Annex A5

ANALYSIS OF VARIANCE RELATED TO ITEM FORMAT

This annex provides technical details for the analysis of variance performed for the item format section of Chapter 5.

In all cases a Full Factorial ANOVA was performed in SPSS using a univariate GLM procedure. The dependent variable in all cases was defined as item difficulty in logits centered at 0 for each country. The two factors in all cases were the same: country and item-format. In the first case no other factors were added (see Table A5.1), in the subsequent cases one of the following factors were added (Table A5.2-Competency, Table A5.3-Context, and Table A5.4-Word-Count). Table A5.5 presents the distribution of items by item format and traditional topic groupings. Please note that interactions between topics and item format were not considered due to the very small number of items in each cell (see Table A5.5). Table A5.6 presents *post hoc* comparisons for item format mean difficulties using the Bonferroni adjustment for multiple comparisons.

In addition to the F statistics, that shows significance of main effects and interactions, partial η^2 is also provided to assess for the percent of total variance in the dependent variable accounted for by the variance between categories (groups) formed by the independent variable(s).

Table A5.1
Full factorial ANOVA with item-format and country as factors

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial η^2
Format	626.798	4	156.700	109.065	0.000	0.120
Country	1.605	39	0.041	0.029	1.000	0.000
Country * Format	29.583	156	0.190	0.132	1.000	0.006
Error	4 597.600	3 200	1.437			
Total	5 253.982	3 400				

Table A5.2
Full factorial ANOVA with item-format, country and competencies as factors

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial η^2
Format	271.631	4	67.908	65.563	0.000	0.078
Country	1.551	39	0.040	0.038	1.000	0.000
Competency	770.719	2	385.360	372.053	0.000	0.193
Format * Competency	113.499	7	16.214	15.654	0.000	0.034
Country * Format	28.953	156	0.186	0.179	1.000	0.009
Country * Competency	10.222	78	0.131	0.127	1.000	0.003
Error	3 224.334	3 113	1.036			
Total	5 253.982	3 400				

Table A5.3
Full factorial ANOVA with item-format, country and context as factors

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial η^2
Format	441.548	4	110.387	86.526	0.000	0.101
Country	1.957	39	0.050	0.039	1.000	0.000
Context	91.389	3	30.463	23.878	0.000	0.023
Context * Format	559.524	11	50.866	39.871	0.000	0.125
Country* Format	30.789	156	0.197	0.155	1.000	0.008
Context * Country	25.709	117	0.220	0.172	1.000	0.007
Error	3 915.339	3 069	1.276			
Total	5 253.982	3 400				

Table A5.4
Full factorial ANOVA with item-format, country and word-count as factors

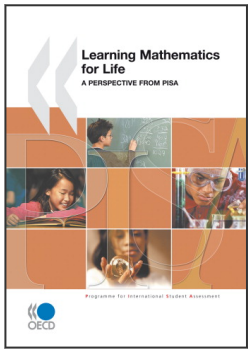
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial η^2
Format	466.839	4	116.710	88.561	0.000	0.102
Country	1.898	39	0.049	0.037	1.000	0.000
Word-count	256.207	2	128.104	97.207	0.000	0.059
Word-count * Format	96.723	6	16.120	12.232	0.000	0.023
Country * Format	28.778	156	0.184	0.140	1.000	0.007
Word-count * Country	15.529	78	0.199	0.151	1.000	0.004
Error	4 103.759	3 114	1.318			
Total	5 253.982	3 400				

Table A5.5
Item distribution across item-format categories and traditional topics

	Item Format					
Topic	Complex Multiple Choice	Multiple Choice	Multiple Short Answer	Open Constructed Response	Short Answer	Total
Algebra	1	1	1	2	2	7
Data	3	5	1	9	8	26
Geometry	3	3	0	0	6	12
Measurement	1	1	0	1	5	8
Number	3	8	3	2	16	32
Total	11	18	5	14	37	85

Table A5.6
Post hoc comparisons for item format mean difficulties using Bonferroni adjustment

Item Format (I)	Item Format (J)	Mean Difference (I-J)	Std. Error	Sig.	99% Confidence Interval	
					Lower Bound	Upper Bound
Complex Multiple Choice	Multiple Choice	0.91573	0.072532	0.000	0.67684	1.15461
	Multiple Short Answer	0.36958	0.102221	0.003	0.03291	0.70625
	Open Constructed Response	-0.36749	0.076361	0.000	-0.61899	-0.11599
	Short Answer	0.55356	0.065085	0.000	0.33920	0.76793
Multiple Choice	Complex Multiple Choice	-0.91573	0.072532	0.000	-1.15461	-0.67684
	Multiple Short Answer	-0.54614	0.095808	0.000	-0.86169	-0.23059
	Open Constructed Response	-1.28322	0.067536	0.000	-1.50565	-1.06078
	Short Answer	-0.36216	0.054463	0.000	-0.54154	-0.18278
Multiple Short Answer	Complex Multiple Choice	-0.36958	0.102221	0.003	-0.70625	-0.03291
	Multiple Choice	0.54614	0.095808	0.000	0.23059	0.86169
	Open Constructed Response	-0.73707	0.098739	0.000	-1.06228	-0.41187
	Short Answer	0.18398	0.090302	0.417	-0.11344	0.48140
Open Constructed Response	Complex Multiple Choice	0.36749	0.076361	0.000	0.11599	0.61899
	Multiple Choice	1.28322	0.067536	0.000	1.06078	1.50565
	Multiple Short Answer	0.73707	0.098739	0.000	0.41187	1.06228
	SA Short Answer	0.92105	0.059468	0.000	0.72519	1.11692
Short Answer	Complex Multiple Choice	-0.55356	0.065085	0.000	-0.76793	-0.33920
	Multiple Choice	0.36216	0.054463	0.000	0.18278	0.54154
	Multiple Short Answer	-0.18398	0.090302	0.417	-0.48140	0.11344
	Open Constructed Response	-0.92105	0.059468	0.000	-1.11692	-0.72519



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