

Appendix A

Country-specific descriptives, including information about their distribution in terms of skewness and kurtosis (see Tables A.1, A.2, A.3, A.4, A.5 and A.6.).

Table A.1 Country-specific descriptives of teacher's years of experience

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Poland	0.00	3.00	2.74	0.63	-2.72	(0.02)	7.18	(0.04)
Lithuania	0.00	3.00	2.68	0.56	-1.77	(0.06)	3.26	(0.13)
Armenia	0.00	3.00	2.61	0.71	-2.03	(0.07)	3.93	(0.13)
Italy	0.00	3.00	2.55	0.77	-1.74	(0.01)	2.37	(0.03)
Serbia	0.00	3.00	2.52	0.68	-1.41	(0.04)	1.74	(0.08)
Hungary	0.00	3.00	2.48	0.91	-1.67	(0.04)	1.60	(0.07)
Georgia	0.00	3.00	2.43	0.83	-1.56	(0.05)	1.87	(0.10)
Azerbaijan	0.00	3.00	2.39	0.83	-1.18	(0.03)	0.50	(0.06)
Romania	0.00	3.00	2.29	0.82	-0.94	(0.02)	0.14	(0.04)
Croatia	0.00	3.00	2.28	0.93	-1.19	(0.05)	0.47	(0.10)
Slovenia	0.00	3.00	2.26	0.93	-1.09	(0.08)	0.18	(0.16)
Slovak Republic	0.00	3.00	2.22	0.98	-1.06	(0.05)	-0.01	(0.09)
Tunisia	0.00	3.00	2.16	1.06	-0.95	(0.03)	-0.45	(0.06)
Spain	0.00	3.00	2.15	1.11	-0.98	(0.02)	-0.52	(0.04)
Portugal	0.00	3.00	2.14	0.81	-0.73	(0.03)	0.08	(0.06)
Czech Republic	0.00	3.00	2.13	1.07	-0.92	(0.04)	-0.49	(0.07)
Iran	0.00	3.00	2.10	0.97	-0.90	(0.01)	-0.15	(0.02)
Finland	0.00	3.00	2.07	0.98	-0.83	(0.04)	-0.35	(0.09)
Germany	0.00	3.00	2.00	1.11	-0.71	(0.01)	-0.91	(0.03)
Morocco	0.00	3.00	1.99	0.99	-0.68	(0.02)	-0.60	(0.03)
Thailand	0.00	3.00	1.99	1.16	-0.68	(0.01)	-1.07	(0.03)
Sweden	0.00	3.00	1.97	0.93	-0.63	(0.04)	-0.45	(0.08)

(continued)

Table A.1 (continued)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Chinese Taipei	0.00	3.00	1.93	0.84	-0.60	(0.02)	-0.05	(0.05)
Northern Ireland	0.00	3.00	1.92	0.93	-0.39	(0.08)	-0.81	(0.17)
Norway	0.00	3.00	1.85	0.99	-0.44	(0.04)	-0.87	(0.09)
Hong Kong	0.00	3.00	1.81	0.98	-0.67	(0.06)	-0.50	(0.12)
Japan	0.00	3.00	1.81	1.24	-0.36	(0.01)	-1.53	(0.02)
Denmark	0.00	3.00	1.79	1.10	-0.36	(0.05)	-1.21	(0.09)
Korea	0.00	3.00	1.77	1.14	-0.31	(0.02)	-1.34	(0.04)
Chile	0.00	3.00	1.76	1.21	-0.39	(0.03)	-1.41	(0.05)
Yemen	0.00	3.00	1.76	0.82	-0.72	(0.02)	0.14	(0.04)
Netherlands	0.00	3.00	1.72	1.05	-0.18	(0.03)	-1.22	(0.06)
United States	0.00	3.00	1.68	1.01	-0.28	(0.01)	-1.00	(0.01)
Botswana	0.00	3.00	1.64	1.06	-0.23	(0.07)	-1.17	(0.13)
Bahrain	0.00	3.00	1.63	0.85	-0.24	(0.11)	-0.51	(0.22)
Malta	0.00	3.00	1.61	1.03	-0.03	(0.28)	-1.16	(0.54)
Saudi Arabia	0.00	3.00	1.59	1.00	-0.28	(0.02)	-0.99	(0.04)
Ireland	0.00	3.00	1.58	1.19	-0.07	(0.04)	-1.52	(0.08)
New Zealand	0.00	3.00	1.57	1.10	-0.11	(0.04)	-1.30	(0.08)
Honduras	0.00	3.00	1.53	1.04	-0.18	(0.03)	-1.15	(0.05)
Turkey	0.00	3.00	1.48	1.06	-0.08	(0.01)	-1.24	(0.02)
England	0.00	3.00	1.46	1.17	0.00	(0.02)	-1.49	(0.03)
Qatar	0.00	3.00	1.42	1.11	0.10	(0.11)	-1.33	(0.21)
United Arab Emirates	0.00	3.00	1.26	1.01	0.18	(0.06)	-1.12	(0.11)
Singapore	0.00	3.00	1.18	1.02	0.33	(0.07)	-1.08	(0.14)
Oman	0.00	3.00	1.14	0.79	0.53	(0.06)	0.08	(0.12)
Kuwait	0.00	3.00	1.01	0.83	0.22	(0.08)	-1.00	(0.15)

Note A normal distribution has a skewness of 0 and a kurtosis of 3. Countries are ordered according to the mean of the categories “less than 5 years” (0), “at least 5 years but less than 10 years” (1), “at least 10 years but less than 20 years” (2), or “20 years or more” (3) of experience

Table A.2 Country-specific descriptives of teacher’s degree from teacher education

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Slovak Republic	1.00	5.00	4.98	0.25	-13.04	(0.05)	179.26	(0.09)
Poland	2.00	5.00	4.95	0.29	-7.44	(0.02)	64.39	(0.04)
Czech Republic	1.00	5.00	4.74	0.93	-3.37	(0.04)	9.66	(0.07)
Georgia	2.00	5.00	4.70	0.59	-2.28	(0.05)	5.65	(0.10)
Finland	1.00	5.00	4.67	0.78	-3.44	(0.04)	12.98	(0.08)
United States	4.00	5.00	4.61	0.49	-0.46	(0.01)	-1.79	(0.01)
England	2.00	5.00	4.37	0.53	-0.09	(0.02)	-0.30	(0.03)
Armenia	0.00	5.00	4.34	1.27	-1.57	(0.06)	0.88	(0.13)
Northern Ireland	3.00	5.00	4.28	0.52	0.23	(0.08)	-0.51	(0.17)

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Table A.2 (continued)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Chinese Taipei	2.00	5.00	4.22	0.53	-0.60	(0.02)	3.81	(0.05)
Qatar	2.00	5.00	4.17	0.65	-1.20	(0.10)	3.62	(0.21)
Bahrain	2.00	5.00	4.17	0.47	-0.30	(0.11)	5.08	(0.21)
Hong Kong	3.00	5.00	4.15	0.50	0.30	(0.06)	0.53	(0.12)
Ireland	3.00	5.00	4.14	0.43	0.73	(0.04)	1.36	(0.08)
Korea	3.00	5.00	4.13	0.50	0.26	(0.02)	0.67	(0.04)
Thailand	1.00	5.00	4.07	0.47	-2.41	(0.01)	19.08	(0.03)
Kuwait	2.00	5.00	4.04	0.31	-0.89	(0.08)	19.94	(0.15)
United Arab Emirates	1.00	5.00	4.03	0.61	-1.13	(0.06)	3.78	(0.11)
Hungary	3.00	5.00	4.02	0.18	2.31	(0.04)	26.52	(0.07)
Chile	3.00	5.00	4.01	0.46	0.05	(0.03)	1.69	(0.05)
Spain	4.00	5.00	4.01	0.10	9.73	(0.02)	92.75	(0.03)
New Zealand	3.00	5.00	4.01	0.59	0.00	(0.04)	-0.13	(0.08)
Lithuania	2.00	5.00	4.01	0.56	-1.16	(0.06)	4.33	(0.12)
Netherlands	1.00	5.00	3.99	0.30	-7.37	(0.03)	78.76	(0.06)
Norway	3.00	5.00	3.98	0.29	-0.59	(0.04)	8.65	(0.09)
Portugal	3.00	5.00	3.96	0.28	-1.28	(0.03)	9.39	(0.06)
Sweden	0.00	4.00	3.90	0.44	-6.10	(0.04)	43.58	(0.08)
Turkey	3.00	5.00	3.89	0.40	-0.81	(0.01)	2.30	(0.02)
Japan	2.00	5.00	3.86	0.62	-2.06	(0.01)	4.60	(0.02)
Denmark	1.00	5.00	3.83	0.50	-2.08	(0.05)	8.72	(0.09)
Germany	1.00	5.00	3.75	0.79	-2.55	(0.01)	6.31	(0.03)
Malta	0.00	5.00	3.74	1.14	-1.82	(0.28)	3.19	(0.56)
Oman	0.00	5.00	3.74	0.88	-1.69	(0.06)	2.91	(0.12)
Singapore	1.00	5.00	3.65	0.84	-0.91	(0.07)	0.50	(0.14)
Slovenia	3.00	5.00	3.62	0.50	-0.33	(0.08)	-1.44	(0.16)
Azerbaijan	0.00	5.00	3.61	0.80	-1.42	(0.03)	5.38	(0.06)
Saudi Arabia	2.00	5.00	3.42	0.93	-0.82	(0.02)	-1.17	(0.04)
Croatia	1.00	5.00	3.35	0.55	0.21	(0.05)	1.13	(0.10)
Serbia	1.00	5.00	3.12	1.09	-0.36	(0.04)	-1.48	(0.08)
Iran	1.00	5.00	3.07	0.99	-0.91	(0.01)	0.09	(0.02)
Botswana	1.00	5.00	3.07	0.61	-0.14	(0.06)	2.97	(0.13)
Romania	1.00	5.00	2.73	1.34	-0.12	(0.02)	-1.40	(0.04)
Honduras	0.00	4.00	2.57	1.35	-0.19	(0.02)	-1.72	(0.05)
Yemen	0.00	4.00	2.24	1.23	0.47	(0.02)	-1.30	(0.04)
Tunisia	0.00	5.00	2.14	1.13	0.32	(0.03)	-1.32	(0.06)
Morocco	0.00	5.00	1.95	1.54	0.59	(0.02)	-1.40	(0.03)
Italy	1.00	5.00	1.71	1.34	1.44	(0.01)	0.25	(0.03)

Note Countries are ordered according to the mean of the categories “Not completed ISCED level 3” (0), “Finished ISCED level 3” (1), “Finished ISCED level 4” (2), “Finished ISCED level 5B” (3), “Finished ISCED level 5A, first degree” (4), or “Finished ISCED level 5A, second degree or higher” (5)

Table A.3 Country-specific descriptives of teacher's major in mathematics or mathematics education

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Kuwait	0.00	1.00	0.97	0.18	-5.18	(0.08)	24.90	(0.15)
Bahrain	0.00	1.00	0.93	0.26	-3.38	(0.11)	9.44	(0.21)
Oman	0.00	1.00	0.84	0.37	-1.84	(0.06)	1.37	(0.12)
United Arab Emirates	0.00	1.00	0.81	0.40	-1.55	(0.05)	0.41	(0.11)
Azerbaijan	0.00	1.00	0.80	0.40	-1.50	(0.03)	0.25	(0.06)
Saudi Arabia	0.00	1.00	0.78	0.41	-1.35	(0.02)	-0.17	(0.04)
Georgia	0.00	1.00	0.77	0.42	-1.28	(0.05)	-0.37	(0.10)
Armenia	0.00	1.00	0.76	0.43	-1.19	(0.06)	-0.58	(0.13)
Qatar	0.00	1.00	0.70	0.46	-0.89	(0.10)	-1.22	(0.21)
Sweden	0.00	1.00	0.68	0.47	-0.77	(0.04)	-1.41	(0.08)
Hong Kong	0.00	1.00	0.66	0.48	-0.66	(0.06)	-1.57	(0.12)
Singapore	0.00	1.00	0.65	0.48	-0.65	(0.07)	-1.58	(0.14)
Thailand	0.00	1.00	0.63	0.48	-0.53	(0.01)	-1.72	(0.03)
Denmark	0.00	1.00	0.58	0.49	-0.32	(0.05)	-1.90	(0.09)
Germany	0.00	1.00	0.51	0.50	-0.04	(0.01)	-2.00	(0.03)
Yemen	0.00	1.00	0.48	0.50	0.07	(0.02)	-1.99	(0.04)
Botswana	0.00	1.00	0.44	0.50	0.26	(0.06)	-1.94	(0.13)
Tunisia	0.00	1.00	0.42	0.49	0.31	(0.03)	-1.90	(0.06)
Chile	0.00	1.00	0.36	0.48	0.59	(0.03)	-1.65	(0.05)
Romania	0.00	1.00	0.35	0.48	0.61	(0.02)	-1.63	(0.05)
Morocco	0.00	1.00	0.34	0.47	0.69	(0.02)	-1.53	(0.03)
Chinese Taipei	0.00	1.00	0.34	0.47	0.69	(0.02)	-1.52	(0.05)
Norway	0.00	1.00	0.32	0.47	0.77	(0.04)	-1.41	(0.09)
Serbia	0.00	1.00	0.31	0.46	0.83	(0.04)	-1.32	(0.08)
Spain	0.00	1.00	0.31	0.46	0.84	(0.02)	-1.29	(0.03)
Portugal	0.00	1.00	0.27	0.45	1.02	(0.03)	-0.95	(0.06)
Iran	0.00	1.00	0.26	0.44	1.10	(0.01)	-0.80	(0.02)
Netherlands	0.00	1.00	0.24	0.43	1.22	(0.03)	-0.51	(0.06)
Turkey	0.00	1.00	0.24	0.43	1.24	(0.01)	-0.47	(0.02)
England	0.00	1.00	0.23	0.42	1.31	(0.02)	-0.29	(0.03)
Japan	0.00	1.00	0.20	0.40	1.48	(0.01)	0.19	(0.02)
Poland	0.00	1.00	0.20	0.40	1.53	(0.02)	0.34	(0.04)
Honduras	0.00	1.00	0.19	0.39	1.57	(0.03)	0.48	(0.05)
Italy	0.00	1.00	0.18	0.38	1.70	(0.02)	0.88	(0.04)
Croatia	0.00	1.00	0.17	0.37	1.78	(0.05)	1.16	(0.10)
Malta	0.00	1.00	0.15	0.36	1.95	(0.28)	1.85	(0.56)
New Zealand	0.00	1.00	0.15	0.36	1.97	(0.04)	1.87	(0.08)
Slovak Republic	0.00	1.00	0.14	0.35	2.06	(0.05)	2.25	(0.09)

(continued)

Table A.3 (continued)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Finland	0.00	1.00	0.14	0.35	2.08	(0.04)	2.31	(0.08)
Ireland	0.00	1.00	0.13	0.33	2.27	(0.04)	3.15	(0.08)
United States	0.00	1.00	0.11	0.32	2.44	(0.01)	3.93	(0.01)
Northern Ireland	0.00	1.00	0.10	0.30	2.63	(0.08)	4.95	(0.16)
Lithuania	0.00	1.00	0.10	0.30	2.73	(0.06)	5.45	(0.12)
Korea	0.00	1.00	0.09	0.29	2.83	(0.02)	6.01	(0.04)
Hungary	0.00	1.00	0.08	0.27	3.20	(0.04)	8.24	(0.07)
Czech Republic	0.00	1.00	0.07	0.26	3.25	(0.04)	8.60	(0.07)
Slovenia	0.00	1.00	0.04	0.20	4.57	(0.08)	18.88	(0.16)

Note Countries are ordered according to the proportion of teachers with a major in mathematics or mathematics education

Table A.4 Country-specific descriptives of the item parcel indicating teacher’s participation in professional development (PD) activities preparing for specific challenges of mathematics instruction (out of three item-parcels of the latent construct “PD”)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Kuwait	0.00	1.00	0.78	0.33	-1.32	(0.08)	0.49	(0.15)
Singapore	0.00	1.00	0.70	0.37	-0.83	(0.07)	-0.77	(0.14)
New Zealand	0.00	1.00	0.68	0.41	-0.76	(0.04)	-1.12	(0.08)
Thailand	0.00	1.00	0.67	0.40	-0.67	(0.01)	-1.18	(0.03)
Hong Kong	0.00	1.00	0.66	0.37	-0.59	(0.06)	-1.07	(0.12)
Saudi Arabia	0.00	1.00	0.64	0.40	-0.61	(0.02)	-1.25	(0.04)
United States	0.00	1.00	0.64	0.40	-0.58	(0.01)	-1.26	(0.01)
Honduras	0.00	1.00	0.63	0.39	-0.53	(0.02)	-1.27	(0.05)
Armenia	0.00	1.00	0.62	0.41	-0.46	(0.06)	-1.44	(0.13)
Azerbaijan	0.00	1.00	0.59	0.34	-0.46	(0.03)	-0.92	(0.06)
Northern Ireland	0.00	1.00	0.58	0.44	-0.30	(0.08)	-1.69	(0.16)
Portugal	0.00	1.00	0.58	0.44	-0.32	(0.03)	-1.68	(0.06)
England	0.00	1.00	0.57	0.42	-0.27	(0.02)	-1.60	(0.03)
Sweden	0.00	1.00	0.54	0.40	-0.08	(0.04)	-1.52	(0.08)
Croatia	0.00	1.00	0.53	0.38	-0.11	(0.05)	-1.41	(0.10)
Qatar	0.00	1.00	0.53	0.44	-0.14	(0.11)	-1.72	(0.21)
Romania	0.00	1.00	0.52	0.43	-0.06	(0.02)	-1.67	(0.04)
United Arab Emirates	0.00	1.00	0.51	0.39	-0.05	(0.06)	-1.48	(0.11)
Serbia	0.00	1.00	0.49	0.40	0.01	(0.04)	-1.56	(0.08)
Bahrain	0.00	1.00	0.48	0.42	0.08	(0.11)	-1.64	(0.21)
Chinese Taipei	0.00	1.00	0.47	0.42	0.10	(0.02)	-1.64	(0.05)
Poland	0.00	1.00	0.46	0.38	0.08	(0.02)	-1.42	(0.04)

(continued)

Table A.4 (continued)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Germany	0.00	1.00	0.44	0.38	0.16	(0.01)	-1.41	(0.03)
Oman	0.00	1.00	0.44	0.40	0.28	(0.06)	-1.49	(0.12)
Japan	0.00	1.00	0.42	0.40	0.22	(0.01)	-1.52	(0.02)
Lithuania	0.00	1.00	0.40	0.39	0.39	(0.06)	-1.33	(0.13)
Iran	0.00	1.00	0.40	0.42	0.38	(0.01)	-1.54	(0.02)
Korea	0.00	1.00	0.40	0.39	0.36	(0.02)	-1.40	(0.04)
Tunisia	0.00	1.00	0.37	0.39	0.55	(0.03)	-1.19	(0.06)
Chile	0.00	1.00	0.35	0.37	0.53	(0.03)	-1.19	(0.06)
Slovenia	0.00	1.00	0.33	0.36	0.69	(0.08)	-0.85	(0.16)
Italy	0.00	1.00	0.32	0.38	0.70	(0.01)	-1.01	(0.03)
Ireland	0.00	1.00	0.29	0.37	0.91	(0.04)	-0.71	(0.08)
Hungary	0.00	1.00	0.28	0.33	0.89	(0.04)	-0.44	(0.07)
Slovak Republic	0.00	1.00	0.26	0.33	1.02	(0.05)	-0.08	(0.09)
Georgia	0.00	1.00	0.26	0.35	1.06	(0.05)	-0.28	(0.10)
Yemen	0.00	1.00	0.26	0.35	1.03	(0.02)	-0.39	(0.04)
Malta	0.00	1.00	0.24	0.35	1.20	(0.28)	0.02	(0.55)
Denmark	0.00	1.00	0.23	0.34	1.13	(0.05)	-0.14	(0.10)
Norway	0.00	1.00	0.22	0.33	1.16	(0.04)	-0.17	(0.09)
Spain	0.00	1.00	0.21	0.32	1.32	(0.02)	0.47	(0.03)
Netherlands	0.00	1.00	0.19	0.30	1.38	(0.03)	0.62	(0.06)
Czech Republic	0.00	1.00	0.18	0.28	1.47	(0.04)	1.27	(0.07)
Morocco	0.00	1.00	0.15	0.33	1.94	(0.02)	2.04	(0.03)
Botswana	0.00	1.00	0.13	0.28	2.12	(0.07)	3.28	(0.13)
Turkey	0.00	1.00	0.11	0.26	2.48	(0.01)	5.10	(0.02)
Finland	0.00	1.00	0.10	0.21	1.99	(0.04)	2.91	(0.08)

Note Countries are ordered according to the proportion of teachers that took part in specific PD activities

Table A.5 Country-specific descriptives of teacher's sense of preparedness to teach geometry (item-parcel)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Poland	0.50	2.00	1.95	0.17	-4.31	(0.02)	24.04	(0.04)
Denmark	1.43	2.00	1.93	0.13	-2.24	(0.05)	4.38	(0.10)
Kuwait	1.00	2.00	1.93	0.18	-3.46	(0.08)	12.62	(0.15)
Romania	1.00	2.00	1.92	0.19	-2.96	(0.02)	9.04	(0.04)
Portugal	0.57	2.00	1.90	0.16	-2.51	(0.03)	10.19	(0.06)
United States	0.00	2.00	1.90	0.22	-3.44	(0.01)	17.20	(0.01)
Croatia	0.00	2.00	1.89	0.26	-4.01	(0.05)	20.87	(0.16)
Saudi Arabia	0.00	2.00	1.89	0.27	-3.94	(0.02)	19.79	(0.04)

(continued)

Table A.5 (continued)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
England	0.86	2.00	1.89	0.23	-2.76	(0.02)	7.81	(0.03)
Czech Republic	0.75	2.00	1.88	0.26	-2.58	(0.04)	6.27	(0.07)
Northern Ireland	0.00	2.00	1.88	0.24	-3.26	(0.08)	16.94	(0.17)
Lithuania	1.00	2.00	1.87	0.22	-1.86	(0.06)	3.03	(0.13)
Slovak Republic	0.57	2.00	1.86	0.25	-1.98	(0.05)	3.49	(0.10)
Qatar	0.00	2.00	1.86	0.32	-3.22	(0.11)	12.52	(0.21)
Malta	1.00	2.00	1.86	0.26	-1.98	(0.28)	3.25	(0.56)
Chinese Taipei	0.86	2.00	1.84	0.30	-1.77	(0.02)	1.88	(0.05)
Botswana	0.14	2.00	1.84	0.30	-2.53	(0.07)	7.57	(0.13)
Oman	0.29	2.00	1.84	0.28	-1.87	(0.06)	3.29	(0.12)
Ireland	0.71	2.00	1.83	0.28	-1.70	(0.04)	2.13	(0.08)
Spain	0.67	2.00	1.83	0.31	-1.95	(0.02)	2.74	(0.03)
Chile	0.71	2.00	1.83	0.28	-1.64	(0.03)	1.98	(0.06)
Singapore	0.50	2.00	1.83	0.31	-1.92	(0.07)	3.04	(0.14)
United Arab Emirates	0.00	2.00	1.83	0.38	-2.71	(0.06)	7.40	(0.12)
Georgia	0.00	2.00	1.82	0.33	-2.66	(0.05)	8.98	(0.10)
Slovenia	0.43	2.00	1.82	0.30	-2.04	(0.08)	4.51	(0.16)
Tunisia	0.57	2.00	1.82	0.32	-2.03	(0.03)	3.51	(0.07)
Serbia	0.40	2.00	1.81	0.31	-1.74	(0.04)	2.31	(0.08)
Morocco	0.00	2.00	1.80	0.37	-2.31	(0.02)	5.56	(0.04)
Bahrain	0.75	2.00	1.80	0.33	-1.59	(0.11)	1.24	(0.22)
Hungary	0.50	2.00	1.78	0.33	-1.41	(0.04)	0.84	(0.08)
Norway	0.71	2.00	1.77	0.35	-1.43	(0.04)	0.75	(0.09)
Finland	0.00	2.00	1.77	0.32	-1.96	(0.04)	4.87	(0.08)
Armenia	0.00	2.00	1.77	0.36	-2.22	(0.06)	5.86	(0.13)
Netherlands	0.00	2.00	1.76	0.37	-1.98	(0.03)	4.69	(0.06)
New Zealand	0.14	2.00	1.73	0.34	-1.37	(0.04)	1.38	(0.08)
Turkey	0.29	2.00	1.73	0.37	-1.60	(0.01)	2.20	(0.02)
Iran	0.33	2.00	1.73	0.37	-1.45	(0.01)	1.49	(0.03)
Germany	0.57	2.00	1.73	0.33	-1.30	(0.01)	1.03	(0.03)
Korea	0.00	2.00	1.72	0.42	-1.56	(0.02)	1.77	(0.04)
Hong Kong	0.00	2.00	1.71	0.42	-1.47	(0.06)	1.75	(0.12)
Sweden	0.00	2.00	1.70	0.35	-1.39	(0.04)	2.18	(0.08)
Azerbaijan	0.29	2.00	1.67	0.34	-1.06	(0.03)	0.87	(0.07)
Italy	0.67	2.00	1.66	0.38	-0.86	(0.02)	-0.58	(0.03)
Yemen	0.00	2.00	1.61	0.52	-1.38	(0.02)	0.95	(0.05)
Honduras	0.00	2.00	1.51	0.48	-0.89	(0.02)	0.30	(0.05)
Japan	0.14	2.00	1.48	0.46	-0.23	(0.01)	-1.26	(0.03)
Thailand	0.00	2.00	1.40	0.46	-0.30	(0.01)	-0.37	(0.03)

Note Countries are ordered according to the mean of the categories “Not well prepared” (0), “Somewhat prepared” (1) and “Very well prepared” (2)

Table A.6 Country-specific descriptives of the item-parcel indicating the frequency with which teachers implemented InQua in terms of cognitive activation (out of three item-parcels of the latent construct “InQua”)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
England	1.50	3.00	2.89	0.25	-2.55	(0.02)	7.73	(0.03)
Poland	1.00	3.00	2.87	0.35	-2.75	(0.02)	7.52	(0.04)
Qatar	0.50	3.00	2.85	0.38	-2.99	(0.10)	10.15	(0.21)
Slovak Republic	1.00	3.00	2.84	0.34	-2.21	(0.05)	4.35	(0.09)
Romania	1.50	3.00	2.84	0.36	-2.19	(0.02)	3.70	(0.04)
Georgia	1.50	3.00	2.84	0.33	-1.87	(0.05)	2.28	(0.10)
Hungary	1.00	3.00	2.83	0.37	-2.91	(0.04)	9.39	(0.07)
United States	1.00	3.00	2.83	0.34	-2.50	(0.01)	7.55	(0.01)
Malta	1.50	3.00	2.81	0.38	-1.93	(0.27)	2.85	(0.54)
Lithuania	1.00	3.00	2.80	0.38	-2.40	(0.06)	6.76	(0.12)
United Arab Emirates	0.50	3.00	2.79	0.40	-2.26	(0.06)	5.78	(0.11)
Azerbaijan	0.50	3.00	2.78	0.42	-2.51	(0.03)	7.08	(0.06)
Czech Republic	1.00	3.00	2.78	0.36	-1.69	(0.04)	2.75	(0.07)
Portugal	1.00	3.00	2.78	0.41	-1.82	(0.03)	2.56	(0.06)
Northern Ireland	0.00	3.00	2.78	0.43	-2.91	(0.08)	12.67	(0.16)
Italy	1.50	3.00	2.77	0.41	-1.61	(0.01)	1.41	(0.03)
Armenia	1.00	3.00	2.76	0.42	-2.06	(0.06)	4.22	(0.13)
Serbia	1.50	3.00	2.76	0.39	-1.42	(0.04)	0.93	(0.08)
Japan	1.50	3.00	2.76	0.37	-1.38	(0.01)	1.12	(0.02)
Croatia	1.50	3.00	2.74	0.40	-1.52	(0.05)	1.54	(0.10)
Korea	0.00	3.00	2.74	0.39	-2.38	(0.02)	10.75	(0.04)
Oman	0.50	3.00	2.70	0.48	-1.79	(0.06)	3.36	(0.12)
Slovenia	1.50	3.00	2.70	0.45	-1.41	(0.08)	0.95	(0.16)
Chile	1.50	3.00	2.70	0.43	-1.20	(0.03)	0.29	(0.05)
Iran	1.00	3.00	2.69	0.43	-1.58	(0.01)	2.58	(0.02)
Botswana	0.50	3.00	2.65	0.57	-1.63	(0.06)	1.84	(0.13)
Singapore	1.00	3.00	2.64	0.52	-1.37	(0.07)	0.98	(0.14)
Thailand	1.00	3.00	2.64	0.48	-1.24	(0.01)	0.96	(0.03)
Spain	1.00	3.00	2.62	0.49	-0.93	(0.02)	-0.34	(0.03)
Turkey	0.00	3.00	2.62	0.54	-1.56	(0.01)	2.44	(0.02)
Bahrain	1.50	3.00	2.62	0.47	-0.86	(0.11)	-0.48	(0.21)
Ireland	1.00	3.00	2.61	0.45	-0.85	(0.04)	-0.17	(0.08)
Hong Kong	1.00	3.00	2.61	0.50	-1.20	(0.06)	0.91	(0.12)
Saudi Arabia	1.00	3.00	2.60	0.52	-1.16	(0.02)	0.50	(0.04)
New Zealand	1.00	3.00	2.58	0.46	-1.01	(0.04)	0.54	(0.08)
Honduras	1.00	3.00	2.57	0.58	-1.14	(0.02)	0.23	(0.05)
Tunisia	1.00	3.00	2.53	0.56	-0.88	(0.03)	-0.20	(0.06)
Kuwait	1.00	3.00	2.51	0.56	-0.91	(0.08)	0.09	(0.15)

(continued)

Table A.6 (continued)

Country	Min	Max	M	SD	Skewness (<i>SE</i>)		Kurtosis (<i>SE</i>)	
Morocco	1.00	3.00	2.50	0.61	-0.97	(0.02)	-0.15	(0.03)
Germany	0.50	3.00	2.44	0.50	-0.77	(0.01)	0.46	(0.03)
Netherlands	1.00	3.00	2.38	0.56	-0.64	(0.03)	-0.46	(0.06)
Yemen	0.50	3.00	2.34	0.60	-0.61	(0.02)	-0.24	(0.04)
Norway	1.00	3.00	2.33	0.47	-0.37	(0.04)	-0.28	(0.09)
Chinese Taipei	1.00	3.00	2.33	0.62	-0.55	(0.02)	-0.68	(0.05)
Sweden	1.00	3.00	2.25	0.55	-0.64	(0.04)	-0.25	(0.08)
Finland	0.00	3.00	2.23	0.54	-0.18	(0.04)	-0.47	(0.08)
Denmark	1.00	3.00	2.02	0.53	-0.04	(0.05)	-0.56	(0.09)

Note Countries are ordered according to the mean of the categories “Never” (0), “Some lessons” (1), “Half the lessons” (2), or “Every lesson” (3)

Appendix B

Establishing measurement invariance across 47 countries of the latent constructs used in Chap. 3. (Note that as the configural model fits perfectly, a comparison with the metric and scalar models is not meaningful.) (Tables B.1, B.2 and B.3).

Table B.1 Professional development (three item parcels, TG10 and TM11)

Model	χ^2	df	p	RMSEA	CFI	Δ RMSEA	Δ CFI
Metric	93.76	92	0.43	0.00	1.00	–	–
Scalar	1561.09	184	<0.01	0.04	0.39	0.04	–0.61

Table B.2 Preparedness (three item parcels, TM12)

Model	χ^2	df	p	RMSEA	CFI	Δ RMSEA	Δ CFI
Metric	242.23	92	<0.01	0.02	0.96	–	–
Scalar	867.60	184	<0.01	0.03	0.84	0.01	–0.13

Table B.3 Instructional quality (three item parcels, TG15)

Model	χ^2	df	p	RMSEA	CFI	Δ RMSEA	Δ CFI
Metric	231.91	92	<0.01	0.02	0.92	–	–
Scalar	1132.83	184	<0.01	0.03	0.47	0.01	–0.45

Appendix C

Measurement invariance testing of measures across 50 countries (Table C.1).

Table C.1 Results of measurement invariance testing of measures across 50 countries

Invariance model	SB- χ^2 (df)	CFI	TLI	RMSEA	SRMR _w	SRMR _b	Δ CFI	Δ TLI	Δ RMSEA	Δ SRMR _w	Δ SRMR _b
<i>School emphasis on academic success (5 items)—L2 invariance</i>											
Configural	434.2 (101)*	0.975	0.876	0.025	0.000	0.050	—	—	—	—	—
Metric	1245.5 (396)*	0.936	0.919	0.020	0.000	0.066	-0.029	+0.043	-0.005	0.000	+0.016
Scalar	5507.5 (592)*	0.630	0.688	0.039	0.000	0.073	-0.345	-0.288	+0.014	0.000	+0.023
<i>Safety and order in schools (5 items)—L2 invariance</i>											
Configural	538.9 (200)*	0.979	0.948	0.018	0.000	0.044	—	—	—	—	—
Metric	957.0 (348)*	0.963	0.946	0.018	0.000	0.056	-0.016	-0.002	0.000	0.000	+0.012
Scalar	2279.3 (495)*	0.891	0.890	0.026	0.000	0.057	-0.088	-0.058	+0.008	0.000	+0.013
<i>Instructional quality (4 items)—L1 invariance</i>											
Configural	2421.2 (100)*	0.988	0.963	0.064	0.019	—	—	—	—	—	—
Metric	4455.5 (247)*	0.978	0.973	0.055	0.051	—	-0.010	+0.010	-0.009	+0.032	—
Scalar	27,385.8 (394)*	0.857	0.891	0.110	0.142	—	-0.131	-0.072	+0.046	+0.123	—
<i>Instructional quality (4 items)—L2 invariance</i>											
Configural	921.0 (100)*	0.995	0.973	0.038	0.002	0.079	—	—	—	—	—
Metric	1992.2 (271)*	0.990	0.979	0.034	0.002	0.077	-0.005	+0.006	-0.004	0.000	-0.002
Scalar	15,037.6 (413)*	0.919	0.882	0.079	0.003	0.260	-0.076	-0.091	+0.041	+0.001	+0.181
<i>Academic self-concept in mathematics (3 items)—L1 invariance</i>											
Configural	0.0 (0) [#]	1.000	1.000	0.000	0.000	—	—	—	—	—	—
Metric	2548.0 (98)*	0.988	0.981	0.067	0.043	—	—	—	—	—	—
Scalar	11,568.8 (196)*	0.943	0.957	0.102	0.078	—	—	—	—	—	—
<i>Academic self-concept in mathematics (3 items)—L2 invariance</i>											
Configural	197.2 (0)*	0.999	1.000	0.000	0.001	0.030	—	—	—	—	—
Metric	763.8 (148)*	0.997	0.993	0.027	0.001	0.042	-0.002	-0.007	+0.027	0.000	+0.012
Scalar	11,235.5 (295)*	0.940	0.939	0.081	0.002	0.079	-0.059	-0.061	+0.054	+0.001	+0.049

(continued)

Table C.1 (continued)

Invariance model	SB- χ^2 (df)	CFI	TLI	RMSEA	SRMR _w	SRMR _b	Δ CFI	Δ TLI	Δ RMSEA	Δ SRMR _w	Δ SRMR _b
<i>Intrinsic value (6 items)—L1 invariance</i>											
Configural	2521.8 (350)*	0.995	0.990	0.033	0.013	—	—	—	—	—	—
Metric	9371.7 (595)*	0.982	0.977	0.051	0.067	—	-0.013	-0.013	+0.018	+0.054	—
Scalar	39,177.0 (840)*	0.920	0.929	0.090	0.127	—	-0.075	-0.046	+0.057	+0.114	—
<i>Intrinsic value (6 items)—L2 invariance</i>											
Configural	1418.9 (350)*	0.998	0.991	0.023	0.001	0.077	—	—	—	—	—
Metric	3218.6 (645)*	0.995	0.988	0.027	0.002	0.116	-0.003	-0.003	+0.004	+0.001	+0.039
Scalar	28,400.2 (939)*	0.944	0.910	0.072	0.003	0.165	-0.054	-0.081	+0.049	+0.001	+0.088
<i>Extrinsic value (5 items)—L1 invariance</i>											
Configural	2535.3 (150)*	0.990	0.966	0.053	0.015	—	—	—	—	—	—
Metric	5870.3 (346)*	0.976	0.966	0.053	0.046	—	-0.014	0.000	0.000	+0.031	—
Scalar	26,179.7 (542)*	0.889	0.898	0.092	0.094	—	-0.101	-0.068	+0.039	+0.079	—
<i>Extrinsic value (5 items)—L2 invariance</i>											
Configural	629.7 (150)*	0.998	0.988	0.024	0.001	0.096	—	—	—	—	—
Metric	1517.3 (396)*	0.996	0.989	0.022	0.002	0.120	-0.002	+0.001	-0.002	+0.001	+0.024
Scalar	18,820.1 (641)*	0.931	0.892	0.071	0.002	0.186	-0.067	-0.096	+0.047	+0.001	+0.090

Note SB- χ^2 (df) = Satorra-Bentler corrected chi-square statistic with degrees of freedom (Satorra and Bentler 2010). For model fit comparisons, the configural models served as references. # As the student-level configural model is fully identified (i.e., $df = 0$), a comparison with the metric and scalar model is only trivial

* $p < 0.05$

Appendix D

Measurement invariance testing of bullying (Table D.1) and instructional quality (Box D.1).

Table D.1 Measurement invariance: bullying

Model	χ^2	df	p	RMSEA	CFI	TIL	$\Delta\chi^2$	p	RMSEA	CFI
Configural invariance	8215.61	918	<0.01	0.039	0.961	0.939	–	–	–	–
Metric invariance	15446.28	1481	<0.01	0.043	0.926	0.928	7230.67	<0.01	0.004	–0.035
Scalar invariance	21519.02	1574	<0.01	0.05	0.895	0.904	6072.74	<0.01	0.007	–0.031

Box D.1 Measurement invariance for instructional quality

The item SM2A-E reflecting instructional quality in the student questionnaire in grade 4 TIMSS 2011 was analyzed

<i>Student-level models</i>	<i>Student- and class-level models</i>
In the first step a series of one-level models was run on student data, in order to get a first impression of the dimensionality of the data. There were indications of a two-factor structure, the two items SM2D and SM2E forming one factor, presumably related to interest, and the other four items another factor. However, the two factors were highly correlated and in several countries the correlation was close to unity. An alternative one-factor model with a covariance among the residuals of items D and E therefore was tested. It also was observed that item SM2B	Here we are of course interested in investigating metric invariance at both student- and class-levels, the important thing being that metric invariance can be established at class-level given that both outcomes and other independent variables are at this level of observation In the first step a one-factor two-level model was fitted, with the covariances for items D and E included at the student level. This 52-group model was fitted under the Mplus default, which imposes constraints on intercepts and factor loadings, implying an

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The item SM2A-E reflecting instructional quality in the student questionnaire in grade 4 TIMSS 2011 was analyzed

in most of the countries had low loadings on the latent variable, so this item was excluded, leaving five items for the ensuing analyses. The student-level one-factor model had good fit to data and when the covariance between the residuals of items D and E was added fit improved. When the metric invariance requirement was imposed fit was worsened. However, with ΔCFI at 0.02 it could be argued that metric invariance is at least marginally supported with student-level data

assumption of scalar invariance. This model had poor fit, as indicated by a CFI of 0.874. Relaxing the equality constraints on the intercepts across countries improved fit dramatically (CFI = 0.962, ΔCFI = 0.088). Relaxing the equality constraints on the student-level factor loadings caused some further improvement (CFI = 0.979, ΔCFI = 0.017), but small enough to support the claim of student-level metric invariance. Relaxing the equality constraints on the class-level factor loadings caused little improvement (CFI = 0.982, ΔCFI = 0.003), supporting class-level metric invariance

In conclusion, these results show that across all the 52 countries investigated there was metric invariance at class- and student-levels.

Reference

- Satorra, A., & Bentler, P. M. (2010). Ensuring positiveness of the scaled difference chi-square test statistic. *Psychometrika*, 75(2), 243–248.