

Teacher Preparation

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Higher mathematics achievement was related to teachers' having more teaching experience, being confident in their preparation to teach the TIMSS mathematics topics, and feeling very confident in teaching mathematics.

In view of the importance of a well prepared teaching force to an effective education system, TIMSS 2011 collected a range of information about teacher

Exhibit 7.3 shows the percentages of students in the TIMSS 2011 fourth grade assessment whose teachers had a major or specialization in primary education and if they also had a major or specialization in mathematics. Similar to the situation with formal education, there was a great deal of variation across countries in the degree of specialization by primary school teachers in mathematics education. On average across the fourth grade countries,

Exhibit 7.1: Mathematics Teachers' Formal Education* (Continued)

Country	Percent of Students by Teacher Educational Level			
	Completed Postgraduate University Degree**	Completed Bachelor's Degree or Equivalent but Not a Postgraduate Degree	Completed Post-secondary Education but Not a Bachelor's Degree	No Further than Upper-secondary Education
Sub-Saharan Africa				
Botswana	2 (1.3)	14 (3.1)	2 (3.4)	2 (1.4)
Honduras	0 (0.0)	4 (3.1)	21 (3.1)	34 (4.1)
Yemen	1 (0.9)	34 (4.1)	3 (4.1)	2 (3.1)
Selected Pacific				
Alberta, Canada	13 (2.1)	1 (2.1)	0 (0.0)	0 (0.0)
Ontario, Canada	1 (2.1)	3 (2.1)	0 (0.0)	0 (0.0)
Quebec, Canada	14 (3.3)	1 (3.3)	0 (0.1)	0 (0.0)
Abu Dhabi, UAE	1 (3.1)	4 (3.1)	10 (2.3)	0 (0.0)
Dubai, UAE	29 (4.4)	3 (4.3)	1 (1.1)	1 (0.1)
Florida, US	44 (1.0)	1 (1.1)	1 (0.0)	0 (0.0)
North Carolina, US	4 (1.1)	1 (1.1)	0 (0.0)	0 (0.0)

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Exhibit 7.2: Mathematics Teachers' Formal Education* (Continued)

Country	Percent of Students by Teacher Educational Level			
	Completed Postgraduate University Degree**	Completed Bachelor's Degree or Equivalent but Not a Postgraduate Degree	Completed Post-secondary Education but Not a Bachelor's Degree	No Further than Upper-secondary Education
N				
Botswana	1 (0.)	12 (2.)	(2.9)	0 (0.0)
Honduras	3 (1.)	(3.9)	12 (3.1)	9 (2.)
South Africa	1 (3.0)	42 (3.4)	3 (3.)	2 (1.0)

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Teachers' Professional Development

Evidence from recent meta-analyses of research conducted in the United States shows that teacher professional development in mathematics has a significant positive effect on student achievement (Blank & de las Alas, 2009) and that the amount of professional development (more than 14 hours) was an important factor (Yoon, Duncan, Lee, Scarloss, & Shapley, 2007).

Exhibit 7.7 presents, for the fourth grade TIMSS assessment, teachers' reports about areas of professional development in mathematics in which they had participated in the past two years. Although there was a lot of variation across countries, the most common areas of mathematics professional development for teachers of fourth grade students were mathematics pedagogy/instruction, mathematics content, and mathematics curriculum. On average, 46 percent of students had teachers who had professional development in mathematics instruction or pedagogy, 44 percent had teachers taking mathematics content, and 41 percent taking mathematics curriculum. Mathematics assessment and integrating information technology into mathematics were less common areas, with 37 percent and 33 percent of students, respectively, having teachers who had participated in professional development in these areas in the past two years.

As shown in Exhibit 7.8, mathematics teachers of students in the TIMSS eighth grade assessment reported somewhat higher levels of participation in mathematics professional development. On average across the eighth grade countries, the majority of students were taught by mathematics teachers who had participated in professional development in mathematics instruction or pedagogy (58%), content (55%), or curriculum (52%) in the past two years. Furthermore, almost half of the students had teachers with professional development in integrating information technology into mathematics (48%), mathematics assessment (47%), or improving students' critical thinking or problem solving skills (43%).

Exhibit 7.5: Teachers' Years of Experience (Continued)

Country	20 Years or More		At Least 10 but Less than 20 Years		At Least 5 but Less than 10 Years		Less than 5 Years		Average Years of Experience
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
S a m e P a c e									
Botswana	2 (3.)	431 (9.)	34 (4.2)	429 (9.)	22 (3.)	402 (.)	19 (2.)	409 (.)	13 (0.)
Honduras	29 (4.2)	40 (.)	3 (4.)	3 (.0)	1 (3.)	413 (10.0)	1 (4.0)	411 (21.)	14 (0.9)
Yemen	1 (3.0)	34 (9.)	0 (4.1)	343 (.)	1 (3.4)	3 (14.1)	1 (3.3)	32 (12.)	12 (0.)
B c a P a c a									
Alberta, Canada	3 (4.3)	12 (4.2)	24 (4.1)	03 (4.4)	2 (4.3)	01 (.0)	14 (3.4)	09 (.3)	1 (0.9)
Ontario, Canada	1 (2.4)	1 (.)	40 (3.4)	1 (4.)	29 (3.1)	1 (4.)	13 (2.)	2 (.4)	12 (0.4)
Quebec, Canada	32 (4.2)	30 (4.1)	40 (4.)	3 (3.3)	20 (3.)	32 (.4)	(2.0)	3 (.4)	1 (0.)
Abu Dhabi, UAE	1 (3.)	432 (1.0)	31 (3.9)	40 (11.)	2 (3.)	401 (.)	2 (3.)	43 (10.2)	10 (0.)
Dubai, UAE	1 (4.3)	4 (13.2)	2 (3.0)	41 (.)	2 (3.)	42 (.)	29 (4.4)	40 (11.1)	11 (0.9)
Florida, US	1 (3.1)	44 (10.9)	34 (4.)	3 (.0)	30 (4.2)	3 (.4)	20 (3.)	3 (9.0)	12 (0.9)
North Carolina, US	19 (4.4)	4 (9.)	3 (.0)	(.)	24 (4.2)	9 (.2)	21 (4.0)	31 (.)	12 (1.0)

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011



Teachers' Preparation to Teach the TIMSS Mathematics Topics

Although a sound knowledge of mathematics (数学) is a prerequisite for teaching mathematics (数学), it is not sufficient to ensure that teachers can teach mathematics (数学) effectively. Teachers must also have a good understanding of the TIMSS mathematics topics (数学) and be able to apply this knowledge in the classroom. This is particularly true for teachers in countries where the curriculum is not aligned with the TIMSS mathematics topics (数学).

“very well” prepared to teach the TIMSS topics. The results are averaged across all 18 topics for a perspective on mathematics overall, as well as separately by content domain: eight topics in number, seven topics in geometric shapes and measures, and three topics in data display. Internationally across the fourth grade countries

Country	Percent of Students Whose Teachers Feel “Very Well” Prepared to Teach TIMSS Mathematics Topics			
	Overall Mathematics (18 Topics)	Number (8 Topics)	Geometric Shapes and Measures (7 Topics)	Data Display (3 Topics)
S G a P a c a				
Botswana	90 (1.)	93 (1.)	(2.2)	92 (2.3)
Honduras	70 (2.)	72 (2.)	2 (3.4)	(4.3)
Yemen	72 (2.0)	91 (1.)	(3.1)	73 (3.)



Teachers' Confidence in Teaching Mathematics

Teachers with a strong sense of personal ability to organize and execute their teaching are more open to new ideas and less likely to experience emotional burnout. Research has shown that teachers' self-confidence in their teaching skills is not only associated with their professional behavior, but also with students' performance and motivation (Bandura, 1997; Henson, 2002).

To investigate teachers' confidence in teaching mathematics to the TIMSS class, teachers were asked to indicate how confident they feel about doing each of the following:

- Answer students' questions about mathematics;
- Show students a variety of problem solving strategies;
- Provide challenging tasks for capable students;
- Adapt my teaching to engage students' interest; and
- Help students appreciate the value of learning mathematics.

Exhibit 7.11 .ppt p. 605

Exhibit 7.12 provides further information about the components of the Confidence in Teaching Mathematics scale, by showing the percentage of students whose teachers reported feeling very confident in using each of the five

Exhibit 7.14: Components of Confidence in Teaching Mathematics Scale (Continued)

Country	Percent of Students Whose Teachers Feel Very Confident to				
	Answer Students Questions About Mathematics	Show Students a Variety of Problem Solving Strategies	Provide Challenging Tasks for Capable Students	Adapt Teaching to Engage Student Interests	Help Students Appreciate the Value of Learning Mathematics
Non-GAAP Countries					
Botswana	9 (1.)	4 (3.1)	2 (4.3)	4 (4.)	3 (3.0)
Honduras	93 (2.)	93 (2.)	0 (4.)	9 (3.1)	9 (1.)
South Africa	9 (1.)	3 (3.0)	0 (3.9)	9 (3.3)	2 ()
Basic Countries					
Alberta, Canada	93 (2.2)	2 (2.)	2 (3.)	3 (3.9)	3 (3.)
Ontario, Canada	2 (2.9)	3 (3.)	4 (4.3)	0 (3.)	3 (3.9)
Quebec, Canada	9 (1.4)	4 (3.0)	4 (4.1)	2 (3.)	0 (3.)
Abu Dhabi, UAE	3 ()	1 (3.4)	3 ()	2 (3.9)	3 ()
Dubai, UAE	1 (1.1)	2 (3.4)	0 (2.3)	0 (4.0)	0 (2.2)
Alabama, US	9 (2.2)	9 (1.9)	1 ()	3 ()	0 ()
California, US	9 (1.)	93 (2.)	0 ()	1 ()	1 ()
Colorado, US	9 (2.1)	92 (3.)	2 ()	3 ()	1 ()
Connecticut, US	100 (0.0)	93 (2.)	9 (4.3)	1 ()	0 ()
Florida, US	100 (0.4)	91 (4.3)	0 ()	1 ()	1 ()
Indiana, US	100 (0.0)	92 (3.2)	0 ()	1 ()	1 ()
Massachusetts, US	99 (1.2)	92 (4.0)	4 (4.2)	2 ()	1 ()
Minnesota, US	99 (1.3)	92 (3.)	1 (4.0)	1 ()	1 ()
North Carolina, US	9 (2.1)	94 (3.9)	1 (4.9)	9 (4.9)	1 ()

SOURCE: IEA's Trends in International Mathematics and Science Study – TIMSS 2011

Teachers' Career Satisfaction

Teachers who are satisfied with their profession and the working conditions at their school are more motivated to teach and prepare their instruction. Further, having teachers that can provide leadership is a dimension of teacher quality.

The Teacher Career Satisfaction scale was positively related to average mathematics achievement. On average, mathematics achievement was higher for the fourth grade students of Satisfied teachers than for students of Slightly Satisfied or Less Satisfied teachers. However, looking across the countries at the fourth grade, sixth grade, and benchmarking participants, it is clear that there are differences from country to country. In particular, it is noteworthy that four of the highest achieving countries in mathematics at the fourth grade—

Exhibit 7.15: Teacher Career Satisfaction (Continued)

Country	Satisfied		Somewhat Satisfied		Less Than Satisfied		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
South Pacific							
Honduras	9 (1.)	39 (.0)	(1.)	3 (1.)	0 (0.0)		12.2 (0.13)
Yemen	44 (3.9)	342 (.)	2 (3.)	33 (.0)	4 (1.)	34 (3.)	9. (0.12)
Botswana	2 (4.0)	433 (.)	9 (4.1)	41 (.4)	13 (2.9)	41 (.3)	. (0.1)
Black Pacific							
Dubai, UAE	9 (1.)	40 (2.)	29 (1.)	44 (.)	2 (0.)		10. (0.09)
Abu Dhabi, UAE	(3.)	42 (.)	30 (3.)	40 (.3)	4 (1.4)	399 (21.1)	10. (0.1)
Alberta, Canada	9 (4.3)	14 (3.)	40 (4.3)	49 (3.)	1 (0.)		10.2 (0.1)
Ontario, Canada	(3.)	19 (3.)	39 (3.)	1 (4.)	3 (1.2)	21 (10.)	10.2 (0.13)
Quebec, Canada	40 (3.)	39 (4.0)	0 (4.1)	2 (3.1)	10 (2.)	3 (.)	9. (0.1)
Florida, US	3 (4.9)	43 (.)	4 (.2)	43 (.2)	(2.9)	4 (13.4)	9. (0.19)
North Carolina, US	3 (.)	9 (.1)	(.0)	1 (.0)	(2.2)	39 (.)	9.3 (0.24)



