

Relationship Among Curriculum Coverage, Teacher Preparedness, and Student Achievement in TIMSS Advanced 2008

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Abstract

This study was built on the long history of IEA studies considering curriculum coverage as central to students' opportunities to learn. It uses the TIMSS Advanced 2008 achievement data for advanced mathematics and the extensive information about curriculum coverage provided by participating countries to develop country-by-country profiles of the relationship between curriculum coverage and achievement at the topic level. More specifically, for each country, a topic-by-topic analysis was done for 16 advanced mathematics topics (6 in algebra, 5 in calculus, and 5 in geometry) specified in the *TIMSS Advanced 2008 Assessment Frameworks*. The TIMSS Advanced 2008 advanced mathematics items were classified according to the 16 topics and students' achievement was summarized for each of the topic clusters using average percent correct. Achievement for each country was then related to: 1) whether the topic was included in the country's curriculum, 2) the percentage of students taught the topic according to their teachers, and 3) the teachers' reports of their level of preparedness to teach the topic. As would be anticipated, achievement was higher for topics that were included in the curriculum and then taught to students by "very well" prepared teachers.

Keywords: *teacher preparedness, opportunity to learn, curriculum coverage, mathematics achievement, TIMSS Advanced*

Introduction

Improving students' achievement in mathematics is featured prominently as a goal of educational reform in many countries, and the methods for monitoring success often center on conducting assessments at the local, national, and international levels. Because good curricular practice is part of this monitoring process, it seems important to provide students with an adequate opportunity to learn the material that is being tested. That is, there should be alignment across the curriculum, instruction, and assessment. Information about students' opportunities to learn the content targeted by assessments is receiving more and more attention as integral to examining the quality of school instruction (Boscardin et al., 2005; Mitchell, 1999; Porter, 2002; Schmidt et al., 2001; Squires, 2008). According to Porter (2002), addressing the curriculum content of the specific topics being assessed is essential in researching factors that affect student achievement. The purpose of this study was to

investigate the relationship between curriculum coverage and student performance in various advanced mathematics topics using TIMSS Advanced 2008 data.

As a research concept, “opportunity to learn” was first introduced in the early 1960s in IEA’s First International Mathematics Study, and then more fully implemented in the mid-1980s as part of IEA’s Second International Mathematics Study. Building on the earlier IEA studies, TIMSS has continued to use the curriculum, broadly defined, as the major organizing concept in considering how educational opportunities are provided to students. The TIMSS curriculum model has three aspects: the intended curriculum as described in the official documents prepared by countries, the implemented curriculum as actually taught in classrooms, and the achieved curriculum as measured by achievement on the assessment¹. Thus, it seems especially fitting to study one of the fundamental aspects of “opportunity to learn” using IEA’s most recent assessment of mathematics—TIMSS Advanced 2008.

In addition to the achievement data, TIMSS Advanced 2008 collected extensive information about the structure and content of the curriculum taught to the students, particularly in regards to the topics in the, Advanced Mathematics Framework (Garden, et al., 2006), and summarized the results in the *TIMSS Advanced 2008 International Report* (Mullis, Martin, Robitaille, & Foy, 2009). That is, the data about the topics in the intended curriculum were related to the topics in the implemented or taught curriculum, and then to achievement overall and for the three content areas (i.e., algebra, calculus, and geometry). However, the content coverage information was not analyzed topic-by-topic for the 16 topics specified in the Framework: 6 in algebra, 5 in calculus, and 5 in geometry. The topic-by-topic data about content coverage is available from three perspectives—inclusion of the topics assessed in the countries’ curriculum, students’ exposure to the topics in their instruction, and teachers’ preparation to teach the topics. For this paper, the data about curriculum coverage from these three perspectives was examined in light of students’ achievement on these 16 topics.

In keeping with the curriculum model, TIMSS routinely collects extensive information about the mathematics curriculum in the participating countries at a topic-by-topic level, although results are typically summarized at a macro-level. Ten countries participated in TIMSS Advanced 2008, which assessed achievement in advanced mathematics for students who had taken advanced mathematics courses according to a carefully specified Assessment Framework (Garden, et al., 2006). Table 1, reproduced from the *TIMSS Advanced 2008 International Report*, summarizes students’ performance across the three content domains covered in the assessment—algebra, calculus, and geometry (Mullis, Martin, Robitaille, &

¹ For example, see the *TIMSS 2011 Assessment Frameworks* (Mullis, Martin, Ruddock, O’Sullivan & Preuschoff, 2009)

Foy, 2009). The table shows the average percent correct for each country on the set of 71 items that comprised the advanced mathematics assessment as well as on each of the three content domains. This analysis by content domains uses average percent correct rather than average scale scores because there were insufficient items in all of the different domains to develop reliable scales.

[Take in Table 1 about here]

The results in Table 1 indicate general strengths and weaknesses. For example, in Armenia and the Russian Federation, students did relatively better in the algebra domain than they did overall, whereas geometry was a relative strength in Lebanon, Norway, the Philippines, and Slovenia. Interestingly, calculus was a relative weakness in half the participating countries.

Methodology

Research was conducted using the *TIMSS Advanced 2008 database* (Foy and Arora, 2009), which contained the student achievement data, students' and teachers' background data, as well as curriculum data for the 10 participating countries. The database included data for 22,242 students and 1,435 teachers. The present study was conducted using data from eight of the countries, including Armenia, Iran, Italy, Lebanon, Netherlands, Norway, Slovenia, and Sweden. The teacher data used in the study were not available for the Russian Federation and the data for the Philippines were excluded because its student population was much younger than the rest of the countries. The analysis was conducted with the student as the unit of analysis, using MATWGT (advanced mathematics teacher weight) to properly account for the complex sample design used in TIMSS Advanced 2008 study and to ensure that each teacher's data were appropriately attributed to their students.

To determine students' opportunities to learn the TIMSS Advanced 2008 advanced mathematics content, two variables were used—one from the curriculum questionnaire and the other from the teacher questionnaire. The countries participating in TIMSS Advanced 2008 were asked whether each of the TIMSS Advanced 2008 mathematics topics was included in their official curriculum, and the advanced mathematics teachers were asked whether the advanced mathematics students had been taught each of these topics. Teachers also were asked to indicate how well prepared they were to teach the advanced mathematics topics; that is, whether they felt “very well” prepared, “somewhat” prepared, or “not well” prepared. The present analysis was based on responses to these three questions as well as the student achievement data. Student achievement in advanced mathematics was assessed based on 71 items (totaling 79 score points), including both multiple-choice and constructed-response formats, with some constructed-response items worth more than 1 point.

This research began by examining these 71 items and their classification into the 16 different topics specified in the *TIMSS Advanced 2008 Assessment Frameworks* (Garden et al., 2006). Descriptive statistics were then calculated for both the teacher variables and response patterns were examined across countries for these two variables. Then, the percent correct for each item and for each of the 16 item clusters (topics) was calculated. The average percent correct for each topic was analyzed from several different perspectives related to content coverage: whether the topic was in the national curriculum, whether it was taught, and whether the teachers who were teaching these topics felt prepared while teaching. The complete set of descriptive statistics is available in the Appendix (see Tables 2-4). The relationship among the four variables was then analyzed for each country and for each topic, with several interesting patterns emerging.

Findings and Discussion

Based on the Extent of Instructional Coverage, Learning Is Less Than Might Be Anticipated

One of the most significant and universal findings from the analysis was that “learning”, as measured by the achievement results, was lower than would be expected given the reports about curriculum inclusion and instructional coverage. For the eight countries, Figure 1 presents the average percents for all curricular aspects across all 16 topics. On average, 90% of the advanced mathematics topics were included in the national curriculum of the participating countries, which was expected because the *TIMSS Advanced 2008 Assessment Frameworks* were designed in collaboration with the participating countries. As well, 87% of students in the study, on average, were taught these topics in classes as part of their instruction, and 84% were taught by teachers who felt “very well” prepared to teach these topics. However, the picture of student achievement does not look as encouraging as might be expected. The average percent correct for student achievement (39%) is approximately half the statistics for inclusion and for being taught the topic.

[Take in Figure 1 about here]

Learning Is Better When Topics Are in the Curriculum and Taught to Students

If TIMSS Advanced 2008 topics were in the mathematics curriculum and covered in class by teachers who felt “very well” prepared to teach these topics, then the students had higher achievement. As an example, Figure 2 shows the results for Lebanon, one of the higher performing countries on the TIMSS Advanced 2008 mathematics assessment (see Table 1). As shown in Figure 2, all 16 topics were included in the Lebanese curriculum, with

approximately 96% of the students, on average, being taught these topics, and most of them being taught by the teachers who felt that they were “very well” prepared to teach these topics. The higher percents for curriculum coverage and teacher preparedness were related to Lebanese students’ average achievement on these topics being 54%, compared to 39%, across the eight countries.

[Take in Figure 2 about here]

Having Topics in the Curriculum Without Teacher Training Is Less Successful

Although having topics in the curriculum and teaching them to students is very important, it is not sufficient to secure students’ achievement. In other words, it is very important to continue giving support and training to teachers over the years so that they are prepared to teach the topics included in the curriculum. Figure 3 shows the results for Italy, where for some reason about one-third of the teachers reported feeling either “somewhat” or “not” prepared to teach the TIMSS Advanced 2008 advanced mathematics topics. Even though 94% of the topics were included in the Italian curriculum, and, on average, 85% of the students were taught these topics, fewer students (68% on average) had teachers who reported being “very well” prepared to teach the topics. Also, the average percent of students correctly answering items on these topics was lower in Italy (34%) than might have been anticipated considering the relatively high degree of curriculum coverage and instruction.

[Take in Figure 3 about here]

Having Less Curricular Coverage Impacts Learning

Figure 4 presents the results for Sweden. Sweden is an interesting example of the results for a country that was relatively lower on three curricular aspects—somewhat fewer TIMSS Advanced topics in the national curriculum, smaller percentages of students taught the topics, and smaller percentages of teachers feeling “very well” prepared to teach the topics. One-fifth of the advanced mathematics topics were not included in Sweden’s national curriculum, with approximately one-fifth of the students, on average, not exposed to the content of these topics in classes. Correspondingly, on average, somewhat fewer Swedish students correctly answered the items on these topics— 30% compared to 34% for all eight countries, on average.

[Take in Figure 4 about here]

If the Topic Is Not in the Curriculum, Achievement Is Likely to Be Low

If the mathematics content is not included in the official curriculum to be taught to students,

then teachers are unlikely to teach the material, and students will not have the opportunity to learn. Figure 5 shows the topic-by-topic results for Norway, with the lowest percents occurring for the topic of “Complex Numbers”. This topic was not included in the curriculum, so it follows that only 3% of Norwegian students were taught this topic, and that the average percent correct on this topic was only 20%. (Interestingly, however, 56% of Norwegian students had teachers who felt “very well” prepared to teach this topic.)

In actuality, “Complex Numbers” was the one topic in the advanced mathematics framework which was not covered in many countries, with only Iran, Italy, and Lebanon including this topic in their official curriculum. Figure 6 shows the distribution of percents for various curricular aspects for these three countries where the curriculum did include the topic of “Complex Numbers”, while Figure 7 shows the corresponding percents for countries where the curriculum did not include “Complex Numbers”. On average, 84% of the students were taught the topic of “Complex Numbers” in countries where this topic is included in the curriculum compared to 19% where it was not. As would be expected, the average percent of students correctly answering the items was much lower in countries not including the topic—23% compared to 39%.

[Take in Figures 5, 6, and 7 about here]

Some Advanced Mathematics Topics Are Extremely Difficult

Another notable finding was that some advanced mathematics topics were very difficult for students across the eight countries, especially “Using Derivatives to Solve Problems”. This topic was in the national curriculum of all eight countries, but student performance on this topic was relatively low for most of the countries. Figure 8 presents the results, with performances ranging from a high of 39% for the Dutch students to 14% in the case of the Slovenian students. Interestingly, in Armenia and Slovenia almost one-third of the students were not even taught this topic. Beyond that, however, the topic itself is challenging. The description of this topic in the assessment frameworks (Garden et al., 2006, p.14) reads “Use derivatives to solve problems (e.g., in kinematics, optimization, and rates of change)”. Thus, all of the items in this topic involved problem-solving. That is, students had to first read these problems and understand that they needed to employ methods of differentiation. Then, they had to perform the differentiations correctly to solve these problems.

[Take in Figure 8 about here]

Conclusion and Implications

The results of this study provide further insight into how student performance varied across different topics within the larger content domains (i.e., algebra, calculus, and geometry) in relation to curricular and instructional coverage. The findings were consistent with prior studies showing the importance of curriculum alignment in improving student achievement (Mitchell, 1999; Schmidt et al. 1983; Schmidt et al., 2001; Boscardin et al., 2005). These results also validated findings from Boscardin et al. (2005) that teacher expertise was highly related to student achievement. These results are important because curriculum and teacher training are both areas countries can control. Each country decides what is to be included in its curriculum based on what they think is important for their students to learn. Parallel to this, the *TIMSS Advanced 2008 Frameworks* were developed based on what the participating countries' representatives and experts in the field thought it was important for students to learn. Therefore, the countries can use these results in order to further review and revise their curriculum as they deem necessary. Moreover, with the help of the results from this study, countries can target their teachers' professional development training in the areas where it is needed most.

References

- Boscardin, C.K., Aguirre-Munoz, Stoker, Kim, J., Kim, M., & Lee, J. (2005). Relationship between opportunity to learn and student performance, *Educational Assessment*, 10(4), 307-332.
- Foy, P. & Arora, A. (2009). *TIMSS Advanced 2008 user guide for the international database*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Garden, R.A., Lie, S., Robitaille, D.F., Angell, C., Martin, M.O., Mullis, I.V.S., Foy, P., & Arora, A. (2006). *TIMSS Advanced 2008 assessment frameworks*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Mitchell, F. M., (1999). *All students can learn: The effects of curriculum on the mathematics achievement of third-grade students as measured by the Iowa test of basic skills*. ED 440838.
- Mullis, I.V.S., Martin, M.O., Robitaille, D.F. & Foy, P. (2009). *TIMSS Advanced 2008 international report: Findings from IEA's study of achievement in advanced mathematics and physics in the final year of secondary school*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Mullis, I.V.S., Martin, M.O., Ruddock, G.J., O'Sullivan, & C.Y., Preuschoff, C. (2009). *TIMSS 2011 assessment frameworks*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

- Porter, A. C. (2002). Measuring the content of instruction: Uses in research and practice, *Educational Researcher*, 31(7), 3-14.
- Schmidt, W. H. (1983). High school course-taking: Its relationship to achievement. *Journal of Curriculum Studies*. 15 (3), 311-332
- Schmidt, W. H., McKnight, C.C., Houang, R.T., Wang, H. C., Wiley, D.E., Cogan, L.S., Wolfe, R.G., (2001). *Why schools matter: A cross national comparison of curriculum and learning*. San Francisco: Jossey-Bass.
- Schmidt, W. H., McKnight, C.C., Valverde, G.A., Houang, R.T., Wiley, D.E., (1997). *Many visions, many aims (Vol. I)*. Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Squires, D.A. (2008). *Curriculum alignment: Research-based strategies for increasing student achievement*. Thousand Oaks, CA: Corwin Press.

Appendix

[Take in Tables 2, 3, and 4 about here]

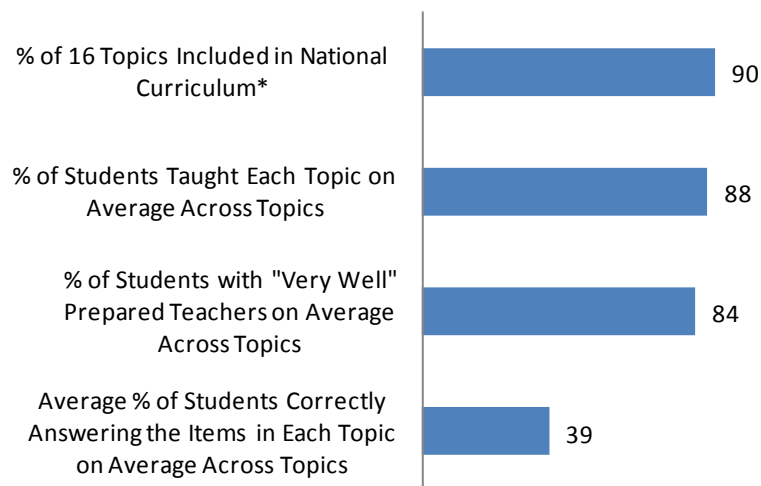
Table1: Average Percent Correct in the Advanced Mathematics Content Domains

Country	Advanced Mathematics (71 Items)	Advanced Mathematics Content Domains		
		Algebra (25 Items)	Calculus (25 Items)	Geometry (21 Items)
Armenia	32 (0.7)	37 (0.8)*	27 (0.6)*	33 (0.8)
Iran	43 (1.4)	45 (1.5)	41 (1.4)	44 (1.4)
Italy	35 (1.1)	33 (1.2)	36 (1.3)	36 (1.1)
Lebanon	53 (0.5)	51 (0.6)*	53 (0.6)	55 (0.5)*
Netherlands	54 (0.5)	55 (0.5)	53 (0.6)	53 (0.6)
Norway	33 (0.7)	33 (0.8)	30 (0.7)*	37 (0.7)*
Philippines	24 (0.6)	24 (0.9)	19 (0.5)*	31 (0.6)*
Russian Federation	57 (1.6)	62 (1.6)	53 (1.6)	56 (1.6)
Slovenia	36 (0.7)	38 (0.7)	32 (0.8)*	38 (0.9)*
Sweden	31 (0.7)	32 (0.9)	28 (0.8)*	32 (0.6)

*Significantly different than overall advanced mathematics percent

() Standard error appears in parentheses.

Figure 1: Average Percent Across Eight TIMSS Advanced Countries for Aspects of the Advanced Mathematics Curriculum



*For purpose of this analysis, topics partially included in the national curriculum were considered as included

Figure 2: Percents in Lebanon for Aspects of the Advanced Mathematics Curriculum

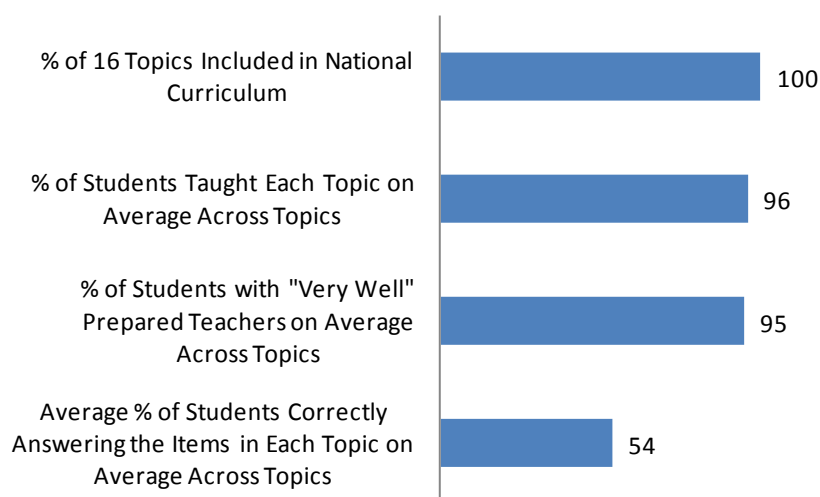


Figure 3: Percents in Italy for Aspects of the Advanced Mathematics Curriculum

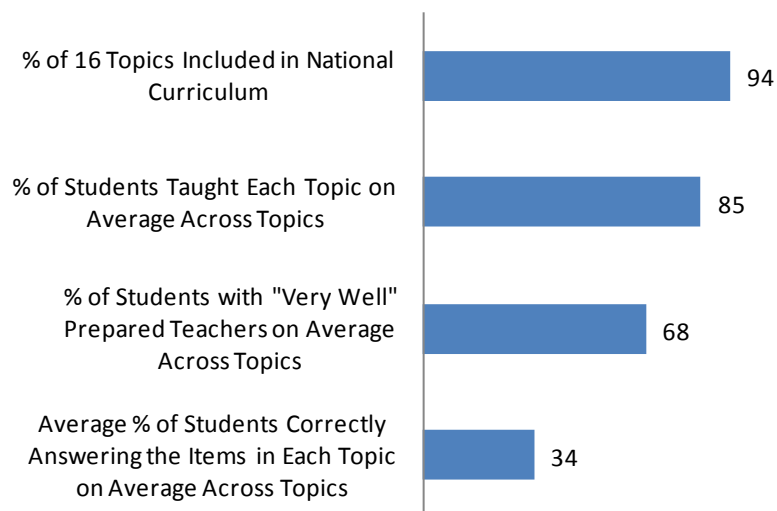
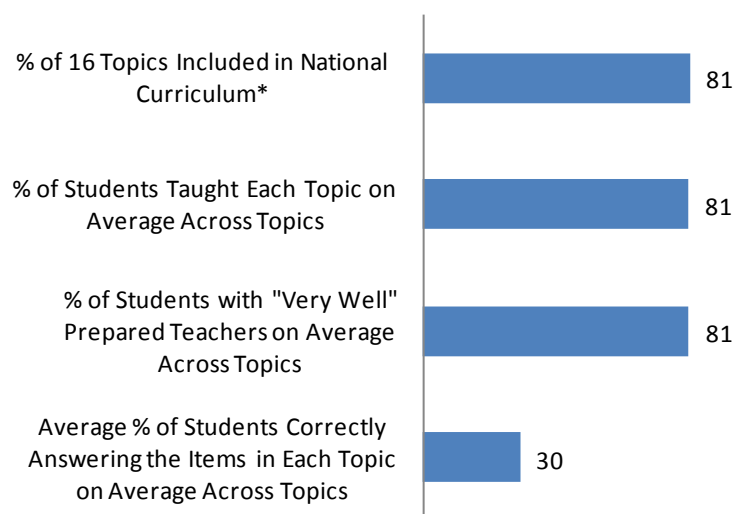
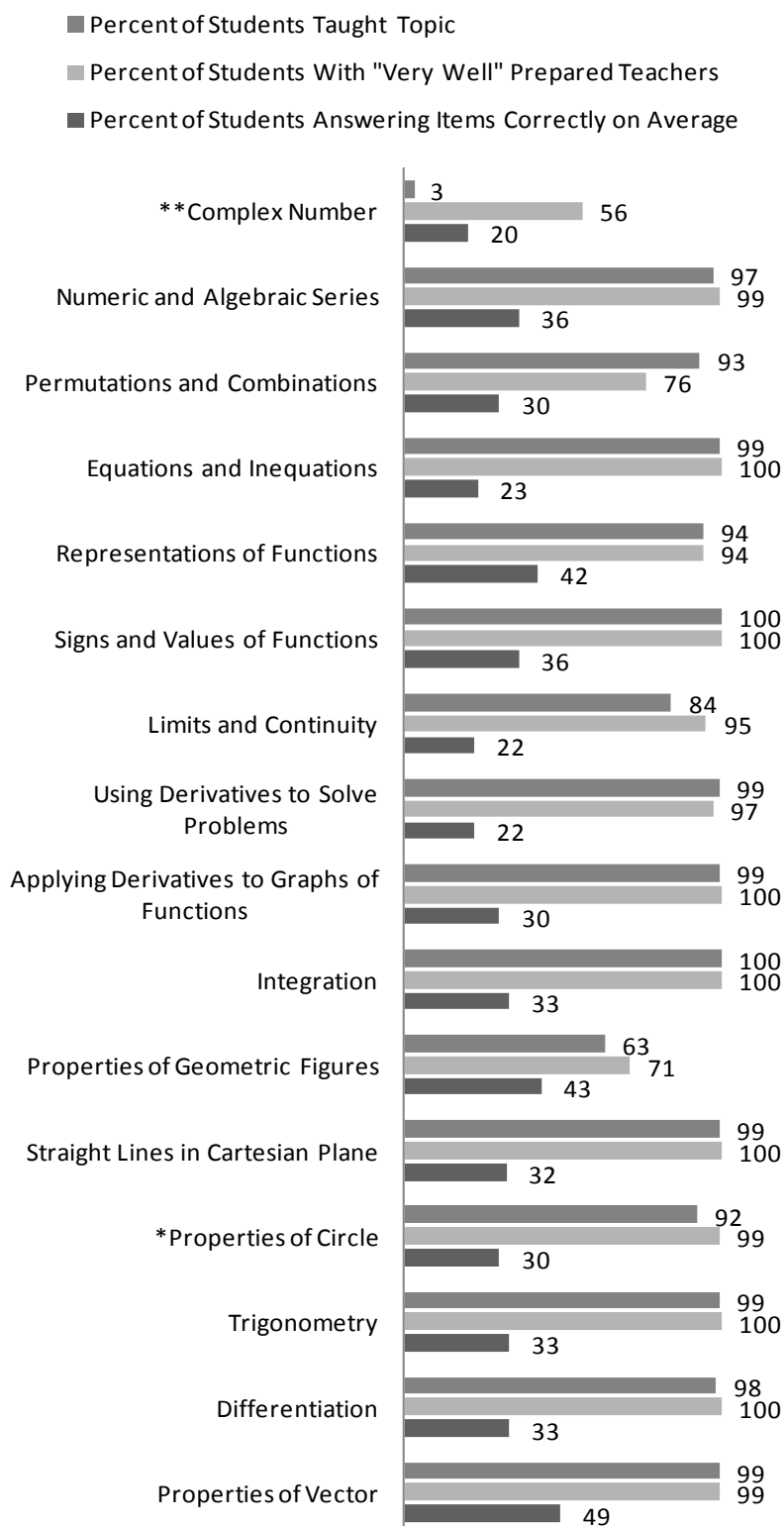


Figure 4: Percents in Sweden for Aspects of the Advanced Mathematics Curriculum



* For purpose of this analysis, topics partially included in the national curriculum were considered as included

Figure 5: Topic-by-Topic Percents in Norway for Aspects of the Advanced Mathematics Curriculum



** Topic is not included in the national curriculum. *Topic is partially included in the curriculum

Figure 6: Three TIMSS Advanced Countries Where the National Curriculum Includes Complex Numbers (Italy, Lebanon, and Slovenia)

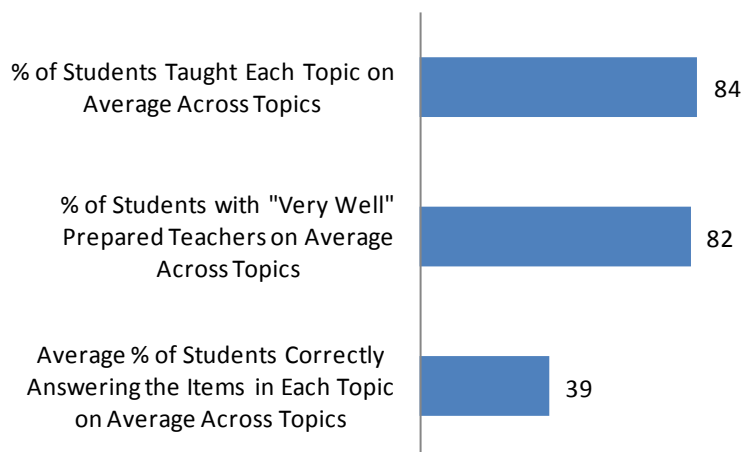


Figure 7: Five TIMSS Advanced Countries Where the National Curriculum Does **NOT** Include Complex Numbers

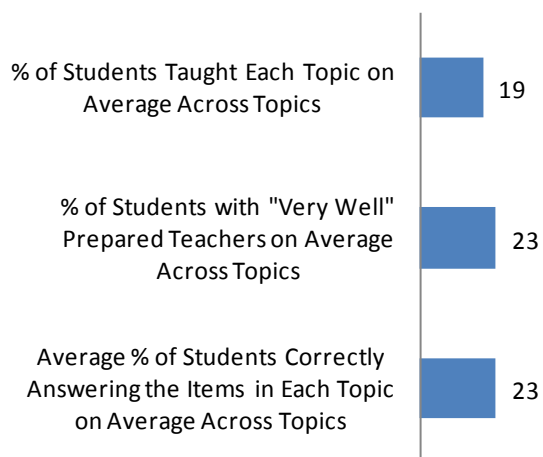


Figure 8: Country-by-Country Percents for Different Aspects of the Curriculum for the Topic
 “Using Derivatives to Solve Problems”

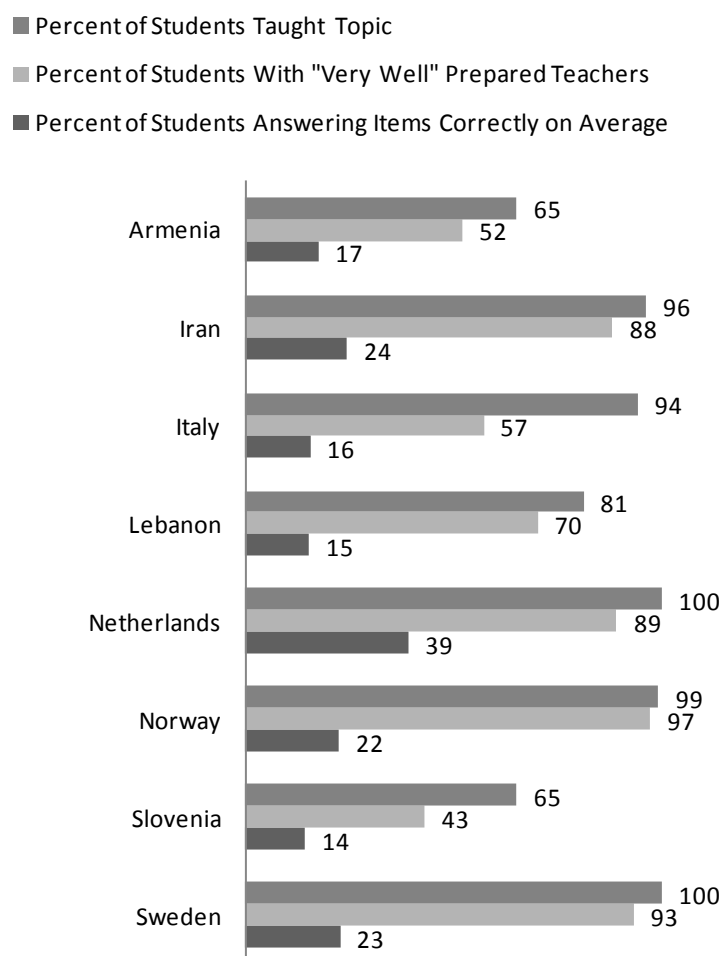


Table 2: TIMSS Advanced 2008 Advanced Mathematics Algebra Topics

Country	Complex Numbers (3)			Numeric and Algebraic Series (7)			Permutations and Combinations (1)			Equations and Inequations (6)			Representations of Functions (7)			Signs and Values of Functions (4)								
	¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students							
		Taught Topics	² With Prepared Teachers		With Correct Answer s on Average	Taught Topics		² With Prepared Teachers	With Correct Answer s on Average		Taught Topics	² With Prepared Teachers		With Correct Answer s on Average	Taught Topics		² With Prepared Teachers	With Correct Answer s on Average	Taught Topics	² With Prepared Teachers	With Correct Answer s on Average			
Armenia	N	12	40	17	Y	95	94	40	Y	89	62	31	Y	96	94	45	Y	94	78	34	Y	91	83	46
Iran	N	7	47	22	Y	93	81	45	Y	93	80	42	Y	96	96	39	Y	95	97	49	Y	96	96	65
Italy	Y	54	54	20	N	34	39	24	Y	46	25	16	Y	97	87	40	Y	92	63	39	Y	99	79	44
Lebanon	Y	99	98	71	Y	92	92	33	Y	93	95	42	Y	97	96	48	Y	92	94	54	Y	96	97	66
Netherlands	N	14	61	28	Y	96	82	57	Y	100	74	64	Y	100	98	57	Y	94	89	60	Y	99	97	59
Norway	N	3	56	20	Y	97	99	36	Y	93	76	30	Y	99	100	23	Y	94	94	42	Y	100	100	36
Slovenia	Y	100	94	27	Y	100	89	31	Y	89	52	45	Y	100	96	36	Y	96	89	44	Y	100	96	49
Sweden	N	59	80	29	Y	82	65	29	P	37	44	19	Y	98	96	28	Y	91	85	41	Y	94	92	37

() Number of Score points for each topic shown in parentheses.

¹N = topic not in national curriculum, Y = topic in national curriculum and P = part of topic is in national curriculum.

²Prepared = Based on teachers who reported feeling “Very Well” prepared to teach topic

Note: Standard errors for most statistics available in the TIMSS Advanced 2008 International Report (http://timssandpirls.bc.edu/timss_advanced/ir.html)

Table 3: TIMSS Advanced 2008 Advanced Mathematics Calculus Topics

	Limits and Continuity (4)				Differentiation (6)				Using Derivatives to Solve Problems (3)				Applying Derivatives to Graphs of the Functions (7)				Integration (8)			
Country	In Curriculum	Percent of Students			In Curriculum	Percent of Students			In Curriculum	Percent of Students			In Curriculum	Percent of Students			In Curriculum	Percent of Students		
		Taught Topics	With Prepared Teachers	With Correct Answers on Average		Taught Topics	With Prepared Teachers	With Correct Answers on Average		Taught Topics	With Prepared Teachers	With Correct Answers on Average		Taught Topics	With Prepared Teachers	With Correct Answers on Average		Taught Topics	With Prepared Teachers	With Correct Answers on Average
Armenia	P	91	91	30	Y	87	96	54	Y	65	52	17	P	66	51	21	N	20	36	13
Iran	Y	97	97	66	Y	97	99	61	Y	96	88	24	Y	97	100	38	Y	89	93	22
Italy	Y	98	86	47	Y	97	84	55	Y	94	57	16	Y	96	78	28	Y	85	79	30
Lebanon	Y	99	97	62	Y	97	98	86	Y	81	70	15	Y	100	97	50	Y	98	98	43
Netherlands	N	69	82	31	Y	100	98	65	Y	100	89	39	Y	100	98	52	Y	98	92	62
Norway	Y	84	95	22	Y	98	100	33	Y	99	97	22	Y	99	100	30	Y	100	100	33
Slovenia	Y	100	73	38	Y	100	95	46	Y	65	43	14	P	93	95	26	Y	81	89	30
Sweden	N	77	69	16	Y	100	97	40	Y	100	93	23	Y	100	98	26	Y	97	95	28

() Number of Score points for each topic shown in parentheses.

¹N = topic not in national curriculum, Y = topic in national curriculum and P = part of topic is in national curriculum.

²Prepared = Based on teachers who reported feeling "Very Well" prepared to teach topic

Note: Standard errors for most statistics available in the TIMSS Advanced 2008 International Report (http://timssandpirls.bc.edu/timss_advanced/ir.html)

Table 4: TIMSS Advanced 2008 Advanced Mathematics Geometry Topics

Country	Properties of Geometric Figures (6)			Straight Lines in Cartesian Figures (6)			Properties of Circles (1)			Trigonometry (7)			Properties of Vector (3)							
	¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students		¹ In Curriculum	Percent of Students						
		Taught Topics	² With Prepared Teachers		With Correct Answers on Average	Taught Topics		² With Prepared Teachers	With Correct Answers on Average		Taught Topics	² With Prepared Teachers		With Correct Answers on Average	Taught Topics	² With Prepared Teachers	With Correct Answers on Average			
Armenia	Y	97	91	34	Y	92	85	27	Y	95	85	31	Y	96	96	29	Y	92	87	50
Iran	Y	92	62	46	Y	95	91	46	Y	93	92	52	Y	94	88	32	Y	92	86	59
Italy	Y	92	49	46	Y	93	70	34	Y	97	82	38	Y	98	87	27	Y	85	68	36
Lebanon	Y	97	98	55	Y	99	98	67	Y	100	98	73	Y	99	95	42	Y	100	98	57
Netherlands	P	100	71	63	N	79	80	52	N	69	79	49	Y	100	97	52	Y	55	86	42
Norway	Y	63	71	43	Y	99	100	32	P	92	99	30	Y	99	100	33	Y	99	99	49
Slovenia	P	100	59	45	Y	100	99	37	Y	96	82	37	Y	100	94	31	Y	100	95	43
Sweden	P	88	63	35	Y	97	95	25	N	55	61	28	Y	100	97	34	N	19	67	34

() Number of Score points for each topic shown in parentheses.

¹N = topic not in national curriculum, Y = topic in national curriculum and P = part of topic is in national curriculum.

²Prepared = Based on teachers who reported feeling "Very Well" prepared to teach topic

Note: Standard errors for most statistics available in the TIMSS Advanced 2008 International Report (http://timssandpirls.bc.edu/timss_advanced/ir.html)