Appendix

Table A.1. *Participants in I.E.A.*

Representing National Centers

Australia

Dr. J. P. Keeves, Australian Council for Educational Research, Hawthorn E2 Victoria.

Belgium

Monsieur F. Hotyat, Institut Supérieur de Pédagogie de Morlanwelz, Morlanwelz, Hainaut.

England

Dr. W. D. Wall, Mr. D. A. Pidgeon, Dr. K. M. Miller, The National Foundation for Educational Research in England and Wales, 79, Wimpole Street, London, W.1.

Federal

Republic of Germany Professor Dr. W. Schultze, Deutsches Institut für Internationale Pädagogische Forschung, Frankfurt/M. Schlossstrasse 29.

Finland

Professor M. Takala, Mr. O. Ylinentalo, Center for Educational Research, University of Jyväskylä, Jyväskylä.

France

Professor G. Mialaret, Université de Caen, Faculté des Lettres et Sciences Humaines, Caen.

Israel

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Japan

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Netherlands

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Scotland

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Sweden

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U.S.A.

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Consultants

Test Editors

Professor R. L. Thorndike, Mr. D. A. Pidgeon.

International Sampling Referee

Mr. G. F. Peaker, C. B. E., Grasmere, Ambleside, Westmorland, England.

Comparative Educationist

Mr. R. F. Goodings, University of Durham Department of Education, Old Elvet, Durham.

Data Processor

Dr. R. M. Wolf, University of Chicago.

Coordinator

Mr. T. N. Postlethwaite placed at the Unesco Institute for Education, Hamburg.

Table A.2. *Summary of topics for populations 1 a and 1 b.*

Subject matter	Objectives	Importance
000 ARITHMETIC		
001 Reasonable competence in the 4 operations on natural numbers	A, B	3
002 Ability to carry out simple operations involving decimal fractions	A, B	3
003 Ability to carry out simple operations involving simple vulgar fractions	A, B	2
004 Understanding the concept of fractions (vulgar and decimal)	C, D	3
005 Application of (001)–(004) to everyday life situations	C, D	3
006 Measurement of quantities, including length, area, volume capacity, time, speed and money	A, B	3
007 Notion of ratio and proportion, including percentages	A, C	3
008 Notion of arithmetical mean	A, C	2
009 Interpreting and making of simple practical graphs and tables	A, B, C	3
010 Intuitive understanding of properties of operations, i.e. associative, distributive, commutative laws	A, D	2
011 Expression of these laws by means of letters	B, C	1
012 Prime factors, divisors and multiples	A, B	2
013 Notions of powers and simple calculations of area and volume	A, C	2
014 Notions of number systems other than the decimal system	A, D, E	2
015 Notions of square roots	A	1
100 ALGEBRA		
101 Notions of positive and negative numbers/graphical representation	A, C	3
102 Extension to all positive and negative rational numbers of the four fundamental operations	A, B	2
103 Negative and zero exponents	A, C	1
104 Formulae and algebraic expressions	A, C	3

Table A.2. (*Continued.*)

Subject matter	Objectives	Importancee
105 Numerical evaluation of these formulae and algebraic expressions	B	3
106 Operations with polynomials and monomials	A, B	2
107 $(x+y)^2$, $(x-y)^2$		
$(x+y)(x-y)$	A, B	1
108 Notions of equation	A	3
109 Equations of the first degree with numerical coefficients	B	3
110 Simple problems using (109)	C	3
111 Simple systems of linear equations with two unknowns	A, B	1
112 General (modern) notions of functions	A, C	2
113 Graphical representation of the functions of the type:		
$y=ax$; $y=ax+b$; $y=a/x$, $y=ax^2$	B, C	2
114 Elementary notions of sets	A, C	3
200 GEOMETRY		
201 Intuitive treatment of some geometrical figures: angle, triangle, square, parallelogram, rhombus, trapezium, circle	A	3
202 Intuitive treatment of: straight line, opposite angles, perpendicular and parallel	A	3
203 Intuitive treatment of symmetry and congruence	A	3
204 Intuitive treatment of translation and rotation	A	1
205 Measurement of distance and angles	A, B	3
206 Simple constructions with graduated ruler, straight edge, compasses, protractor, etc.	B	3
207 Intuitive treatment of similarity. Scale drawing	A, B, C	3
208 Properties of simple solids	A	2
209 Calculation of area and volume	B, C	2
210 Simple deductive reasoning based on the following:		
(a) properties of angles determined by 2 parallel lines, cut by a transversal and the sum of the angles in a triangle;		
(b) symmetry of isosceles triangle and rhombus;		
(c) fundamental conditions of congruence of 2 triangles (SSS, SAS);	A, D, E	3
(d) inequality in triangles;		
(e) characteristic properties of the parallelogram.		
211 Simple deductive reasoning based on the following: Properties of the inscribed angle of a circle	A, D, E	1
212 The theorem of Pythagoras for solving simple practical problems	A, B, C	2

Subject matter		Objectives	Importance
1.0	SETS, RELATIONS AND FUNCTIONS		
1.1	Sets		
	Notion of Sets		
	Intersection of Sets		
	Union of Sets	A, C	3
	Inclusion of Sets		
1.2	Relations and Functions		
	Condition in 2 variables		
	Sets of ordered pairs, relations	A, C, D	3
	Functional relations, etc.		
2.0	ARITHMETIC		
2.1	General treatment of number systems in terms of letters	A, B, C	3
2.2	Natural numbers	A, D	1
2.3	Integers	A, D	1
2.4	Real numbers	A, B	2
2.5	Complex numbers	A, B, D	1
3.0	ALGEBRA		
3.1	Polynomials	A, B	2
	Operations and Factorization		
3.2	Equations and Inequalities	A, B, C, D	3
3.3	Irrational equations	A, B, C	1
3.4	Systems of equations	A, B, C, D	3
3.5	Matrices and determinants	A, B	1
4.0	ELEMENTS OF ANALYSIS		
4.1	Polynomial functions	A, B2	3
4.2	Rational functions	A, B	2
4.3	Irrational functions	A, B	1
4.4	Circular functions	A, B, C, D	3
4.5	Inverse-circular functions	A, B	1
4.6	Logarithmic and exponential functions	A, B, C, D	3
4.7	Limits	A, B, C, D	3
4.8	Continuity	A, D	2
4.9	Derivatives	A, B, D	3
4.10	Integrals	A, B, D	2
4.11	Series	A, B	1
4.12	Differential equations	A, B, C	1
5.0	GEOMETRY		
5.1	Geometry mainly according to Euclid	A, B, D, E	2
5.2	19th-century geometry (projective, affine, etc.)	A, B, D	1

Table A.3. (*Continued.*)

Subject matter		Objectives	Importance
5.3	Trigonometry	A, B, C	1
5.4	Analytical geometry	A, B, C, D	2
5.5	Vectors	A, B, C	1
6.0	PROBABILITY AND STATISTICS		
6.1	Descriptive statistics	A, B, C	2
6.2	Probability	A, B, C, D	1
6.3	Distribution	A, D	1
6.4	Statistical inference	A	1
7.0	LOGIC		
7.1	Elementary formal logic	A, C, D	1
7.2	Deductive systems	A, D	1
8.0	HISTORY OF MATHEMATICS	A	1
9.0	ADDITIONAL TOPICS		

Table A.4. *Regression scaling of 1b and 3a onto the 3b scale.*

	Regression of test 3 on 3b score $y = a + b_x$		Regression of test 5 on 3b score $y = a + b_x$		1b Mean test 3	3a Mean test 5	3b Mean total	1b Mean scaled	3a Mean scaled
Belgium	−0.011	2.041	7.215	2.072	4.964	14.905	24.30	10.12	38.10
England	−2.109	2.095	8.398	2.128	4.156	14.659	22.10	6.60	39.59
Finland	−0.940	2.027	6.825	2.034	4.308	12.942	22.50	7.79	33.15
Germany	3.083	1.928	10.340	1.875	4.704	12.381	27.65	12.15	33.55
Japan	−6.268	2.491	8.046	2.234	6.104	14.326	25.36	8.94	40.05
Scotland	−2.029	2.053	7.926	2.160	3.499	12.424	20.77	5.15	34.76
Sweden	−0.488	1.553	9.028	1.758	2.151	12.436	12.69	2.85	30.89
U.S.A.	−1.105	1.848	4.375	2.146	2.244	7.066	8.63	3.04	19.56

Table A.5. *Indices of social bias.*

Country	Pop. 3a	3b	Country	Pop. 3a	3b	Country	Pop. 3a	3b
Australia	4.7	—	Finland	6.0	3.7	Netherlands	12.3	—
Belgium	3.6	7.3	France	17.3	—	Scotland	10.4	5.7
England	16.2	24.5	Israel	3.6	—	Sweden	2.1	7.0
Fed. Rep. of Germany	45.3	56.4	Japan	6.0	2.9	U.S.A.	1.9	1.0

Table A.6. *Means, standard deviations and N's for total mathematics score, lower mental process and higher mental process by sub-sample.*

(Population 1b)

Country	Total math. score			Lower mental process score			Higher mental process score		
	M	S.D.	N	M	S.D.	N	M	S.D.	N
AUSTRALIA									
Subsample 1	17.58	12.34	770	13.83	9.53	770	3.76	3.65	770
Subsample 2	18.32	11.30	769	14.86	9.03	769	3.46	3.28	769
Subsample 3	21.44	12.42	770	16.90	9.78	770	3.59	3.71	769
Subsample 4	18.16	13.04	770	14.56	10.10	770	3.59	3.71	770
Average	18.88	12.28	770	15.04	9.61	770	3.84	3.53	770
BELGIUM									
Subsample 1	26.43	12.96	661	12.15	10.09	661	5.28	3.72	661
Subsample 2	32.37	14.05	661	17.92	11.33	661	5.06	4.30	661
Subsample 3	34.04	12.74	661	26.95	9.55	661	7.13	3.99	661
Subsample 4	28.90	15.25	661	22.53	11.51	661	6.38	4.45	661
Average	30.43	13.75	661	23.98	10.41	661	6.46	4.11	661
ENGLAND									
Subsample 1	25.25	18.45	793	19.22	14.21	793	6.03	4.86	793
Subsample 2	22.28	18.81	789	16.95	14.33	789	5.28	4.93	789
Subsample 3	23.69	177.3	773	18.31	13.44	773	7.38	4.86	773
Subsample 4	23.71	19.03	793	18.23	14.73	793	5.47	4.91	793
Average	23.76	18.53	787	18.20	14.19	787	5.56	4.90	787
FINLAND									
Subsample 1	25.98	9.59	210	19.37	6.88	210	6.07	3.55	210
Subsample 2	25.51	8.56	210	19.48	6.61	210	6.03	2.89	210
Subsample 3	26.43	9.73	210	20.19	7.40	210	6.25	3.14	210
Subsample 4	27.55	10.39	210	20.25	7.69	210	7.30	3.43	210
Average	26.37	9.57	210	19.82	7.15	210	6.54	3.25	210
FRANCE									
Subsample 1	19.10	13.95	922	15.18	10.54	922	3.91	3.95	922
Subsample 2	22.87	12.99	924	18.12	9.77	924	4.76	3.96	924
Subsample 3	21.09	12.92	710	16.70	9.68	710	4.39	3.88	710
Subsample 4	20.76	13.05	893	16.75	9.92	893	4.01	3.76	893
Average	20.96	13.23	862	16.69	9.98	862	4.27	3.89	862
GERMANY									
Subsample 1	23.95	11.67	1119	18.72	8.94	1119	5.24	3.43	1119
Subsample 2	23.22	12.76	1119	17.64	9.52	1119	5.58	3.78	1119
Subsample 3	27.80	10.98	1119	21.88	8.13	1119	5.92	3.73	1119
Subsample 4	26.85	11.41	1119	20.69	8.59	1119	6.16	3.43	1119
Average	25.45	11.70	1119	19.73	8.80	1119	5.72	3.59	1119

Table A.6. (*Continued.*)

Country	Total math score			Lower mental process score			Higher mental process score		
	M	S.D.	N	M	S.D.	N	M	S.D.	N
HOLLAND									
Subsample 1	21.89	12.11	361	16.88	9.03	361	5.01	3.74	361
Subsample 2	19.53	12.71	361	15.01	9.70	361	4.52	3.61	361
Subsample 3	21.79	10.68	361	16.72	8.04	361	5.03	3.46	361
Subsample 4	22.52	12.94	361	17.40	9.62	361	5.13	3.80	361
Average	21.43	12.12	361	16.51	9.10	361	4.92	3.68	361
ISRAEL									
Subsample 1	34.95	14.20	834	26.31	10.16	834	8.64	4.75	834
Subsample 2	31.11	13.88	759	23.86	9.84	759	7.35	4.65	759
Subsample 3	29.76	16.60	805	22.83	12.10	805	6.93	5.08	805
Subsample 4	33.35	13.99	834	25.38	10.10	834	7.97	4.62	834
Average	32.29	14.67	3232	24.59	10.55	3232	7.70	4.77	3232
JAPAN									
Subsample 1	32.38	17.00	512	25.52	12.56	512	6.86	5.07	512
Subsample 2	31.28	16.92	513	24.40	12.54	513	6.87	5.02	513
Subsample 3	31.11	16.73	512	24.54	12.33	512	6.57	4.98	512
Subsample 4	29.87	16.94	512	23.69	12.51	512	6.19	5.07	512
Average	31.16	16.90	2050	24.54	12.48	2050	6.62	5.03	2050
SCOTLAND									
Subsample 1	23.72	15.22	1443	18.48	11.75	1443	5.24	4.08	1443
Subsample 2	22.72	16.60	1440	17.62	12.70	1440	5.10	4.48	1440
Subsample 3	20.45	15.92	1440	15.96	12.39	1440	4.49	4.17	1440
Subsample 4	22.32	15.03	1395	17.57	11.91	1395	4.75	3.83	1365
Average	22.31	15.69	1425	17.41	12.18	1425	4.90	4.14	1425
SWEDEN									
Subsample 1	15.97	10.81	727	11.55	8.32	727	3.42	3.38	727
Subsample 2	14.32	10.35	656	11.32	8.12	656	3.00	3.05	656
Subsample 3	15.56	11.48	737	12.14	8.89	737	3.41	3.36	737
Subsample 4	15.20	10.73	708	12.07	8.30	708	3.12	3.27	708
Average	15.26	10.83	707	12.02	8.41	707	3.24	3.26	707
UNITED STATES									
Subsample 1	17.42	13.49	1622	14.20	10.42	1622	3.22	3.80	1622
Subsample 2	19.14	12.90	1639	15.35	9.93	1639	3.79	3.73	1639
Subsample 3	18.23	12.98	1662	14.69	10.09	1662	3.54	3.64	1662
Subsample 4	16.61	13.89	1621	13.53	10.66	1621	3.07	3.92	1621
Average	17.85	13.32	6544	14.44	10.28	6544	3.40	3.77	6544

Table A.7. *Means, standard deviations and N's for total mathematics score, lower mental process and higher mental process by sub-sample.*

(Population 1a)

Country	Total math. score			Lower mental process score			Higher mental process score		
	M	S.D.	N	M	S.D.	N	M	S.D.	N
AUSTRALIA									
Subsample 1	20.37	14.60	729	16.07	11.34	729	4.30	3.97	729
Subsample 2	19.33	13.48	729	15.56	10.59	729	3.78	3.69	729
Subsample 3	22.21	14.31	729	17.59	11.05	729	4.62	4.03	729
Subsample 4	18.82	13.65	729	15.04	10.65	729	3.77	3.76	729
Average	20.18	14.01	729	16.06	10.09	729	4.12	3.86	729
BELGIUM									
Subsample 1	23.67	14.11	387	19.04	11.02	387	4.63	3.92	387
Subsample 2	28.53	14.82	433	22.34	11.16	433	6.19	4.34	433
Subsample 3	30.94	15.15	433	24.41	11.70	433	6.52	4.16	433
Subsample 4	27.82	15.99	433	21.58	12.05	433	6.25	4.62	433
Average	27.74	15.02	422	21.84	11.48	422	5.90	4.26	422
ENGLAND									
Subsample 1	33.02	15.89	736	25.00	12.14	736	8.02	4.55	736
Subsample 2	13.88	12.47	776	10.51	9.13	776	3.78	3.80	776
Subsample 3	15.10	11.23	750	11.03	8.77	750	4.07	3.09	750
Subsample 4	19.19	17.53	750	14.77	13.61	750	4.43	4.53	750
Average	19.31	16.97	753	14.79	13.17	753	4.53	4.42	753
FINLAND									
Subsample 1	24.55	10.07	187	18.21	7.17	187	6.34	3.75	187
Subsample 2	23.24	9.16	187	17.85	7.17	187	5.39	2.91	187
Subsample 3	24.30	9.67	187	18.40	7.39	187	5.90	2.96	187
Subsample 4	24.16	10.52	187	17.89	7.74	187	6.28	3.43	187
Average	24.06	9.85	187	18.09	7.36	187	5.98	3.86	187
FRANCE									
Subsample 1	13.96	10.40	589	11.31	8.28	589	2.64	2.84	589
Subsample 2	22.02	13.60	662	17.39	10.30	662	4.62	4.05	662
Subsample 3	19.69	13.18	523	15.47	9.83	523	4.22	3.90	523
Subsample 4	17.61	12.30	636	14.32	9.41	636	3.29	3.57	636
Average	18.32	12.37	602	14.62	9.45	602	3.70	3.59	602
HOLLAND									
Subsample 1	24.59	15.62	107	18.95	11.70	107	5.64	4.35	107
Subsample 2	24.18	18.36	107	18.53	13.73	107	5.65	5.01	107
Subsample 3	22.72	14.22	107	17.48	10.82	107	5.24	3.90	107
Subsample 4	23.98	15.46	107	18.45	11.65	107	5.53	4.43	107
Average	23.86	15.91	107	18.35	11.98	107	5.52	4.42	107

Table A.7. (*Continued.*)

Country	Total math score			Lower mental process score			Higher mental process score		
	M	S.D.	N	M	S.D.	N	M	S.D.	N
JAPAN									
Subsample 1	32.38	17.00	512	25.52	12.56	512	6.86	5.07	512
Subsample 2	31.28	16.92	513	24.04	12.54	513	6.87	5.02	513
Subsample 3	31.11	16.73	512	24.54	12.33	512	6.57	4.98	512
Subsample 4	29.87	16.94	512	23.68	12.51	512	6.19	5.07	512
Average	31.16	16.90	512	24.54	12.48	512	6.62	5.03	512
SCOTLAND									
Subsample 1	20.58	14.80	1326	15.99	11.40	1326	4.59	3.99	1326
Subsample 2	20.17	15.88	1323	15.73	12.35	1323	4.44	4.18	1323
Subsample 3	18.03	14.90	1323	14.11	11.69	1323	3.93	3.89	1323
Subsample 4	17.43	13.00	1284	13.72	10.40	1284	3.71	3.37	1284
Average	10.05	14.64	1314	14.88	11.46	1314	4.17	3.86	1314
SWEDEN									
Subsample 1	16.30	10.94	658	12.81	8.39	658	3.49	3.43	658
Subsample 2	15.21	10.07	595	12.08	7.93	595	3.13	2.99	595
Subsample 3	15.63	11.64	663	12.18	9.03	663	3.44	3.39	663
Subsample 4	15.66	10.60	637	12.49	8.22	637	3.17	3.23	637
Average	15.70	10.81	638	12.39	8.39	638	3.31	3.26	638
UNITED STATES									
Subsample 1	16.81	12.73	1540	4.33	6.14	1540	1.83	4.02	1540
Subsample 2	18.00	12.85	1566	5.48	10.38	1566	5.30	3.76	1566
Subsample 3	17.00	12.63	1582	8.20	5.19	1582	2.93	3.43	1582
Subsample 4	15.62	12.49	1543	5.11	10.47	1543	.25	3.78	1543
Average	16.15	13.34	1558	13.06	10.36	1558	3.09	3.72	1558