TEDS-M Final Report to IEA General Assembly

October 5, 2010

Gaborone, Botswana

TEDS-M Main Research Questions

What are the policies that support prospective primary and secondary teachers' achieved level of mathematics and related teaching knowledge?

What learning opportunities in mathematics available to prospective primary and secondary teachers allow them to attain such knowledge?

What is the level and depth of the mathematics and related teaching knowledge attained by prospective primary and secondary teachers at the end of their pre-service teacher education?

Comparative question: How do these policies, opportunities to learn and knowledge vary across countries?

Four Surveys

- Teacher Education Institutions & Programs
- Teacher Educators
- Primary Future Teachers
- Secondary Future Teachers
  - Background
  - Opportunities to learn
  - Beliefs
  - Assessments of knowledge
    - Mathematics Content
      - University level
      - School level
    - Mathematics Pedagogical Content

General Types of Samples

- **Full censuses** in Botswana, Georgia, Norway, Oman, Singapore, and Thailand.

- **Census of institutions; samples of educators and/or future teachers**, in Canada, Chile, Malaysia, Poland, and Switzerland; Chinese Taipei & Germany (samples of future teachers).

- **Samples of institutions, educators and future teachers** in Philippines, Russian Federation, Spain, and the USA; Germany & Chinese Taipei (samples of educators).

17 Countries Participating

Botswana	Norway	Spain
Canada	Oman	Switzerland
Chile	Philippines	Chinese Taipei
Georgia	Poland	Thailand
Germany	Russia	USA
Malaysia	Singapore	

TEDS-M

TEDS-M Collected Data 2008-09:

- 15,163 Primary Future Teachers
- 9, 389 Secondary Future Teachers
- 500 institutions which included
  - 451 units preparing future primary teachers, and
  - 339 units preparing future secondary teachers
- 4837 Teacher Educators

Sampling Adjudication Criteria

- Reporting without any annotation
  - full coverage of the target population (100%)
  - exclusion rate was below 5%
- Reporting with annotation because of low participation rates
  - combined participation rate below 100% but above 60%
  - exclusion rate exceeded 5%
- Reporting together with other countries not advisable
  - combined participation rate below 60% but above 30%
- Unacceptable (not reported)
  - combined participation rate below 30%

TEDS-M Participation Rates

Country	TEDS-M Participation Rates Summary			
	Institution Participation Rate $IPR_{I\text{-}wgt}$ (%)	Educators Combined Participation Rate $CPR_{E\text{-}wgt}$ (%)	Future Primary Teachers Combined Participation Rate $CPR_{P\text{-}wgt}$ (%)	Future Secondary Teachers Combined Participation Rate $CPR_{S\text{-}wgt}$ (%)
Botswana	100	98	86	88
Canada	47	26	5	20
Chile	88	54	68	64
Chinese Taipei	100	96	90	97
Georgia	100	98	77	67
Germany	100	55	76	76
Malaysia	57	53	93	75
Norway	96	NA	75	64
Oman	100	84	NA	93
Philippines	80	81	75	79
Poland	86	67	67	69
Russian Federation	91	91	91	92
Singapore	100	85	90	91
Spain	97	86	76	NA
Switzerland (g)	94	52	76	81
Thailand	96	88	97	96
USA	83	15	72	60

Sampling Adjudication Summary

	No annotations # Countries	Annotations # Countries	Not reported # Countries
Institutions	9	5	3
Educators	7	3	7
Primary Future Teachers	10	5	1
Secondary Future Teachers	9	6	1

Highlights From Contextual Analysis

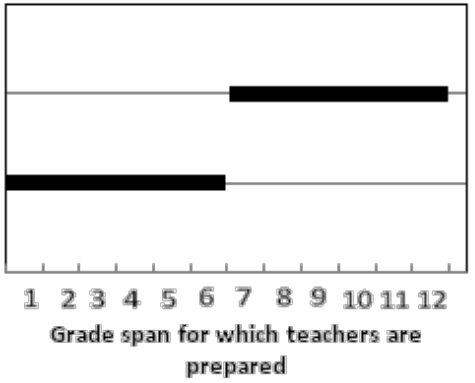
[Chapter 2 & 3]

Chinese Taipei

Program-types in TEDS-M

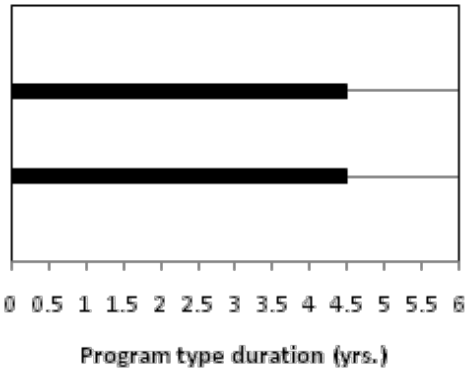
Secondary Mathematics Teacher Education

Elementary Teacher Education



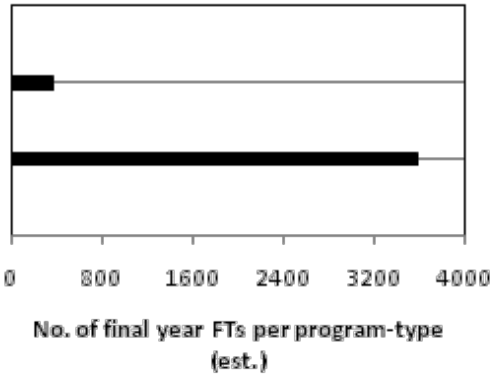
Secondary Mathematics Teacher Education

Elementary Teacher Education



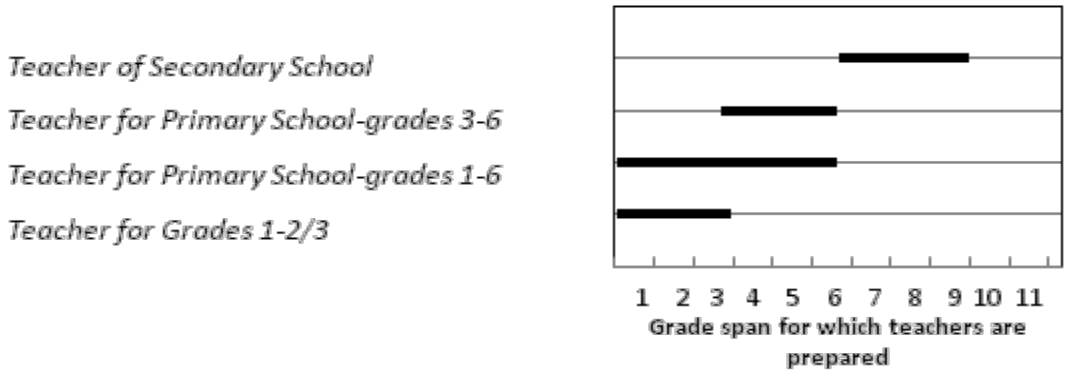
Secondary Mathematics Teacher Education

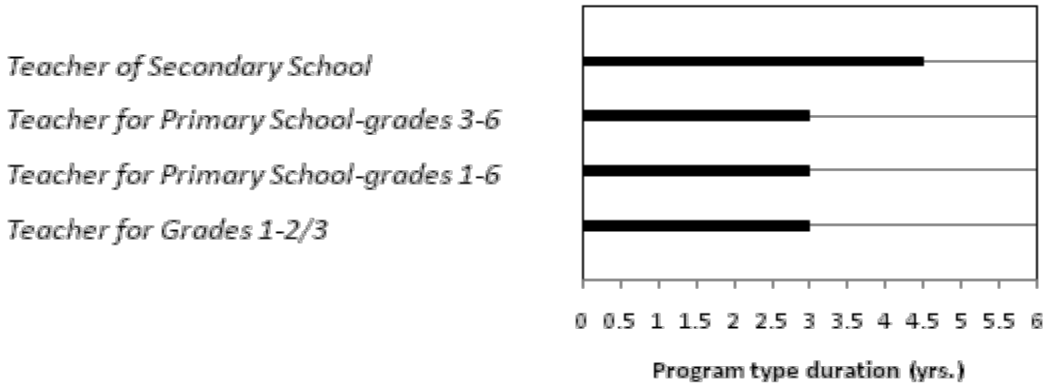
Elementary Teacher Education

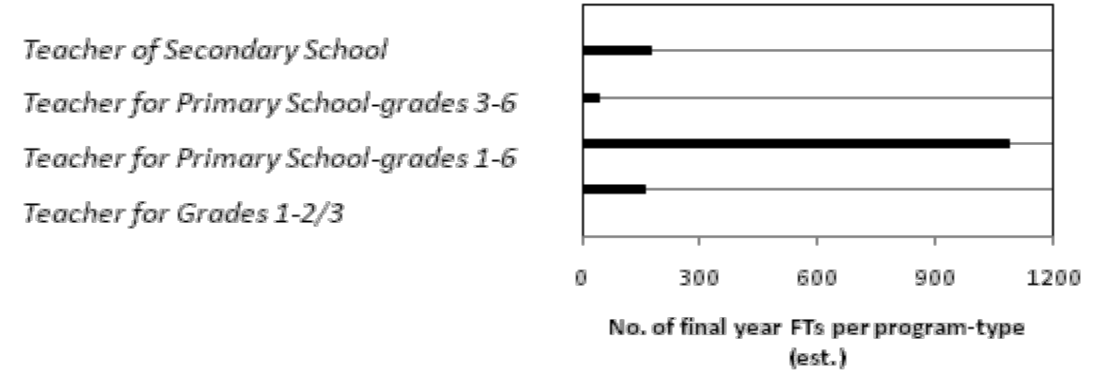


Switzerland

Program-types in TEDS-M







Program Groups for Cross-National Comparison

- Primary Program Groupings
  - Generalists no higher than Grade 4
  - Generalists, no higher than Grade 6
  - Generalists, no higher than Grade 10
  - Mathematics specialists for primary school
- Secondary Program Groupings
  - Lower secondary, no higher than Grade 10
  - Lower and upper secondary (Grade 11 and above)

Highlights From Background on Institutions, Educators and Future Teachers

[Chapter 4]

MAIN CHARACTERISTICS OF INSTITUTIONS, TEACHER EDUCATORS AND FUTURE TEACHERS

- **Institutional Program Structures and Characteristics** (e.g., route, level, and length of programs, programs' selectivity in mathematics, curricular strategy, graduation standards and guidelines)

- **Teacher Educator Background and Characteristics** (e.g., gender, qualifications in mathematics, mathematics education and pedagogy, academic rank, mathematics specialization, license to teach in primary or secondary schools, beliefs)

- **Future Teacher Background and Characteristics** (e.g., age at time of graduation, gender, self reported summative achievement in secondary school, resources as indicators of socioeconomic status and social capital, level of education in the family, beliefs)

Institutions

Which institutional requirements do primary future teachers have to meet to successfully complete program?

Table 4.11 Institutional requirements that future primary teachers have to meet to successfully complete their program (j =yes; o =no)

Program Group	Country	Passing grade on all subjects	Pass a comprehensive written examination	Pass a comprehensive oral examination	Pass a national or state examination	Pass an examination set by program	Write and defend a thesis	Level of teaching competence in a classroom	Passing grade on field experience
Lower Primary (Gde 4 max)	Georgia	j	o	j	o	j	o	j	j
	Poland [a]	j	o	o	o	j	j	j	j
	Russian Fed[b]	j	o	j	j	j	j	j	j
	Switzerland	j	j	j	o	j	j	j	j
Primary (Gde 6 max)	C.Taipei [c]	j	j	j	j	j	o	j	j
	Philippines [d]	j	j	o	j	j	j	j	j
	Singapore	j	o	o	o	o	o	j	j
	Spain	j	o	o	o	o	o	o	j
	Switzerland	j	j	j	o	j	j	j	j
	USA	j	o	o	j	o	o	j	j

Teacher Educators

Percentage of teacher educators who reported currently holding a <teaching certificate, license or registration> to teach primary or secondary grades

Table 4. 20 Percentage of teacher educators who reported currently holding a <teaching certificate, license or registration> to teach primary and/or secondary grades (percentage who answered "Yes, I Currently Hold a License")

Countries	Math and Math Pedagogy Educator		Pedagogy Educator		Educator with All Responsibilities	
	N	% (SE)	N	% (SE)	N	% (SE)
Botswana	16	94 (6.3)	26	78 (7.9)	0	0 (0)
C. Taipei	85	29 (12.2)	107	46 (2.6)	2	50 (55.6)
Georgia	40	98 (2.4)	20	95 (5)	1	100 (0)
Oman [a]	47	22 (6.2)	28	58 (9)	2	100 (0)
Philippines	194	70 (5.2)	275	70 (4.8)	116	80 (7.5)
Poland [b]	444	67 (2.4)	252	55 (2.5)	24	82 (6.1)
Russian Fed [c]	912	84 (2)	275	98 (0.9)	17	100 (0)
Singapore	25	84 (5.7)	51	65 (6.8)	0	0 (0)
Spain	119	93 (2.4)	394	75 (3.3)	13	71 (4.4)
Thailand	119	30 (4.2)	111	29 (4.5)	72	32 (5.8)

Primary Future Teachers

To what extent does each of the following identify your reasons for becoming a teacher?

*Table 4.39 Percentage of primary future teachers reporting on significant or major reasons for becoming a teacher

Program Group	Country	N	Good Student %	Available Positions %	Love Math %	Talent Teaching %	Like wrkg Young Ppl %	Teacher Salaries %	Influence Nxt Gene %	Challeng Job %	Long Term Security %
Lower Primary (Grade 4 max)	Georgia	304	38	36	43	48	60	28	53	65	57
	Germany	4693	35	24	33	89	94	35	75	91	54
	Poland [a]	4598	15	8	5	54	80	4	47	55	42
	Russian Fed. [b]	8222	30	37	31	59	91	5	64	42	43
	Switzerland	148	25	13	16	93	100	37	80	98	53
Primary (Grade 6 max)	Chinese Taipei	3584	11	7	14	47	60	57	60	54	75
	Philippines	2462	60	63	70	78	84	30	84	85	80
	Singapore	296	32	26	53	76	88	32	86	77	53
	Spain	3762	27	35	22	85	86	37	87	74	55
	Switzerland	1086	35	23	30	91	99	39	79	95	56
	USA [c]	17584	35	20	22	91	97	8	95	78	52
Primary/Secondary (Grade 10 max)	Botswana	52	51	40	88	72	76	16	83	63	50
	Chile [d]	1865	35	42	26	92	86	9	89	91	45
	NorwayALU [e]	1407	32	45	33	86	98	5	71	92	40
	NorwayALU+ [e]	429	29	40	77	88	97	6	67	90	30
Primary Math Spec.	Germany	1037	51	27	74	88	98	29	81	89	42
	Malaysia	613	50	70	91	79	76	45	85	84	74
	Poland [a]	1285	31	7	67	50	68	5	35	49	40
	Singapore	128	34	21	72	80	91	24	90	73	48
	Thailand	1346	39	65	88	62	60	24	83	77	90
	USA [c]	2764	41	28	31	89	95	7	92	81	59

Highlights from analysis of future teachers' mathematics and pedagogical knowledge

[Chapter 6]

Assessment Framework for Mathematics Content Knowledge

Content domains:

- Numbers and operations
- Geometry and measurement
- Algebra and functions
- Data and chance

Cognitive domains:

- Knowing
- Applying
- Reasoning

Curricular level

- School mathematics
- University mathematics

Assessment Framework for Mathematics Pedagogical Content Knowledge

Content domains:

- Numbers and operations
- Geometry and measurement
- Algebra and functions
- Data and chance

Pedagogical domains:

- Curriculum
- Planning
- Enacting

Instrument Design & Question Types

- **Future Primary Teachers Assessment**
  - 70 questions distributed across 5 blocks (2b/p)
  - About 2/3 MCK; 1/3 MPCK
- **Future Secondary Teachers Assessment**
  - 49 questions distributed across 3 blocks (2b/p)
  - About 2/3 MCK; 1/3 MPCK
- **Questions types**:

  Multiple choice; complex multiple choice; constructed response

Reporting Results for MCK and MPCK

- Separate scales for MCK and MPCK for both Primary & Secondary future teachers
- IRT scores scaled to have international mean of 500; standard deviation of 100
- Descriptive statistics and distributions reported by program group and country
- Anchor Points used to give conceptual meaning to selected MCK and MPCK scores

Determining Anchor Points for Scales

- Items chosen to determine anchor points were selected based on location on IRT theta scale from calibration results for the whole study sample

- This is a different procedure than that used by TIMSS and PISA, because populations of future teachers are much smaller than populations of pupils

Procedures for Developing Anchor Point Descriptions

- Two Anchor Points (APs) selected for each MCK scale; one AP for each MPCK scale
- Number of APs determined by distribution of items along theta scale
- Content experts given two sets of items for each AP to write descriptions
  - Those answered correctly with probability ≥ 0.70
  - Those answered correctly with probability ≤ 0.50

Primary MCK: Excerpt from Lower Anchor Point Description (AP1 score = 431)

Likely to answer correctly questions requiring:

- basic computations with whole numbers in simple problem solving situations
- understanding properties of operations with whole numbers
- solving some problems with fractions
- solving problems involving simple expressions and equations

Have difficulty with questions requiring:

- solving abstract problems and those requiring multiple steps
- understanding the number line, and the infinity of numbers between any two real numbers
- knowledge of proportionality and multiplicative reasoning
- reasoning about multiple statements and relationships among several mathematical concepts

Fig. 6.1 Primary Complex Multiple Choice MCK Question about Number

Int. average (key):
A. 81 % (F), B. 86% (F), C. 92% (T), D. 64% (F)

Indicate whether each of the following statements is true for the set of all whole numbers *a*, *b* and *c* greater than zero.

Check <u>one</u> box in <u>each</u> row.

		True	Not True
A.	$a - b = b - a$	o	o
B.	$a \div b = b \div a$	o	o
C.	$(a + b) + c = a + (b + c)$	o	o
D.	$(a - b) - c = a - (b - c)$	o	o

Primary MCK: Excerpt from Upper Anchor Point Description (AP2 score = 516)

Likely to answer questions correctly requiring:

- the mathematics that future teachers at Anchor Point 1 are likely to get correct, AND:
- using fractions to solve story problems
- knowing how to find the least common multiple of two numbers in a familiar context
- determining areas and perimeters of simple figures

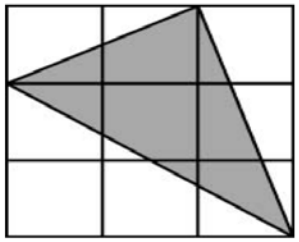
Have difficulty with questions requiring:

- solving problems involving proportional reasoning or percentages
- reasoning about factors and multiples
- solving problems about area involving coordinate geometry
- recognizing applications of quadratic or exponential functions, and algebraic reasoning

Fig. 6.2 Primary Multiple Choice MCK Item about Geometry

Int. average (key): 60% (A)

The area of each small square is 1 cm^2.



What is the area of the shaded triangle in cm^2?

Check <u>one</u> box.

A.	3.5 cm^2	☐
B.	4 cm^2	☐
C.	4.5 cm^2	☐
D.	5 cm^2	☐

Primary Future Teachers: Mathematics Content Knowledge

Program Group	Country	N	Mean	SE	% Missing	Reached AP1		Reached AP2	
						%	SE	%	SE
Lower Primary	Georgia	506	345	3.9	0.0	11.9	1.4	0.9	0.5
(Grade 4 maximum)	Germany	907	501	2.9	2.4	86.4	1.3	43.9	2.1
	Poland [a]	1,799	456	2.3	0.9	67.9	1.3	16.8	1.2
	Russian Fed. [b]	2,260	536	9.9	0.2	89.7	2.3	57.3	4.6
	Switzerland [c]	121	512	6.4	0.0	90.5	2.7	44.2	5.4
Primary	Chinese Taipei	923	623	4.2	0.0	99.4	0.3	93.2	1.4
(Grade 6 maximum)	Philippines	592	440	7.6	0.0	60.7	5.1	6.3	0.9
	Singapore	262	586	3.7	0.4	100.0	-	82.5	2.3
	Spain	1,093	481	2.6	0.0	83.4	1.6	26.2	1.6
	Switzerland	815	548	1.9	0.0	97.2	0.6	70.6	1.4
	USA [d]	951	518	4.5	28.6	92.9	1.2	50.0	3.2
Primary/Secondary	Botswana [e]	86	441	5.9	0.0	60.6	5.3	7.1	2.8
(Grade 10 Maximum)	Chile [f]	654	413	2.1	0.4	39.5	1.8	4.0	0.7
	Norway (ALU) [g]	392	509	3.1	0.0	88.5	1.5	46.9	2.3
	Norway (ALU+) [g]	159	553	4.3	0.0	96.5	1.4	68.7	3.1
Primary	Germany	97	555	7.5	0.0	96.0	2.1	71.7	7.0
Mathematics Specialists	Malaysia	574	488	1.8	0.4	88.7	1.1	28.1	1.3
	Poland [a]	300	614	4.8	0.0	97.9	1.0	91.0	1.6
	Singapore	117	600	7.8	0.0	98.3	1.2	87.3	2.8
	Thailand	660	528	2.3	0.0	91.7	0.9	56.2	1.4
	USA [d]	132	520	6.6	33.2	94.9	1.7	48.1	6.5

Fig. 6.4 Distributions of Mathematics Content Knowledge Scaled Scores (Future Primary Teachers)

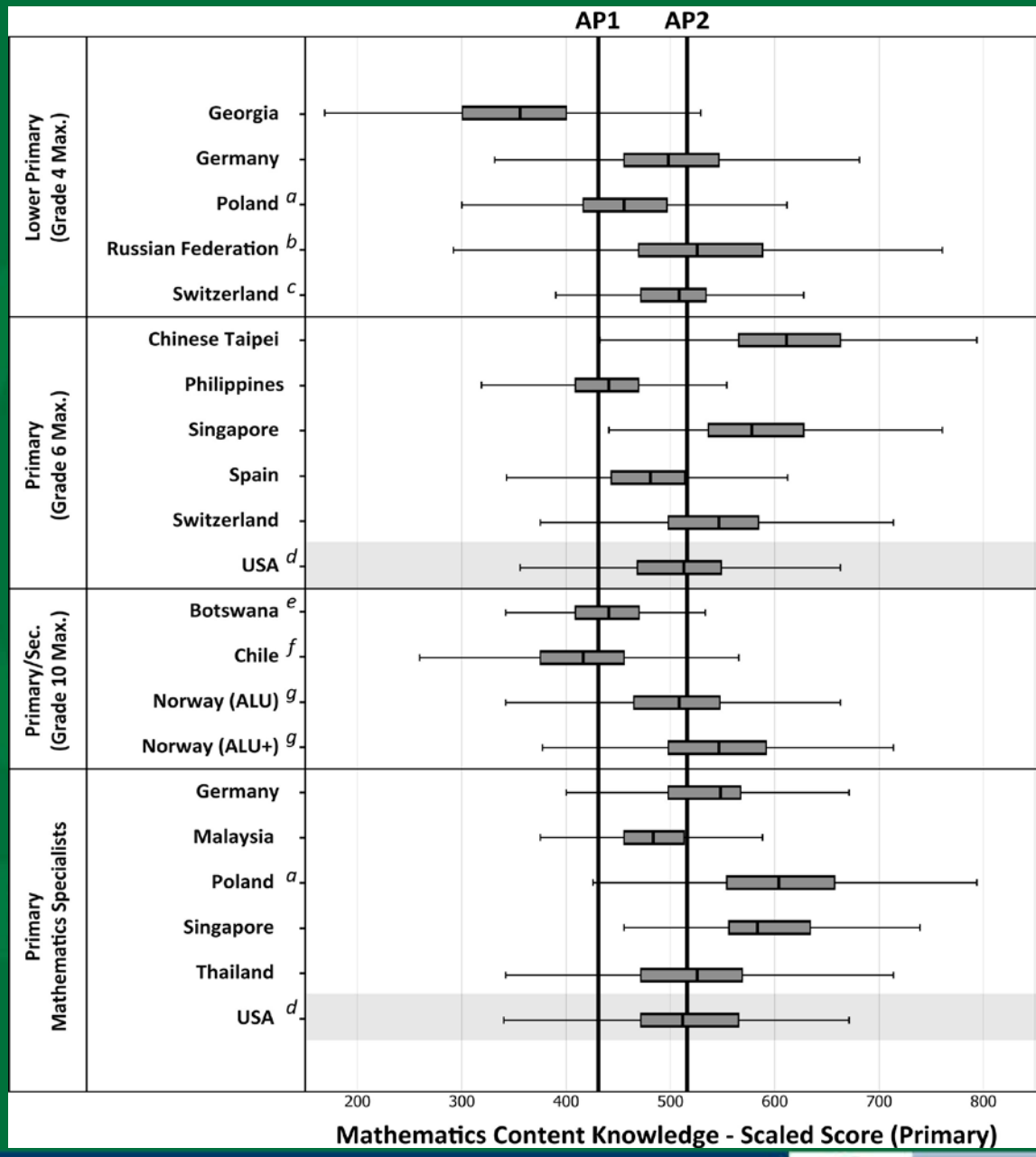


Fig. 6.6 Constructed Response Primary MPCK Item about Enacting Number

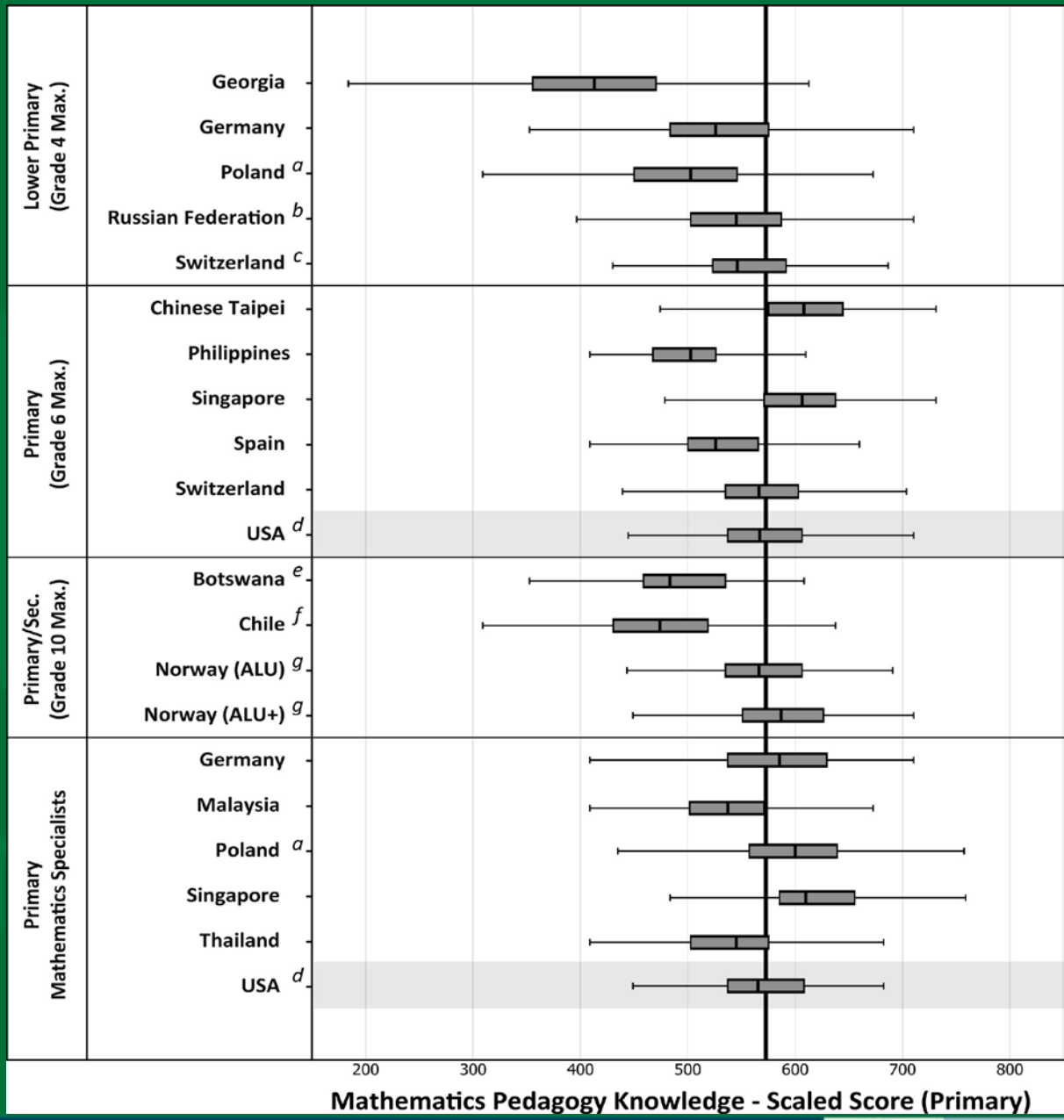
Int. average:
(a) full credit 20%, partial credit 12%
(b) full credit 16%, partial credit 16%

[Jeremy] notices that when he enters 0.2 × 6 into a calculator his answer is smaller than 6, and when he enters 6 ÷ 0.2 he gets a number greater than 6. He is puzzled by this, and asks his teacher for a new calculator!

(a) What is [Jeremy's] most likely misconception?

(b) Draw a visual representation that the teacher could use to model 0.2 × 6 to help [Jeremy] understand **WHY** the answer is what it is?

Fig. 6.7 Distributions of Mathematics Pedagogical Content Knowledge Scaled Score (Primary Level)



Highlights About Opportunities to Learn and Future Teachers' Beliefs

[Chapters 4 & 6]

Reporting OTL & Beliefs

- OTL and Beliefs Scales (IRT)
  - Scales are centered at 10.0
  - Indicating the “midpoint” of the rating scale
    - Perceptions: Agree to Disagree
    - Frequencies: Never to Often
- OTL Domains Studied
  - Original Metric: Number of Areas Studied

Opportunities to Learn Mathematics and Pedagogy

- University level mathematics
- School mathematics
- Mathematics education/pedagogy
- Education/pedagogy

<u>Other opportunities to learn to teach</u>:

- How to teach in diverse classrooms
- Learning from school experience and the practicum

Opportunity to Learn Domains
University Level Mathematics

- **Continuity and functions** (e.g., beginning calculus, calculus, multivariate calculus, advanced calculus or real analysis, and differential equations);
- **Discrete structures and logic** (e.g., linear algebra, set theory, abstract algebra, number theory discrete mathematics, and mathematical logic);
- **Geometry** (e.g., foundations of geometry or axiomatic geometry, analytic or coordinate geometry, non-Euclidean geometry, and differential geometry);
- **Probability and statistics** (e.g., probability and theoretical or applied statistics).

Opportunity to Learn Domains School Mathematics

- **Numbers** (e.g., whole numbers, fractions, decimals, integers, rational, and real numbers; number concepts; number theory; estimation; ratio and proportionality)
- **Measurement** (e.g., measurement units; computations and properties of length, perimeter, area, and volume; estimation and error)
- **Geometry** (e.g., 1-D and 2-D coordinate geometry, Euclidean geometry, transformational geometry, congruence and similarity, constructions with straightedge and compass, 3-D geometry, vector geometry);

Opportunity to Learn Domains School Mathematics (cont.)

- **Data representation, probability, and statistics**;
- **Calculus** (e.g., infinite processes, change, differentiation, integration); and
- **Functions, relations, and equations** (e.g., algebra, trigonometry, analytic geometry);
- **Validation, structuring and abstracting** (e.g., Boolean algebra, mathematical induction, logical connectives, sets, groups, fields, linear space, isomorphism, homomorphism).

UNIVERSITY LEVEL MATHEMATICS

1. Consider the following topics in university level mathematics. Please indicate whether you have ever studied each topic.

Check <u>one</u> box in each <u>row</u>.

	Studied	Not studied
Linear Algebra (e.g., vector spaces, matrices, dimensions, eigenvalues, eigenvectors)	☐1	☐2
Number Theory (e.g., divisibility, prime numbers, structuring integers)	☐1	☐2
Analytic/Coordinate Geometry (e.g., equations of lines, curves, conic sections, rigid transformations or isometrics)	☐1	☐2
Beginning Calculus Topics (e.g., limits, series, sequences)	☐1	☐2
Calculus (e.g., derivatives and integrals)	☐1	☐2
Probability	☐1	☐2
Theoretical or Applied Statistics	☐1	☐2

SCHOOL LEVEL MATHEMATICS

2. Consider the following list of mathematics topics that are often taught at the <primary> or <secondary> school level. Please indicate whether you have studied each topic as part of your current teacher preparation program.

Check one box in each row.

	Studied	Not studied
Numbers (e.g., whole numbers, fractions, decimals, integer, rational, and real numbers; number concepts; number theory; estimation; ratio and proportionality)	☐1	☐2
Measurement (e.g., measurement units; computations and properties of length, perimeter, area, and volume; estimation and error)	☐1	☐2
Geometry (e.g., 1-D and 2-D coordinate geometry, Euclidean geometry, transformational geometry, congruence and similarity, constructions with straightedge and compass, 3-D geometry, vector geometry)	☐1	☐2
Functions, Relations, and Equations (e.g., algebra, trigonometry, analytic geometry)	☐1	☐2
Data Representation, Probability, and Statistics	☐1	☐2
Calculus (e.g., infinite processes, change, differentiation, integration)	☐1	☐2
Validation, Structuring, and Abstracting (e.g., Boolean algebra, mathematical induction, logical connectives, sets, groups, fields, linear space, isomorphism, homomorphism)	☐1	☐2

Secondary future teachers: Percentage reporting ever studying domains in university level mathematics

Group		Linear Algebra	Analytic Geometry	Calculus	Probability	Statistics
Lower Secondary	Botswana[a]	82	91	100	94	77
(Gde 10 Max)	Chile[b]	39	52	24	67	50
	Chinese Taipei	100	92	100	99	95
	Germany	64	63	51	63	41
	Philippines	93	96	94	94	79
	Poland[c]	99	98	98	100	64
	Singapore	61	47	72	62	50
	Switzerland[d]	92	92	77	93	67
	Norway ALU+[e]	76	73	84	92	78
	Norway ALU[e]	50	68	48	90	80
	USA[f]	54	69	36	88	41
Lower & Upper Secondary	Botswana	100	95	100	42	5
(Grade 11+)	Germany	100	87	100	82	48
	Malaysia	98	92	99	98	76
	Oman	100	97	100	100	85
	Poland	98	96	99	100	87
	Russian Fed[h]	99	99	100	99	71
	Singapore	96	70	100	83	57
	Thailand	96	97	100	96	82
	Georgia[g]	97	92	96	89	34
	Norway (PPU & Masters)	98	81	98	85	80
	USA	93	82	95	94	76

Primary Future Teachers: Percentage who studied school mathematics as part of teacher education program

Table 5.5 Primary Future Teachers: Percentage reporting whether they have stu
school mathematics topic as part of their current teacher preparation program

Program Group	Country	N	Numbers	Measurement	Geometry
Lower Primary (Grade 4 max)	Georgia	500	99	94	66
	Germany	923	63	50	55
	Poland [a]	1,803	90	69	54
	Russian Fed [b]	2,257	100	99	93
	Switzerland [c]	121	87	84	49
Primary (Grade 6 max)	Chinese Taipei	923	96	93	66
	Philippines	591	100	100	89
	Singapore	263	98	95	84
	Spain	1,093	98	95	80
	Switzerland	813	94	83	59
	USA [d]	1,290	98	96	84
Primary/Secondary (Grade 10 Max)	Botswana [e]	86	99	100	72
	Chile [f]	657	99	96	65
	Norway ALU [g]	159	99	96	99
	Norway (ALU+) [g]	392	99	97	98
Primary Mathematics Specialists	Germany	97	94	65	88
	Malaysia	572	100	97	69
	Poland [a]	300	91	82	96
	Singapore	117	100	98	95
	Thailand	658	97	92	94
	USA [d]	187	99	97	91

Primary Future Teachers: Percentage who studied school mathematics as part of teacher education program

Table 5.6 Primary Future Teachers: Percentage reporting whether they have studied each school mathematics topic as part of their current teacher preparation program

Program Group	Country	N	Functions	Data Representation	Calculus	Validation Abstracting
Lower Primary (Grade 4 max)	Georgia	500	82	33	45	34
	Germany	923	34	29	27	2
	Poland [a]	1,803	39	33	8	15
	Russian F[b]	2,257	92	48	39	48
	Switzerlnd [c]	121	41	56	9	19
Primary (Grade 6 max)	Chinese Taipei	923	64	77	21	34
	Philippines	591	95	83	26	33
	Singapore	263	56	67	22	12
	Spain	1,093	63	75	44	21
	Switzerland	813	36	46	11	15
	USA [d]	1,290	75	86	22	24
Primary/Second (Grade 10 Max)	Botswana [e]	86	96	100	19	21
	Chile [f]	657	56	65	24	12
	Norway ALU [g]	159	100	90	84	16
	NorwayALU+[g]	392	97	82	37	13
Primary Mathematics Specialists	Germany	97	64	69	48	9
	Malaysia	572	68	78	53	39
	Poland [a]	300	98	95	95	95
	Singapore	117	52	56	20	10
	Thailand	658	97	95	90	76
	USA [d]	187	81	90	25	21

Secondary Future Teachers: Percentage who studied school mathematics as part of teacher education program

Table 5.8. Secondary Future Teachers: Percentage reporting whether they have studied each school mathematics topic as part of their current teacher preparation program

Program Group	Country	N	Functions	Data Representation	Calculus	Validation Abstracting
Lower Secondary (Grade 10 maximum)	Botswana [a]	34	91	97	91	21
	Chile [b]	744	58	67	22	10
	Germany	399	64	63	51	9
	Philippines	151	99	90	77	18
	Poland [c]	731	97	85	59	30
	Singapore	158	96	99	94	96
	Switzerland [d]	141	89	94	31	12
	Norwy ALU+ [e]	141	95	75	52	69
	Norway ALU [e]	169	87	89	20	15
	USA [f]	355	96	83	41	12
Lower & Upper Secondary (Gr 11+)	Botswana	19	95	53	83	74
	Chinese Taipei	365	98	90	83	75
	Georgia [g]	77	96	46	78	42
	Germany	346	88	77	92	39
	Malaysia	388	98	98	96	54
	Oman	268	98	97	96	40
	Poland	43	98	84	96	35
	Russian Fed [h]	140	96	92	93	93
	Singapore	2135	99	78	92	80
	Thailand	250	96	91	69	29
	Norway (PPU & Masters) [e]	650	97	96	89	77
	USA [f]	434	84	89	75	59

Beliefs about Mathematics, Teaching and Learning

- Nature of Mathematics
  - Mathematics as a Process of Inquiry
  - Mathematics as a Set of Rules and Procedures
- Learning Mathematics
- Mathematics Achievement
- Preparedness to Teach Mathematics
- Program Effectiveness & Coherence

BELIEFS ABOUT THE NATURE OF MATHEMATICS

1.

To what extent do you agree or disagree with the following beliefs about the nature of mathematics?

Check one box in each row.

		Strongly disagree	Disagree	Slightly disagree	Slightly agree	Agree	Strongly agree
A.	Mathematics is a collection of rules and procedures that prescribe how to solve a problem.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
B.	Mathematics involves the remembering and application of definitions, formulas, mathematical facts and procedures.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
C.	Mathematics involves creativity and new ideas.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
D.	In mathematics many things can be discovered and tried out by oneself.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
E.	When solving mathematical tasks you need to know the correct procedure else you would be lost.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
F.	If you engage in mathematical tasks, you can discover new things (e.g., connections, rules, concepts).	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
G.	Fundamental to mathematics is its logical rigor and preciseness.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6
H.	Mathematical problems can be solved correctly in many ways.	☐ 1	☐ 2	☐ 3	☐ 4	☐ 5	☐ 6

Mathematics as a Set of Rules and Procedures

Program Group	Country	N	Mean	Standard Error	% Missing
Lower Primary	Georgia	490	11.00	0.09	3.1
(Grade 4 maximum)	Germany	886	10.09	0.06	3.1
	Poland [a]	1,775	11.07	0.04	2.5
	Russian Federation [b]	2,215	10.75	0.05	1.9
	Switzerland [c]	119	10.10	0.06	2.0
Primary	Chinese Taipei	923	10.75	0.04	0.0
(Grade 6 maximum)	Philippines	589	12.64	0.13	0.9
	Singapore	261	11.06	0.07	0.8
	Spain	1,086	10.75	0.05	0.7
	Switzerland	812	9.98	0.02	0.4
	USA [d]	1,005	11.02	0.08	24.1
Primary/Secondary	Botswana [e]	86	11.96	0.15	0.0
(Grade 10 Maximum)	Chile [f]	634	10.88	0.04	3.5
	Norway (ALU) [g]	387	10.27	0.05	1.6
	Norway (ALU+) [g]	156	9.93	0.06	1.6
Primary	Germany	97	9.69	0.10	0.0
Mathematics Specialists	Malaysia	562	11.74	0.07	2.4
	Poland [a]	298	10.32	0.11	0.7
	Singapore	116	11.02	0.10	0.9
	Thailand	653	11.86	0.05	1.1
	USA [d]	144	11.01	0.14	25.6

In short…

In explaining our conclusions we have emphasized both similarities and differences in context …

Pre-service teachers' knowledge and OTL varied according to:

- the grade levels they were expected to teach,
- the specialty [generalist teachers or specialist teachers of mathematics]

MCK And MPCK

- The difference in mean MCK or MPCK scores between the highest and lowest achieving country in each program group was between one and two standard deviations.

- In the highest achieving countries within each program group, the majority of future teachers had scores at or above the higher MCK anchor point.

Opportunities to Learn

- Concentration of primary level OTL on the basics of numbers and measurement

- Concentration of university level OTL (with the exception of statistics) mostly in programs that prepare upper secondary school teachers

- Opportunities to learn general pedagogy and to engage in field experiences were universally available but their duration and nature varied greatly among countries and/or program-types

TEDS- M International Report

Front Matter

Chap. 1 - Introduction

Chap. 2 –National policies and employment conditions for teachers

Chap. 3 – Teacher education in the TEDS-M countries

Chap. 4 - Characteristics of institutions, programs, educators and future teachers

Chap. 5 - Opportunities to learn (OTL) mathematics

Chap. 6 - Knowledge of future teachers of mathematics

Chap. 7 - Conclusions, and issues for further analysis

Appendix - Methodology for TEDS-M

TEDS-M Publications & Other Materials

Available now :

- Conceptual framework
- Cost and salary study of teacher education
- Item almanacs with NRCs
- Item release with NRCs

TEDS-M Website (http://teds.educ.msu.edu/)

IDB Training for NRCs:

- Next week in Hamburg at IEA/DPC

Future publications:

- TEDS-M International Report
- TEDS-M Policy Report
- TEDS-M Technical Report
- TEDS-M Encyclopedia

THANK YOU!

WE WILL BE HAPPY TO ANSWER QUESTIONS!

- Begins section of tables and charts that will be inserted in the power point using hyperlinks

Institutions And Future Primary Teachers Samples *

Institutions and Future Primary Teachers - Expected and Achieved Sample Sizes

Countries	Number of Institutions in Original Sample	Ineligible Institutions	Total Number of Institutions Participated	Number of Sampled Future Primary Teachers in Participating Institutions	Number of Participating Future Primary Teachers
Botswana	4	0	4	100	86
Canada (4 provinces)	28	0	2	52	36
Chile	50	14	31	836	657
Chinese Taipei	11	0	11	1023	923
Georgia	9	0	9	659	506
Germany	15	0	14	1261	1032
Malaysia	28	4	23	595	576
Norway	16	0	14	185	159
Oman	Not applicable				
Philippines	60	19	33	653	592
Poland	91	0	78	2673	2112
Russia	52	1	49	2403	2266
Singapore	1	0	1	424	380
Spain (Primary education only)	50	0	45	1259	1093
Switzerland (German speaking parts)	14	0	14	1230	936
Thailand	46	0	45	666	660
USA (Public Institutions, concurrent and consecutive routes only)	60	0	51	1807	1501

Institutions And Future Secondary Teachers Samples *

Institutions and Future Secondary Teachers - Expected and Achieved Sample Sizes

Countries	Number of Institutions in Original Sample	Ineligible Institutions	Total Number of Institutions Participated	Number of Sampled Future Lower Secondary Teachers in Participating Institutions	Number of Participating Future Lower Secondary Teachers
Botswana	3	0	3	60	53
Canada (4 provinces)	28	0	8	174	125
Chile	50	10	33	977	746
Chinese Taipei	21	2	19	375	365
Georgia	6	0	6	116	78
Germany	13	0	13	952	771
Malaysia	7	0	6	462	389
Norway	25	2	18	242	194
Oman	7	0	7	288	268
Philippines	60	7	48	800	733
Poland	28	0	23	355	298
Russia	50	1	48	2275	2141
Singapore	1	0	1	431	393
Spain (Primary education only)	Not applicable				
Switzerland (German speaking parts)	6	0	6	174	141
Thailand	46	0	45	667	652
USA (Public Institutions, concurrent and consecutive routes only)	59	3	46	726	607

Teacher Educators Sample*

Institutions and Educators - Expected and Achieved Sample Sizes

Countries	Number of Institutions in Original Sample	Ineligible Institutions	Total Number of Institutions Participated	Number of Sampled Educators in Participating Institutions	Number of Participating Educators
Botswana	7	0	7	44	43
Canada (4 provinces)	30	0	10	94	74
Chile	50	10	28	510	392
Chinese Taipei	19	0	19	205	195
Georgia	10	0	10	64	62
Germany	50	0	46	792	482
Malaysia	34	4	22	330	255
Norway	Data not processed				
Oman	7	0	7	99	84
Philippines	80	20	51	626	589
Poland	92	1	72	857	734
Russia	58	1	56	1311	1212
Singapore	1	0	1	91	77
Spain (Primary education only)	50	0	46	574	533
Switzerland (German speaking parts)	16	0	12	318	220
Thailand	46	0	43	331	312
USA (Public Institutions, concurrent and consecutive routes only)	60	0	14	407	241

Annotations Institutional Program Questionnaire Data *

This table must be read with awareness of the limitations reported in the annotations. These annotations refer to the data footnoted in the tables below.

Notes

j = Yes; o = No

Annotations (Institutional Program)*:

The shaded areas identify data that, for reasons explained in the footnotes below, cannot be compared with confidence to data from other countries.

a. Poland: Institutions with consecutive programs only were not covered.
b. Russian Federation: Secondary pedagogical institutions were not covered.
c. Chinese Taipei: Exclusion rate >5% (see Technical Report).
d. Philippines: Exclusion rate >5% (see Technical Report).
e. Oman: Oman provided only secondary education at the time of testing.

*** Germany did not authorize reporting institutions**

Annotations Educator Questionnaire Data *

This table must be read with awareness of the limitations reported in the annotations. These annotations refer to the data footnoted in the table below.

The shaded areas identify data that, for reasons explained in the footnotes below, cannot be compared with confidence to data from other countries

Notes

a. Oman: Oman provided only secondary education at the time of testing.

b. Poland: Combined participation rate between 60% and 75% only; Institutions with consecutive programs only were not covered.

c. Russian Federation: Secondary pedagogical institutions were not covered.

*Participation rates clearly below standard in Germany, Chile, Malaysia and Switzerland; data was excluded in these comparative tables.

**Unacceptable data were from Canada, Norway and the United States of America.

Annotations Primary Future Teacher Questionnaire Data (MCK, MPCK, Beliefs)*

Annotations (Primary Future Teacher data) Notes The shaded areas identify data that, for reasons explained in the footnotes below should be interpreted with caution. The charts are Box and whisker plots (Tukey, 1977) showing the median, the upper and lower quartiles, and the maximum and minimum values. For ease of interpretation, statistical outliers (defined as data points more than 1.5 box widths above or below each box) are not shown.

a. Poland: Reduced coverage: institutions with consecutive programs only were not covered. Combined participation rate between 60 and 75%.
b. Russian Federation: Reduced coverage: secondary pedagogical institutions were excluded.
c. Switzerland: Reduced coverage: the population covered includes only institutions where German is the primary language of use and instruction.
d. USA: Reduced coverage: public institutions only. Combined participation rate between 60% and 75%. An exception was made to accept data from two institutions because, in each case, one additional participant would have brought the response rate above the 50% threshold. Although the participation rate for the complete sample meets the required standard, the data contain records that were completed using a telephone interview, when circumstances did not allow administration of the full questionnaire. Of the 1501 recorded as participants, the full questionnaire was administered to 1185, of whom the number providing sufficient data to receive scores on the achievement and beliefs measures ranged from 1083 to 1149. Bias may arise in the data because significant numbers of individuals were not administered the full questionnaire.
e. Botswana: The sample size is small (N=86), but arises from a census of a small population.
f. Chile: Combined participation rate between 60% and 75%.
g. Norway: Combined participation rate between 60% and 75%. An exception was made to accept data from one institution because one additional participant would have brought the response rate above the 50% threshold. Program types ALU and ALU+ are reported separately because the two populations partly overlap; data from these program types cannot be aggregated.

Annotations Secondary Future Teacher Questionnaire Data (MCK, MPCK, Beliefs)*

Annotations (Secondary Future Teacher data) Notes The shaded areas identify data that, for reasons explained in the footnotes below, cannot be compared with confidence to data from other countries.

The charts are Box and whisker plots (Tukey, 1977) showing the median, the upper and lower quartiles, and the maximum and minimum values. For ease of interpretation, statistical outliers (defined as data points more than 1.5 box widths above or below each box) are not shown.

a. Botswana: The sample size is small (N=53), but arises from a census of a small population.
b. Chile: Combined participation rate between 60 and 75%.
c. Poland: Reduced coverage: institutions with consecutive programs only were not covered. Combined participation rate between 60 and 75%.
d. Switzerland: Reduced coverage: includes only institutions where German is the primary language of use and instruction
e. Norway: Combined participation rate 58%. An exception was made to accept data from one institution because one additional participant would have brought the response rate above the 50% threshold. For the programs that prepare to grade 10 maximum, program types ALU and ALU+ are reported separately because the two populations partly overlap; data from these program types cannot be aggregated.
f. USA: Reduced coverage: public institutions only. Combined participation rate between 60% and 75%. An exception was made to accept data from one institution because one additional participant would have brought the response rate above the 50% threshold. Although the participation rate for the complete sample meets the required standards, the data contain records that were completed using a telephone interview, when circumstances did not allow administration of the full questionnaire. Of the 607 recorded as participants, the full questionnaire was administered to 502, of whom the number providing sufficient data to receive scores on the achievement and beliefs measures ranged from 441 to 490. Bias may arise in the data because significant numbers of individuals were not administered the full questionnaire.
g. Georgia: Combined participation rate between 60 and 75%. An exception was made to accept data from two institutions because, in each case, one additional participant would have brought the response rate above the 50% threshold.
h. Russian Federation: An unknown number of those surveyed had previously qualified to become primary teachers.

Primary Anchor Points on Item Map*

Persons indicated on the left and items on the right.

Red x's are at AP1

Red "numbers" indicate items with greater than .70 probability of correct response for those at AP1.

Yellow x's and numbers indicate AP2 and corresponding items.