01T 70.4 51.4 \$466Q01T 70.3 70.3 \$466Q01T 70.4 51.4 \$478Q01 45.0 43.0 \$478Q01 45.4 50.	\$425Q02	45.2	47.4
\$425Q05 68.5 68.3 \$428Q01 61.9 60.5 \$428Q03 71.3 73.0 \$428Q05 43.7 45.2 \$438Q01T 82.8 83.7 \$438Q02 65.9 66.7 \$438Q03D 38.6 39.3 \$455Q01 49.8 46.8 \$455Q02 60.1 60.4 \$455Q04 36.3 36.2 \$466Q01T 70.6 73.5 \$466Q05 54.8 53.2 \$466Q07T 73.3 70.3 \$478Q01 42.5 43.0 \$478Q01 50.4 54.6 \$478Q03T 66.9 69.1 \$498Q04 59.8 64.7 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 64.9 49.0	\$425Q03	42.2	43.8
\$428Q01 61.9 60.5 \$428Q03 71.3 73.0 \$428Q05 43.7 45.2 \$438Q01T 82.8 83.7 \$438Q02 65.9 66.7 \$438Q03D 38.6 39.3 \$465Q04 60.1 60.4 \$465Q02 60.1 60.4 \$465Q04 36.3 36.2 \$465Q04 36.3 36.2 \$465Q04 36.3 36.2 \$466Q01T 70.6 73.5 \$466Q01T 70.3 32.2 \$466Q07T 73.3 70.3 \$478Q01 42.5 43.0 \$478Q01 50.4 54.6 \$478Q031 66.9 60.1 \$498Q04 59.8 46.7 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	S425Q04	30.6	29.4
\$42803 71.3 73.0 \$42805 43.7 45.2 \$43801T 82.8 83.7 \$43802 65.9 66.7 \$43803D 38.6 39.3 \$45001 49.8 46.8 \$46501 60.1 60.4 \$46504 36.3 36.2 \$46601T 73.5 546601T \$466005 54.8 53.2 \$466007T 73.3 70.3 \$478001 42.5 43.0 \$478001 42.5 43.0 \$478003T 66.9 69.1 \$49803 42.4 38.9 \$49804 59.8 64.7 \$49804 59.8 64.7 \$51402 85.0 84.9 \$51402 85.0 84.9 \$51404 52.3 55.9	\$425Q05	68.5	68.3
\$428Q0543.745.2\$438Q01T82.883.7\$438Q0265.966.7\$438Q03D38.639.3\$465Q0149.846.8\$465Q0260.160.4\$465Q0436.336.2\$466Q01T70.673.5\$466Q0554.853.2\$466Q07T73.370.3\$478Q0142.543.0\$478Q02T50.454.6\$478Q03T66.969.1\$498Q0459.864.7\$498Q0459.864.7\$514Q0285.084.9\$514Q0452.355.9	\$428Q01	61.9	60.5
S438Q01T 82.8 83.7 S438Q02 65.9 66.7 S438Q03D 38.6 39.3 S45Q01 49.8 46.8 S465Q02 60.1 60.4 S465Q04 36.3 36.2 S466Q01T 70.6 73.5 S466Q05 54.8 53.2 S466Q07T 73.3 70.3 S478Q01 42.5 43.0 S478Q02T 50.4 66.9 S498Q02T 46.8 45.0 S498Q03 42.4 38.9 S498Q04 59.8 64.7 S514Q02 85.0 84.9 S514Q03 46.9 49.0	\$428Q03	71.3	73.0
\$438Q0265.966.7\$438Q03D38.639.3\$465Q0149.846.8\$465Q0260.160.4\$465Q0436.336.2\$466Q0554.853.2\$466Q0554.853.2\$466Q07T73.370.3\$478Q0142.543.0\$478Q02T50.454.6\$498Q0342.438.9\$498Q0459.864.7\$514Q0285.084.9\$514Q0346.949.0\$514Q0452.355.9	S428Q05	43.7	45.2
S438Q03D 38.6 39.3 S465Q01 49.8 46.8 S465Q02 60.1 60.4 S465Q04 36.3 36.2 S466Q01T 70.6 73.5 S466Q05 54.8 53.2 S466Q07T 73.3 70.3 S466Q07T 73.5 43.0 S478Q01 42.5 43.0 S478Q02T 50.4 54.6 S478Q03T 66.9 69.1 S498Q02T 46.8 45.0 S498Q03 42.4 38.9 S498Q04 59.8 64.7 S514Q02 85.0 84.9 S514Q03 46.9 49.0	S438Q01T	82.8	83.7
\$465Q01 49.8 46.8 \$465Q02 60.1 60.4 \$465Q04 36.3 36.2 \$466Q01T 70.6 73.5 \$466Q05 54.8 53.2 \$466Q07T 73.3 70.3 \$466Q07T 73.5 43.0 \$478Q01 42.5 43.0 \$478Q02T 50.4 54.6 \$478Q03T 66.9 69.1 \$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	\$438Q02	65.9	66.7
\$465Q02 60.1 60.4 \$465Q04 36.3 36.2 \$466Q01T 70.6 73.5 \$466Q05 54.8 53.2 \$466Q07T 73.3 70.3 \$466Q07T 42.5 43.0 \$478Q01 42.5 43.0 \$478Q02T 50.4 54.6 \$478Q03T 66.9 69.1 \$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	S438Q03D	38.6	39.3
\$465Q04 36.3 36.2 \$466Q01T 70.6 73.5 \$466Q05 54.8 53.2 \$466Q07T 73.3 70.3 \$478Q01 42.5 43.0 \$478Q02T 50.4 54.6 \$478Q03T 66.9 69.1 \$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	S465Q01	49.8	46.8
S466Q01T 70.6 73.5 S466Q05 54.8 53.2 S466Q07T 73.3 70.3 S478Q01 42.5 43.0 S478Q02T 50.4 54.6 S478Q03T 66.9 69.1 S498Q02T 46.8 45.0 S498Q03 42.4 38.9 S498Q04 59.8 64.7 S514Q02 85.0 84.9 S514Q03 46.9 49.0	\$465Q02	60.1	60.4
\$466Q05 54.8 53.2 \$466Q07T 73.3 70.3 \$478Q01 42.5 43.0 \$478Q02T 50.4 54.6 \$478Q03T 66.9 69.1 \$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	S465Q04	36.3	36.2
S466Q07T 73.3 70.3 S478Q01 42.5 43.0 S478Q02T 50.4 54.6 S478Q03T 66.9 69.1 S498Q02T 46.8 45.0 S498Q03 42.4 38.9 S498Q04 59.8 64.7 S514Q02 85.0 84.9 S514Q03 46.9 49.0	S466Q01T	70.6	73.5
\$478Q01 42.5 43.0 \$478Q02T 50.4 54.6 \$478Q03T 66.9 69.1 \$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	S466Q05	54.8	53.2
\$478Q02T 50.4 54.6 \$478Q03T 66.9 69.1 \$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	S466Q07T	73.3	70.3
\$478Q03T 66.9 69.1 \$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 9.0 \$514Q04 52.3 55.9	S478Q01	42.5	43.0
\$498Q02T 46.8 45.0 \$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 9.0 \$514Q04 52.3 55.9	\$478Q02T	50.4	54.6
\$498Q03 42.4 38.9 \$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9	\$478Q03T	66.9	69.1
\$498Q04 59.8 64.7 \$514Q02 85.0 84.9 \$514Q03 46.9 49.0 \$514Q04 52.3 55.9			
S514Q02 85.0 84.9 S514Q03 46.9 49.0 S514Q04 52.3 55.9	S498Q03	42.4	38.9
\$514Q03 46.9 49.0 \$514Q04 \$2.3 \$5.9	S498Q04	59.8	64.7
\$514Q04 52.3 55.9	S514Q02	85.0	84.9
	S514Q03	46.9	49.0
S519O01 35.8 39.7	S514Q04	52.3	55.9
5315201 53.0 53.7	S519Q01	35.8	39.7
\$519Q02T 53.6 54.8	S519Q02T	53.6	54.8
\$519Q03 28.3 25.4	S519Q03	28.3	25.4
\$521Q02 54.4 54.2	S521Q02	54.4	54.2
S521Q06 88.2 89.2	S521Q06	88.2	89.2
S527Q01T 16.1 17.7	S527Q01T	16.1	17.7
\$527Q03T 56.9 57.2	S527Q03T	56.9	57.2
SE27004T 52.6 52.1	S527Q04T	52.6	53.1

Table 12.35 International percent correct for science link items in PISA 2006 and PISA 2009





TRANSFORMING THE PLAUSIBLE VALUES TO PISA SCALES

For PISA 2009 the reading, mathematics and science results are each reported on the scales that were established when the respective domain was a major domain. Therefore in the case of reading, the results are directly comparable with those that have been reported for PISA 2000, PISA 2003 and PISA 2006. In the case of mathematics they are directly comparable with the results reported in PISA 2003 and PISA 2006 and for science they are directly comparable with the results reported in PISA 2003.

Mathematics

For mathematics, the PISA 2009 plausible values were equated to the PISA scale by using common item equating.

A shift to align the scales was computed as follows. Of the 48 mathematics items that were included in the PISA 2006 main survey, 35 were selected for PISA 2009 main survey assessment. The average item difficulty of the 35 link items was set to zero in PISA 2009 while it was 0.0752 in PISA 2006. A shift of 0.0752 of a logit was therefore required to align PISA 2006 and PISA 2009 mathematics scales. After applying this shift, the same transformation was used as in PISA 2006.

The resulting transformation required to place logits on the PISA mathematics scale was:

PISA 2009 scaled score = ((L+0.1691) / 1.2838) * 100 + 500

where L is the logit scale outcome of the 2009 scaling.

For details about equating procedures in 2006, see the PISA 2006 Technical Report (OECD, 2008).

Reading

A two-step equating approach was used to report PISA 2009 reading results on the PISA 2000 reading scale.

Step 1: Common items equating

A shift to align the scales was computed as follows. Of the 101 reading items that were included in the PISA 2009 main survey, 26 were link items that had been used in each previous PISA assessment. The average item difficulty of the 26 link items was –0.0885 in PISA 2009 while in PISA 2006 it was 0.0210. A shift of 0.0906 logits was therefore required to align the PISA 2006 and PISA 2009 reading link items.

Step 2: Common person equating

To equate PISA 2009 student proficiency scores to PISA scale, the dataset that included PISA 2009 OECD countries was scaled twice, once using all the reading items and once using only link items. The difference between the student proficiency means of these two scalings was 0.1261 logits and this shift was applied to the student PVs to place PISA 2009 student performance to the PISA scale.

After applying this shift, the transformations required to place logits on the PISA reading scale were as given below. Note that the transformation is done separately by gender, as has been the case since PISA 2003.

For female students: PISA 2009 scaled score = ((0.8739 * L - 0.4416) / 1.1002) * 100 + 500

For male students: PISA 2009 scaled score = ((0.8823 * *L* – 0.5185) / 1.1002) * 100 + 500

For students with missing gender code: PISA 2009 scaled score = ((0.8830 * L - 0.4837) / 1.1002) * 100 + 500

Science

For science, the PISA 2009 plausible values were equated to the PISA scale by using the common items equating method.

A shift to align the scales was computed as follows. Of the 103 science items that were included in the PISA 2006 main survey, 53 were selected for the PISA 2009 main survey assessment. The average item difficulty of the 53 link items was set to zero in PISA 2009 while it was 0.0151 in PISA 2006. A shift of 0.0151 of a logit is required to align PISA 2006 and PISA 2009 science scales.

After applying this shift, the transformation required to place logits on the PISA science scales was: PISA 2009 scaled score = ((L-0.1646) / 1.0724) * 100 + 500

where L is the logit scale outcome of the 2009 scaling.

DRA

DRA logits were standardised to have mean of 0 and standard deviation of 1 for a combined set of 16 equal weighted OECD countries. Then the mean and standard deviation of PISA paper and pencil reading scale for this combined set was computed. Final linear transformation of the DRA logit value yields a mean and standard deviation of DRA PISA results to be equal to PISA paper and pencil reading results for a combined set.

The transformation required to place DRA logits on the PISA scales was:

PISA 2009 scaled score = (((L-0.5165)/1.1011)*96.3956) + 498.9126

where L is the logit scale outcome of the 2009 scaling.

LINK ERROR

Link errors estimated using the methodology discussed in Chapter 9 were computed for the following eleven links: PISA mathematics scales 2003 to 2006, 2006 to 2009 and 2003 to 2009; PISA reading scales 2000 to 2003, 2000 to 2006, 2000 to 2009, 2003 to 2006, 2003 to 2009 and 2006 to 2009; and PISA science scale 2006 to 2009 and science trend scale 2003 to 2006. The results are given in Table 12.36.

	Link error on PISA scale
PISA mathematics scale 2003 to 2006	1.382
PISA reading scale 2000 to 2003	4.474
PISA reading scale 2000 to 2006	4.976
PISA reading scale 2003 to 2006	5.307
Interim science scale 2000 to 2003	3.112
Science trend scale 2003 to 2006	4.963
PISA mathematics scale 2003 to 2009	1.990
PISA mathematics scale 2006 to 2009	1.333
PISA reading scale 2000 to 2009	4.937
PISA reading scale 2003 to 2009	4.088
PISA reading scale 2006 to 2009	4.069
PISA science scale 2006 to 2009	2.566

Table 12.36 Link error estimates





Notes

1. The "Xs" represent a different number of students in each graph.

2. Note that this section refers to cognitive scales only. PISA has also produced a wide range of other scales that are affective or behavioural scales.

3. This is because conditioning variables were not used in the construction of the scales for the PISA 2000 data (see *PISA 2003 Technical Report*, OECD 2005).

4. This is because gender was the only conditioning variable used in the construction of the content-bases scales. (see PISA 2006 Technical Report, OECD 2008).

5. Note, of course, that as mentioned above comparison across alternative scalings of the same domain are not appropriate.

6. The PISA 2000 frameworks were published as OECD (1999) Measuring Student Knowledge and Skills: A new Framework for Assessment.

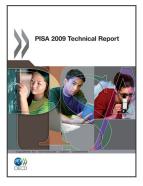
7. The PISA 2003 frameworks were published as OECD (2003) The PISA 2003 Assessment Framework: Mathematics, Reading, Science and Problem Solving Knowledge and Skills.

8. The PISA 2006 frameworks were published as OECD (2006) Assessing Scientific, Reading and Mathematical Literacy: A Framework for PISA 2006.

9. In 2003 the total testing time was also 390 minutes, but 60 minutes of that testing time was allocated to an assessment of problem-solving skills.

10. In 2009 the total testing time per country was also 390 minutes.

- 11. Representing 120 minutes of testing time.
- 12. Representing 90 minutes of testing time.
- 13. Representing 90 minutes of testing time.



From: PISA 2009 Technical Report

Access the complete publication at: https://doi.org/10.1787/9789264167872-en

Please cite this chapter as:

OECD (2012), "Scaling Outcomes", in PISA 2009 Technical Report, OECD Publishing, Paris.

DOI: https://doi.org/10.1787/9789264167872-13-en

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