

Chapter

STUDENT ACHIEVEMENT IN PERFORMANCE
EXPECTATION CATEGORIES

In TIMSS, the term *performance expectation* is used to describe the many kinds of manipulative and cognitive behaviors and attitudes that a given task might be expected to elicit from students.¹ It includes such behaviors as problem solving or using scientific or mathematical procedures, reasoning and conjecturing, or the ability to plan, conduct, and interpret an investigation. The concept of performance expectation is an important key to all the performance assessment tasks in TIMSS, for each task was constructed to allow these manipulative and cognitive skills to be isolated to some degree and measured. However, because real-world tasks are complex, many such skills are often entangled, and the isolation is rarely total. For example, conducting an investigation requires knowledge of the subject in order to know what data to collect, skills in using the equipment, and the ability to organize that data and identify trends, as well as relate findings to prior knowledge. The concept of performance expectation is one of a functional combination of skills and knowledge that are exhibited in response to the challenge of specific tasks.

Because a number of processes are involved in every performance task, TIMSS has presented performance results first by whole task (Chapter 1), while showing how individual items (each measuring a different performance expectation) contribute to whole-task scores. In this chapter, items are collected across tasks by performance expectations in an effort to identify underlying patterns of strength and weakness in students' skills and competencies.

PERFORMANCE EXPECTATION REPORTING CATEGORIES

Performance of eighth-grade and fourth-grade students was analyzed for the following five science and mathematics performance expectation reporting categories, derived from the performance expectations aspect of the TIMSS curriculum frameworks.

- Scientific Problem Solving and Applying Concept Knowledge
- Using Scientific Procedures
- Scientific Investigating
- Performing Mathematical Procedures
- Problem Solving and Mathematical Reasoning

The three science and two mathematics performance expectations reporting categories and the items that address them are presented in Figure 3.1. For each category, the types of skills and processes required are briefly explained, and the TIMSS performance assessment tasks and items relevant to each category, based on the skills and abilities elicited by the item, are listed. The assignment of items to the categories shown in Figure 3.1 is based on the *primary* performance category associated with each item. In this chapter, student performance in these performance expectation categories is presented for each country and internationally at the eighth and fourth grades. In addition, international average performance on selected example items within subcategories of the broad performance expectation categories is shown for the eighth-grade students.

¹ Robitaille, D.F., McKnight, C.C., Schmidt, W.H., Britton, E.D., Raizen, S.A., and Nicol, C. (1993). *TIMSS Monograph No. 1: Curriculum Frameworks for Mathematics and Science*. Vancouver, B.C.: Pacific Educational Press.

Distribution of Performance Assessment Items Across Science and Mathematics Performance Expectation Reporting Categories*

Figure 3.1

Science

Scientific Problem Solving and Applying Concept Knowledge		Using Scientific Procedures		Scientific Investigating	
Applying scientific principles to solve quantitative problems or develop explanations.		Using apparatus or equipment; conducting routine experimental operations; gathering data; organizing, representing, and interpreting data.		Designing and conducting investigations; interpreting investigational data; formulating conclusions from investigational data.	
Eighth Grade	Fourth Grade	Eighth Grade	Fourth Grade	Eighth Grade	Fourth Grade
<ul style="list-style-type: none"> • Pulse Item 3 • Batteries Items 3, 4 • Rubber Band Item 6 • Solutions Item 4 • Shadows Item 2 • Plasticine Items 2A, B, 3A, B, 4A, B 	<ul style="list-style-type: none"> • Pulse Item 4 • Batteries Items 3, 4 • Rubber Band Item 5 • Containers Items 3, 4, 5 • Shadows Item 6 • Plasticine Items 2A, B, 3A, B, 4A, B 	<ul style="list-style-type: none"> • Pulse Item 1A • Rubber Band Items 1A, 2, 3 • Solutions Item 2B • Shadows Item 5 • Plasticine Item 1A 	<ul style="list-style-type: none"> • Pulse Items 1, 2 • Rubber Band Item 2 • Containers Item 1A • Shadows Items 1, 2, 3 • Plasticine Item 1A 	<ul style="list-style-type: none"> • Pulse Items 1B, 2 • Magnets Items 1, 2 • Batteries Items 1, 2 • Rubber Band Items 1B, 4, 5 • Solutions Items 1, 2C, 3, 5 • Shadows Items 1, 3, 6 	<ul style="list-style-type: none"> • Pulse Item 3 • Magnets Items 1, 2 • Batteries Items 1, 2 • Rubber Band Items 1, 3, 4 • Containers Item 1B, 2 • Shadows Item 4, 5, 7

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Mathematics

Performing Mathematical Procedures		Problem Solving and Mathematical Reasoning	
Using equipment; performing routine procedures; using more complex procedures.		Developing strategy; solving problems; predicting; generalizing; conjecturing.	
Eighth Grade	Fourth Grade	Eighth Grade	Fourth Grade
<ul style="list-style-type: none"> • Dice Items 1, 2, 3, 4, 5A • Calculator Items 1, 2 • Around the Bend Items 1, 2, 5A • Packaging Items 2, 3 • Plasticine Item 1A 	<ul style="list-style-type: none"> • Dice Items 1, 2, 3, 4, 5A • Calculator Items 1, 2 • Around the Bend Items 2, 3 • Packaging Items 2, 3 • Plasticine Item 1A 	<ul style="list-style-type: none"> • Dice Item 5B • Calculator Items 3, 4, 5, 6B • Folding & Cutting Items 1, 2, 3, 4 • Around the Bend Items 3, 4, 5B, C, 6 • Packaging Item 1 • Plasticine Items 2A, B, 3A, B, 4A, B 	<ul style="list-style-type: none"> • Dice Item 5B • Calculator Items 3, 4, 5 • Folding & Cutting Items 1, 2, 3 • Around the Bend Items 1, 4 • Packaging Items 1 • Plasticine Items 2A, B, 3A, B

* Item assignments are based on the primary science and mathematics performance expectation category associated with each. Two items are not shown that are assigned to a primary performance expectation category of Communicating: Shadows Item 4 (eighth grade) and Plasticine Item 2B (eighth and fourth grades).

SCIENCE PERFORMANCE EXPECTATIONS

Table 3.1 summarizes for the eighth grade in each country, the average percentage score for each of the science performance expectation reporting categories, as well as the overall average percentage scores across all tasks. The overall averages of the percentage scores across the tasks are those presented in Chapter 2; they are included here for ease of reference. The average percentage score for each performance expectation category is based on the percentage score for each item within the category (see Figure 3.1), averaged across all items within the category.²

The results presented in Table 3.1 reveal that, for the most part, differences in performance between one country and the next higher- and lower-performing countries were relatively small for each of the science performance expectation categories. Note also that, on average internationally, students performed significantly lower on “Scientific Problem Solving and Applying Concept Knowledge” than in “Using Scientific Procedures” and “Scientific Investigating.” Internationally, students performed similarly in the latter two categories, with average percentage scores of about 60% for both, compared to 47% for “Scientific Problem Solving and Applying Concept Knowledge”.

Table 3.2 presents the corresponding results for the fourth grade. Although the categories are the same as for the eighth grade, the tasks and items within the categories are not the same because not all tasks and items were parallel (see Figure 3.1). In particular, some questions on problem solving and investigating, which were presented towards the end of the eighth-grade tasks, were not administered to fourth-grade students, and these were among the most

problematic for the older students. Similar to the eighth-grade students, the fourth graders found “Scientific Problem Solving and Applying Concept Knowledge” to be the most difficult area, with an international average percentage score of 23%. Internationally and in every country, fourth-grade students performed better in “Using Scientific Procedures” than in the other two categories. The international average percentage score of 58% for this category was comparable to performance in this area at the eighth grade. Internationally, “Scientific Investigating” was intermediate in difficulty for the fourth-grade students, with an average percentage score of 43%.

“Scientific Problem Solving and Applying Concept Knowledge” was the most demanding category in all but one country at both grades. In all but six countries, competence in procedural skills and the higher-order skills involved in scientific investigating was approximately equivalent at the eighth grade. A closer look at the item-level scores in Chapter 1, however, reveals that investigating comprises thinking processes of varying levels of difficulty, ranging from planning and collecting data to interpreting and drawing conclusions. Averages across such diverse processes obscure the difference between conducting investigations and using purely procedural skills. Figures 3.3 and 3.4, discussed later in this chapter, are included to illustrate this point.

² The percentage score on an item is the score achieved by a student expressed as a percentage of the maximum points available on that item. A country’s average percentage score is the average of its students’ percentage scores.

**Average Percentage Scores by Science Performance Expectation Categories
Eighth Grade*** Table 3.1

Country	Overall Average Percent Correct [▼]	Average Percentage Scores by Science Performance Expectations Categories [•]			
		Scientific Problem Solving and Applying Concept Knowledge (12 Items)	Using Scientific Procedures (7 Items)	Scientific Investigating (16 Items)	
					◆ Scientific Problem Solving and Applying Concept Knowledge (± 2SE) ▲ Using Scientific Procedures (± 2SE) ● Scientific Investigating (± 2SE)
Singapore	71 (1.7)	59 (3.0)	75 (1.8)	74 (1.9)	
^{††} Switzerland	65 (1.2)	55 (1.6)	63 (1.4)	70 (1.3)	
Sweden	64 (1.2)	56 (2.3)	59 (1.9)	67 (1.5)	
[†] Scotland	62 (1.7)	48 (2.1)	69 (1.8)	65 (1.5)	
Norway	62 (0.8)	48 (1.6)	57 (1.2)	63 (1.1)	
Czech Republic	61 (1.3)	53 (2.2)	57 (2.0)	65 (1.6)	
Canada	60 (1.3)	50 (1.6)	64 (2.2)	60 (1.4)	
New Zealand	60 (1.4)	47 (1.6)	65 (2.1)	57 (1.6)	
Spain	54 (0.8)	39 (1.6)	45 (1.8)	57 (1.2)	
Iran, Islamic Rep.	52 (2.0)	61 (2.0)	53 (3.4)	56 (2.7)	
Portugal	47 (1.1)	32 (1.8)	47 (1.4)	45 (1.4)	
Cyprus	46 (1.0)	37 (1.9)	48 (1.7)	50 (1.1)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for details)					
Australia	65 (1.2)	54 (2.0)	67 (1.9)	66 (1.1)	
² England	67 (0.9)	49 (2.0)	77 (1.4)	73 (1.0)	
Netherlands	60 (1.3)	39 (1.9)	63 (1.7)	57 (1.4)	
United States	55 (1.3)	43 (1.5)	61 (2.2)	55 (1.4)	
Countries Not Meeting Age/Grade Specifications (See Appendix A for Details):					
Colombia	39 (1.8)	32 (2.2)	35 (2.4)	41 (1.5)	
³ Romania	62 (1.9)	48 (3.3)	53 (2.5)	61 (2.2)	
Slovenia	61 (1.0)	48 (1.5)	60 (1.3)	59 (1.3)	
International Average	59 (0.3)	47 (0.5)	59 (0.4)	60 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

20 30 40 50 60 70 80

* Eighth grade in most countries; see Table 2 for information about the grades tested in each country.

• Percentage scores averaged across items in each performance expectation category (see Figure 3.1); items weighted equally.

▼ Overall average of percentage scores across all 12 performance assessment tasks; tasks weighted equally (see overall average in Table 2.1).

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details)

¹ National Desired Population does not cover all of International Desired Population (see Table A.2) - German-speaking cantons only.

² National Defined Population covers less than 90 percent of National Desired Population for the main assessment (see Table A.2).

³ School-level exclusions for performance assessment exceed 25% of the National Desired Population (see Table A.2).

() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals or plots may appear inconsistent.

Table 3.2 Average Percentage Scores by Science Performance Expectation Categories Fourth Grade*

Country	Average of Percentage Scores Across All Tasks [†]	Average Percentage Scores by Science Performance Expectations Categories [•]			
		Scientific Problem Solving and Applying Concept Knowledge (14 Items)	Using Scientific Procedures (8 Items)	Scientific Investigating (13 Items)	
Canada	45 (1.3)	28 (1.2)	61 (1.4)	53 (1.3)	
^{††} New Zealand	38 (1.2)	20 (0.9)	60 (1.6)	41 (1.4)	
Iran, Islamic Rep.	38 (2.4)	34 (2.0)	53 (2.8)	37 (2.0)	
Cyprus	34 (1.4)	17 (1.3)	52 (2.3)	45 (1.8)	
Portugal	30 (1.4)	13 (1.3)	52 (1.8)	30 (1.5)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):					
Australia	44 (0.9)	23 (1.2)	60 (2.5)	49 (1.2)	
Hong Kong	42 (1.4)	19 (1.1)	54 (1.7)	46 (1.5)	
United States	41 (0.9)	22 (0.8)	63 (1.1)	42 (1.1)	
Countries Not Meeting Age/Grade Specifications (See Appendix A for Details):					
Slovenia	46 (1.3)	29 (1.5)	62 (2.2)	48 (1.6)	
International Average	40 (0.5)	23 (0.4)	58 (0.7)	43 (0.5)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

10 20 30 40 50 60 70

* Fourth grade in most countries; see Table 2 for information about the grades tested in each country.

• Percentage scores averaged across items in each performance expectation category (see Figure 3.1); items weighted equally.

† Overall average of percentage scores across all 12 performance assessment tasks; tasks weighted equally (see overall average in Table 2.2).

† Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details)

^{††} School-level exclusions for performance assessment exceed 25% of the National Desired Population (see Table A.3).

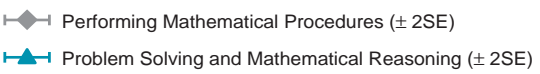
() Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals or plots may appear inconsistent.

MATHEMATICS PERFORMANCE EXPECTATIONS

Table 3.3 summarizes, for the eighth grade, the average percentage score for the two mathematics performance expectation reporting categories as well as the overall average of the percentage scores across all tasks. The latter are the same as those presented in Chapter 2, and, again, they are included here for ease of reference. In all countries and internationally, eighth-grade students performed significantly better in “Performing Mathematical Procedures” than in “Problem Solving and Mathematical Reasoning,” with international average percentage scores of 70% and 52% on the items in the two categories, respectively.

Table 3.4 presents the corresponding results for the fourth grade. Again, although the two categories are the same for the fourth and eighth graders, the tasks and items within the categories differ. Internationally, and in most countries, “Problem Solving and Mathematical Reasoning” was also significantly more difficult for fourth-grade students than was “Performing Mathematics Procedures,” with corresponding average percentage scores of 43% and 32%. In Iran and Slovenia, however, students performed similarly in the two areas.

Table 3.3 Average Percentage Scores by Mathematics Performance Expectation Categories Eighth Grade*

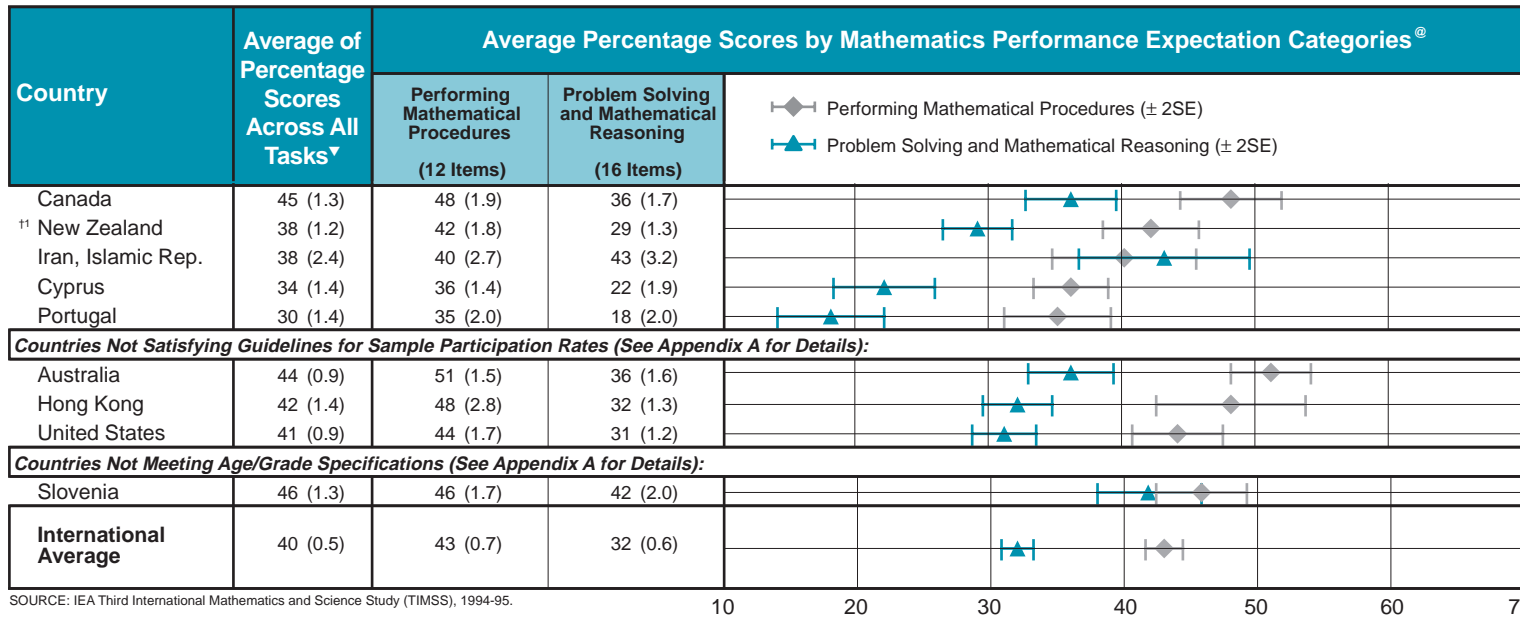
Country	Average of Percentage Scores Across All Tasks [▼]	Average Percentage Scores by Mathematics Performance Expectation Categories [®]		
		Performing Mathematical Procedures (13 Items)	Problem Solving and Mathematical Reasoning (21 Items)	
Singapore	71 (1.7)	80 (1.3)	62 (2.3)	
^{†1} Switzerland	65 (1.2)	76 (1.8)	60 (1.8)	
Sweden	64 (1.2)	73 (1.3)	60 (1.6)	
[†] Scotland	62 (1.7)	75 (1.7)	52 (2.3)	
Norway	62 (0.8)	75 (1.2)	58 (1.3)	
Czech Republic	61 (1.3)	73 (1.6)	56 (1.7)	
Canada	60 (1.3)	74 (1.4)	54 (1.3)	
New Zealand	60 (1.4)	72 (1.1)	55 (1.6)	
Spain	54 (0.8)	66 (1.4)	46 (1.3)	
Iran, Islamic Rep.	52 (2.0)	61 (1.8)	49 (1.8)	
Portugal	47 (1.1)	66 (1.2)	36 (1.6)	
Cyprus	46 (1.0)	58 (1.3)	38 (1.4)	
Countries Not Satisfying Guidelines for Sample Participation Rates (See Appendix A for Details):				
Australia	65 (1.2)	75 (1.4)	61 (1.9)	
² England	67 (0.9)	77 (1.1)	54 (1.3)	
Netherlands	60 (1.3)	77 (1.7)	50 (1.5)	
United States	55 (1.3)	64 (1.6)	49 (1.4)	
Countries Not Meeting Age/Grade Specifications (See Appendix A for Details):				
Colombia	39 (1.8)	49 (2.7)	30 (2.7)	
³ Romania	62 (1.9)	74 (1.9)	60 (2.4)	
Slovenia	61 (1.0)	72 (1.2)	57 (1.1)	
International Average	59 (0.3)	70 (0.4)	52 (0.4)	

SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

* Eighth grade in most countries; see Table 2 for information about the grades tested in each country.
 • Percentage scores averaged across items in each performance expectation category (see Figure 3.1); items weighted equally.
 ▼ Overall average of percentage scores across all 12 performance assessment tasks; tasks weighted equally (see overall average in Table 2.1).
 † Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details)
¹ National Desired Population does not cover all of International Desired Population (see Table A.2) - German-speaking cantons only.
² National Defined Population covers less than 90 percent of National Desired Population for the main assessment (see Table A.2).
³ School-level exclusions for performance assessment exceed 25% of the National Desired Population (see Table A.2).
 () Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals or plots may appear inconsistent.

Average Percentage Scores by Mathematics Performance Expectation Categories Fourth Grade*

Table 3.4



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

* Fourth grade in most countries; see Table 2 for information about the grades tested in each country.
 ● Percentage scores averaged across items in each performance expectation category (see Figure 3.1); items weighted equally.
 ▼ Overall average of percentage scores across all 12 performance assessment tasks; tasks weighted equally (see overall average in Table 2.2).
 † Met guidelines for sample participation rates only after replacement schools were included (see Appendix A for details)
 †† School-level exclusions for performance assessment exceed 25% of the National Desired Population (see Table A.3).
 () Standard errors appear in parentheses. Because results are rounded to the nearest whole number, some totals or plots may appear inconsistent.

VARIATION IN PERFORMANCE IN SUBCATEGORIES OF PERFORMANCE EXPECTATIONS

To provide a better picture of the variation in performance across tasks that may be masked by the aggregation of items into broad performance expectation categories, Figures 3.2 through 3.6 present profiles of international performance for eighth graders on items within subcategories of the science and mathematics performance expectation categories. These displays reveal the performance of students in the finer-level cognitive and procedural skills areas contained within the larger categories. For each subcategory, performance on one or more underlying processes or skills is illustrated through several example items, selected to cover a range of item types and tasks. The tasks and items were shown in full in Chapter 1. While previous displays in this report have shown the average percentage scores for items and tasks, Figures 3.2 through 3.6 show the percentage of students, internationally, providing fully-correct and partially-correct responses.

Figure 3.2 presents the percentage of students internationally that provided fully-correct and partially-correct responses to five items from “Scientific Problem Solving and Applying Concept Knowledge,” which was the most difficult performance expectation category as shown by the international average percentage score of 47% (see Table 3.1). One of the underlying processes exemplified by many of the items in this category is the application of scientific principles to develop explanations. The performance on these example items shows that students had difficulty in this area across several tasks covering different content areas and experimental contexts. The percentage of students with fully-correct responses on these items varied from 8% to 36%.

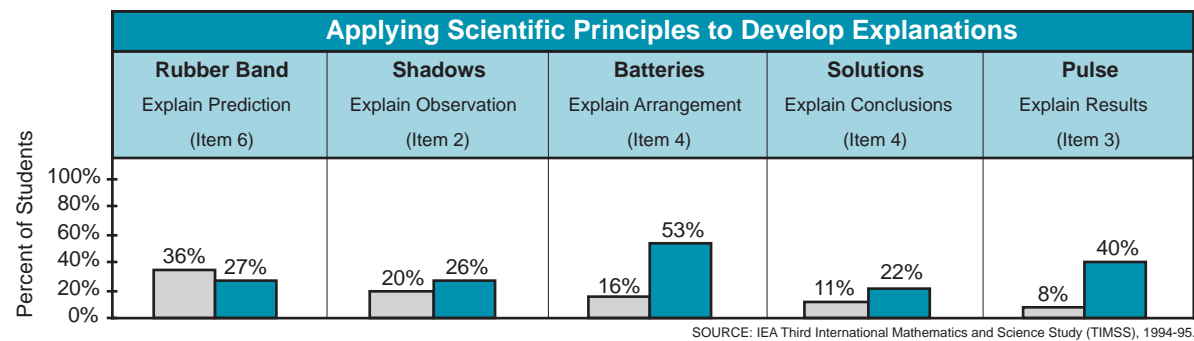
Figure 3.3 shows the percentage of students internationally who provided fully- and partially-correct responses to example items in the “Using Scientific Procedures” category. These items measured

students’ ability to collect, organize, and represent data, and the performance shown in Figure 3.3 reflects the portion of the item scores based only on the quality of their data presentation (properly labeled tables or graphs showing paired measurements). There was more variation in performance on the items in this category, with percentage of students with fully-correct responses ranging from 17% to 77% across tasks.

Figure 3.4 shows the percentages of fully- and partially-correct responses to example items in “Scientific Investigating” for three subcategories in this performance expectation category. The items in the “Conducting Investigations” category (top panel) are the same as those shown in Figure 3.3. In Figure 3.4, however, the performance indicated reflects the portion of the item score based on the quality of the data collection (making appropriate, sufficient, and plausible measurements). Again, a range of performances is found for these items – 14% to 82% of students internationally with fully-correct responses. For the items in “Interpreting Data” (middle panel), students were required to describe their strategy, interpret their observations, and identify the trends observed in their data. On all of these example items across five tasks, nearly 50% or more of students received full credit. Performance on example items in “Formulating Conclusions” (bottom panel) shows that the relative difficulty of the items in this subcategory varied substantially across tasks. International percentages of fully-correct responses ranged from a high of 92% for identifying the stronger of two magnets to only 16% on the much more challenging task of writing a general rule about shadow sizes.

Profiles of International Performance on Example Items That Require Scientific Problem Solving and Applying Concept Knowledge - Eighth Grade*

Figure 3.2



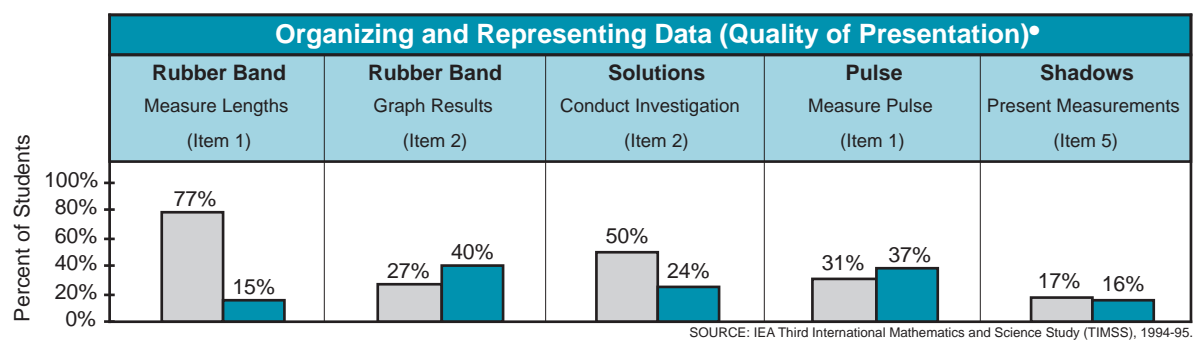
Legend

- Percent of Students Internationally with Fully-Correct Response
- Percent of Students Internationally with Partially-Correct Response

* Eighth grade in most countries; see Table 2 for information about the grades tested in each country.

Figure 3.3

Profiles of International Performance on Example Items That Require Using Scientific Procedures - Eighth Grade*



Legend

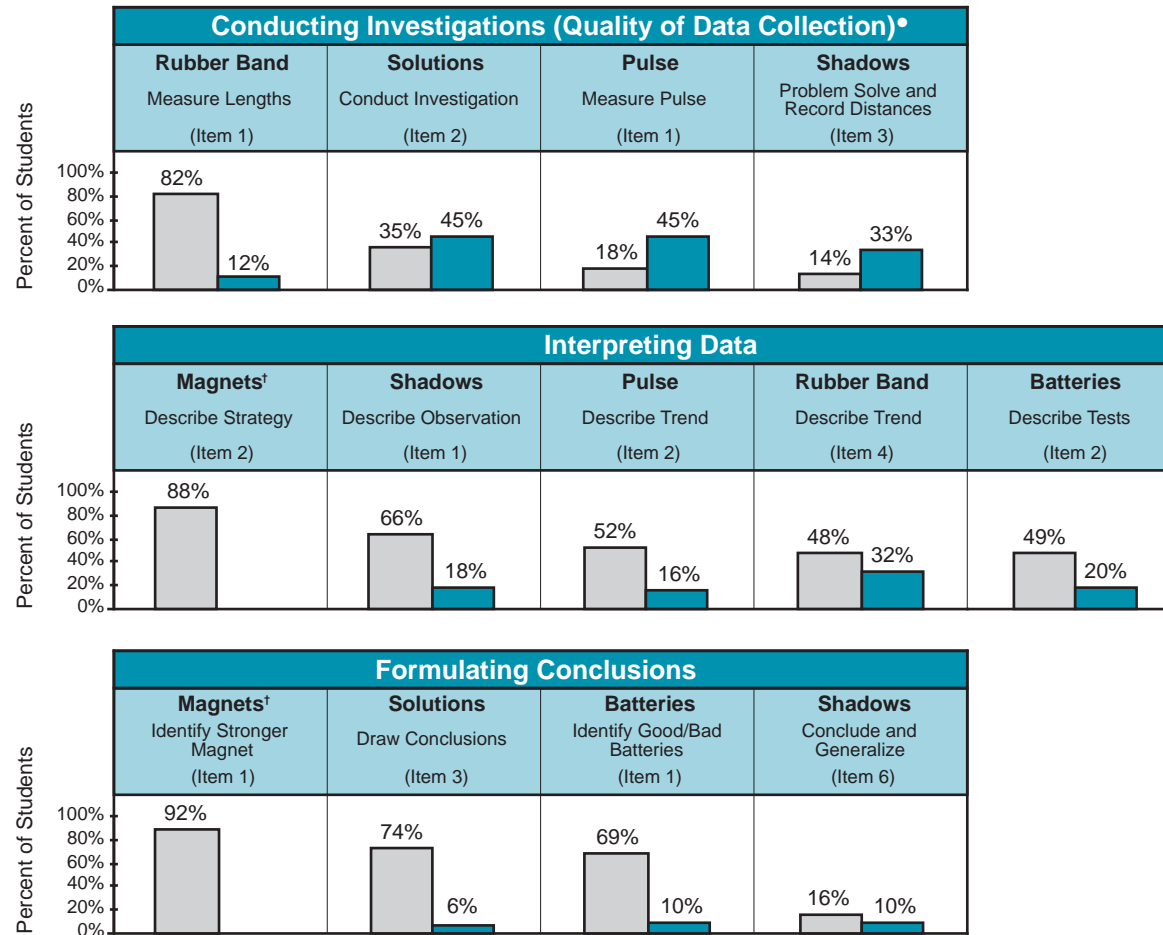
- Percent of Students Internationally with Fully-Correct Response
- Percent of Students Internationally with Partially-Correct Response

* Eighth grade in most countries; see Table 2 for information about the grades tested in each country.

• Percent correct reflects only the portion of the item score based on the quality of the data presentation; quality of data collection results are shown in Figure 3.4.

Profiles of International Performance on Example Items That Require Scientific Investigating - Eighth Grade*

Figure 3.4



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Legend

- Percent of Students Internationally with Fully-Correct Response
- Percent of Students Internationally with Partially-Correct Response

* Eighth grade in most countries; see Table 2 for information about the grades tested in each country.

• Percent correct reflects only the portion of the item score based on the quality of the data presentation; quality of data collection results are shown in Figure 3.4.

† One-point items; no partial-credit scores.

In Figure 3.5, profiles of international performance on example items in the mathematics performance expectation category of “Performing Mathematical Procedures” are presented for the eighth grade. Items requiring students to perform routine mathematical procedures (top panel) included performing calculations, completing a table, comparing frequencies, measuring, and performing conversions. Internationally, students did quite well on these types of items, with more than 65% of students providing fully-correct responses on all of the example items. Students had more difficulty, in general, on items requiring more complex mathematical procedures (bottom panel), such as drawing models to scale, identifying a pattern in numbers, drawing the net of a box, and constructing the net of a box to scale. There was much more variation in performance on items of this type, with performances ranging from 22% to 71% fully-correct responses.

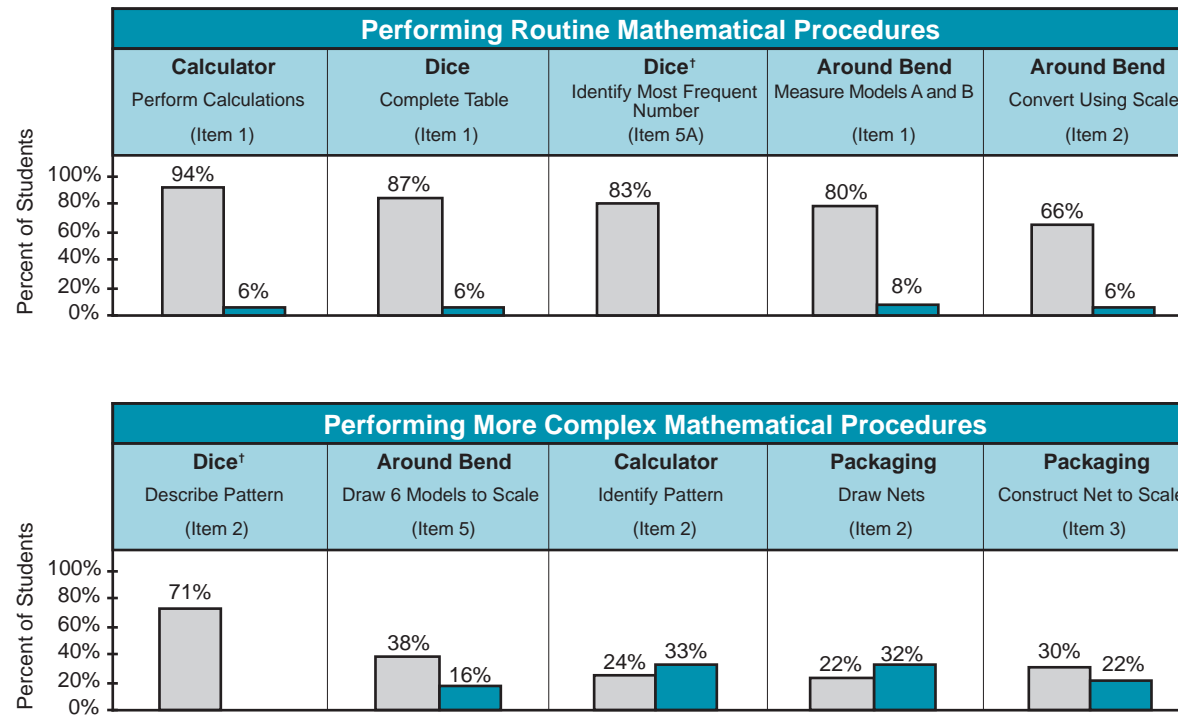
Figure 3.6 shows international performance of eighth-grade students on example items in two subcategories of “Problem Solving and Mathematical Reasoning”. Internationally, students demonstrated a range of performance on example items requiring them to predict, develop strategies, and solve problems (top panel). The highest percentage of fully-correct responses (73%) was on the routine application of a pattern, while only 11% of students received full credit for finding the correct factors of 455 in the Calculator task. There was also variation in performance on the three example items requiring students to generalize and conjecture (bottom panel).

The content area and context of the task seem to affect students’ ability to express skills thought to be comparable regardless of the task (e.g., organizing and representing data shown in Figure 3.3). However, the overall familiarity of the task and its difficulty, as well as the nature of the cognitive processes required, also affect students’ performance. For example, regardless of context, items requiring explanations were consistently more difficult than other types of questions. Similarly, less-familiar content like factoring

or circulation (Pulse task) also shows lower achievement across a variety of performance expectations. Generally, students were more successful in drawing conclusions from an experiment than in developing hypotheses about the causes of their findings, but the degree of the difference varied markedly in different countries. Large differences in performance were found between the use of more complex mathematical procedures like pattern identification or scaling, and familiar routine procedures, including the use of calculators (Figure 3.5). Internationally, the areas of greatest strength at the eighth grade were found in conducting investigations, executing more routine procedures, and solving problems, including some non-routine problems. Areas of greater difficulty were using more complex mathematical procedures and reasoning, as well as explaining and generalizing, both in science and mathematics. Fourth graders did well in conducting investigations in familiar content areas like electricity and magnetism, and they also did well in the use of procedural knowledge in science. In fact, the data show no difference internationally between fourth and eighth graders in the use of scientific procedures. For mathematics, however, use of procedures was sharply lower in fourth grade than in eighth grade in all countries.

Profiles of International Performance on Example Items That Require Performing Mathematical Procedures - Eighth Grade*

Figure 3.5



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Legend

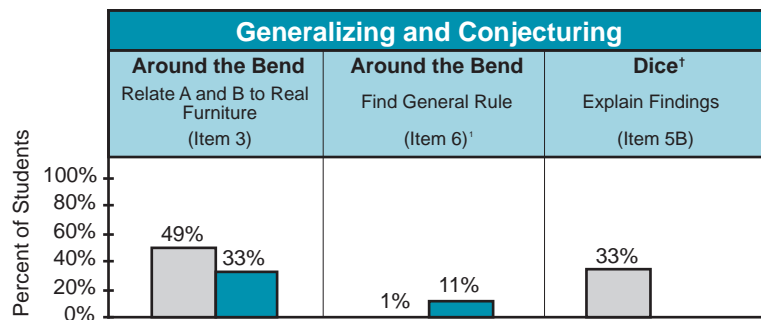
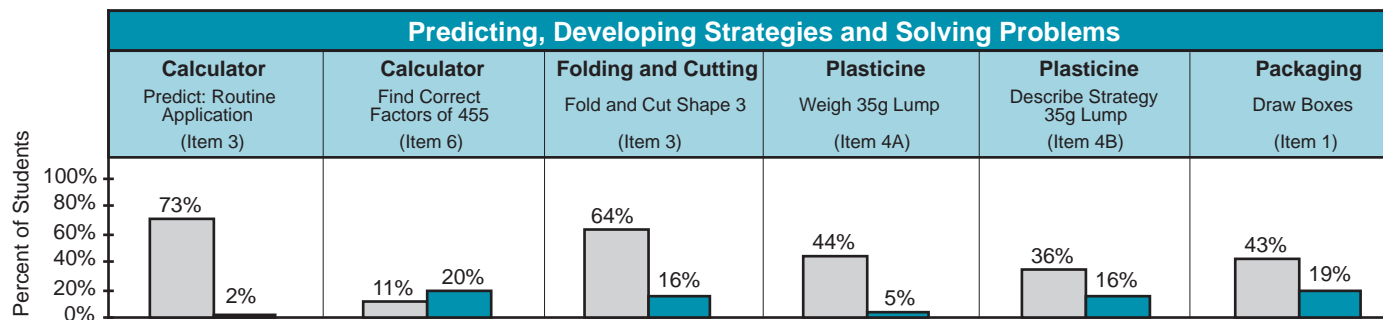
- Percent of Students Internationally with Fully-Correct Response
- Percent of Students Internationally with Partially-Correct Response

* Eighth grade in most countries; see Table 2 for information about the grades tested in each country.

† One-point items; no partial credit scores.

Figure 3.6

Profiles of International Performance on Example Items That Require Problem Solving and Mathematical Reasoning - Eighth Grade*



SOURCE: IEA Third International Mathematics and Science Study (TIMSS), 1994-95.

Legend

- Percent of Students Internationally with Fully-Correct Response
- Percent of Students Internationally with Partially-Correct Response

* Eighth grade in most countries; see Table 2 for information about the grades tested in each country.

[†] One-point items; no partial credit scores.

¹ Columbia did not administer this item; not included in international percentages.