Chapter 12

School Contexts for Physics Learning and Instruction

Chapter 12 presents information about the school contexts for teaching and learning physics during the final year of secondary school among the countries that participated in TIMSS Advanced 2008. Considerable research indicates that a school conducive to learning is important for students to have high achievement. This chapter describes the school environments in the participating countries and how supportive they may be in bringing students to high levels of learning. In particular, information is provided about the principals' roles in their schools and the availability of physics teachers, as well as principals' and teachers' perceptions of their schools' climates and of school safety. Information also is provided about the adequacy of resources for teaching physics, including the availability of various types of technology.

Much of the data in this chapter was collected through questionnaires administered to schools, and completed by the principals or school heads assisted by school personnel. Results are generally shown as the percentages of students whose schools reported various characteristics. That is, the student is the unit of analysis so that TIMSS Advanced 2008 can describe students' school contexts. The exhibits have special notations if relatively large percentages of students

did not have school questionnaire information. That is, in several cases an "r" is included next to the data because data was available for less than 85 percent of the students, but available for at least 70 percent.

Role of the Principal and Availability of Physics Teachers

Even if a country has established a rigorous and coherent curriculum in physics, there are various ways that the school environment can help or hinder classroom instruction in that curriculum. This section presents information about two school staffing issues that can impact students' opportunity to learn the intended curriculum. First, because research shows that achievement improves in schools where principals are effective instructional leaders, data is presented about how principals spend their time. Second, since qualified teachers are important for effective instruction, data is provided about the degree of difficulty schools are having in recruiting physics teachers to fill final year vacancies.

Principals that are effective instructional leaders may actively advocate, nurture, and sustain a positive school culture and an education program conducive to students' learning and teachers' professional growth. Because the primary roles that the principal fulfills provide a useful indication of the administrative and educational structures and priorities of the school, the principals of the schools offering physics courses were asked how they distributed their time across the competing demands of administrative, instructional, supervisory, disciplinary, teaching, and public relations tasks.

Exhibit 12.1 presents, for each country, the percentage of time that principals reported they would have spent on the different types of school-related tasks by the end of the school year. According to their reports, the vast majority of principals' time is distributed across three broad categories of tasks: administrative duties, providing instructional

Exhibit 12.1 **Principals' Percent of Time Spent on Various School-related Activities**

TIMSSAdvanced 2008 Physics

Country	Administrative Duties (e.g., Hiring, Budgeting, Scheduling, Meetings)	Instructional Leadership (e.g., Developing Curriculum and Pedagogy)	Supervising and Evaluating Teachers and Other Staff	Issues Related to Student Discipline	Teaching	Public Relations and Fundraising	Other
Armenia	26 (0.2)	21 (0.2)	23 (0.1)	14 (0.2)	7 (0.1)	12 (0.1)	7 (0.1)
Iran, Islamic Rep. of	19 (0.9)	26 (1.1)	20 (0.8)	13 (0.8)	4 (0.5)	10 (0.7)	8 (0.4)
Italy	29 (1.6)	23 (1.1)	17 (0.8)	13 (1.3)	3 (0.5)	12 (0.9)	4 (0.7)
Lebanon	24 (0.6)	18 (0.4)	19 (0.4)	17 (0.4)	6 (0.3)	10 (0.3)	5 (0.3)
Netherlands	21 (1.4)	26 (1.6)	19 (1.2)	7 (0.8)	8 (1.0)	5 (0.4)	14 (1.3)
Norway	48 (2.2)	24 (1.0)	9 (0.5)	6 (0.6)	3 (0.5)	4 (0.5)	7 (1.4)
Russian Federation	25 (1.0)	21 (0.8)	19 (0.6)	7 (0.5)	8 (0.6)	12 (0.7)	8 (0.7)
Slovenia	35 (0.1)	21 (0.0)	13 (0.0)	6 (0.0)	7 (0.0)	11 (0.0)	8 (0.0)
Sweden	45 (2.6)	16 (1.2)	17 (1.2)	8 (1.0)	3 (0.6)	4 (0.4)	9 (0.9)

Data provided by schools

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

leadership in the areas of curriculum and pedagogy, and supervising teachers and other staff. In Armenia, Iran, Lebanon, the Netherlands, and the Russian Federation, the distribution of time was similar across these three categories (about one fifth to one fourth of principals' time spent on each of the three areas). Among the three categories, a slightly larger percentage of time was devoted to administrative duties in Armenia, Lebanon, and the Russian Federation and to instructional leadership in Iran and the Netherlands. In comparison, in Italy and Slovenia, although principals reported that 23 and 21 percent, respectively, of their time was devoted to instructional leadership, they devote more of their time (29% and 35%, respectively) to administrative duties, and somewhat less of their time to evaluating teachers and other staff (17% and 13%, respectively). The distribution of time across these three areas was least balanced in Norway and Sweden, with principals' time considerably skewed toward the administrative side (48% and 45%, respectively). Although the percentages were not large, principals generally reported more time devoted to disciplining students (6 to 17%) than to teaching them the school's curriculum (3 to 7%), except in the Netherlands, the Russian Federation, and Slovenia. Public relations and fundraising took from 10 to 12 percent of the principals' time except in the Netherlands, Norway, and Sweden where these activities only took from 4 to 5 percent of their time.

Exhibit 12.2 presents schools' reports about the degree of difficulty they are having recruiting physics teachers to fill vacancies in the final year of secondary school. As discussed in Chapter 11, substantial percentages of the teachers of physics have been teaching for 20 to 26 years in nearly all of the TIMSS Advanced countries, and thus could be expected to be considering retirement. Also, as evidenced by the TIMSS Advanced data, there are not large pools of students currently being trained in physics and few of them plan to continue their study

Exhibit 12.2 **Schools' Reports on Physics Teacher Recruitment**

TIMSSAdvanced 2008 Physics

Country	Filling Physics Teaching Vacancies for the School Year							
	No Vacancies		Easy to Fill Vacancies		Somewhat Difficult to Fill Vacancies		Very Difficult to Fill Vacancies	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	83 (0.8)	493 (4.4)	8 (0.4)	507 (7.9)	0 (0.0)	~ ~	10 (0.8)	500 (43.2)
Iran, Islamic Rep. of	28 (4.2)	468 (11.9)	26 (4.8)	438 (11.9)	36 (4.6)	457 (14.8)	10 (2.8)	494 (26.7)
Italy	45 (6.3)	413 (10.8)	26 (5.7)	440 (11.7)	25 (5.5)	418 (21.3)	4 (2.0)	434 (21.6)
Lebanon	47 (2.3)	444 (4.2)	17 (1.8)	462 (7.1)	22 (2.0)	430 (6.6)	14 (1.7)	456 (6.5)
Netherlands	65 (5.3)	584 (3.9)	5 (2.0)	605 (15.6)	20 (3.9)	585 (6.0)	10 (3.4)	580 (8.2)
Norway	32 (6.0)	535 (6.9)	36 (6.8)	537 (6.6)	21 (5.1)	530 (7.1)	10 (3.2)	536 (10.6)
Russian Federation	80 (3.8)	526 (10.6)	9 (2.0)	557 (21.0)	8 (2.9)	413 (36.5)	3 (1.2)	545 (52.1)
Slovenia	87 (0.2)	537 (2.3)	9 (0.2)	514 (6.1)	4 (0.1)	553 (7.6)	0 (0.0)	~ ~
Sweden	66 (6.0)	493 (7.9)	25 (5.4)	505 (9.4)	6 (2.3)	502 (23.5)	3 (2.4)	500 (11.3)

Country	Incentives to Recruit or Retain Physics Teachers			
	School Uses Incentives		School Does Not Use Incentives	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	14 (0.9)	480 (29.4)	86 (0.9)	497 (4.0)
Iran, Islamic Rep. of	38 (4.1)	477 (13.4)	62 (4.1)	447 (8.8)
Italy	– –	– –	– –	– –
Lebanon	34 (2.1)	449 (4.5)	66 (2.1)	441 (3.9)
Netherlands	1 (0.8)	~ ~	99 (0.8)	585 (3.4)
Norway	10 (3.7)	534 (8.6)	90 (3.7)	535 (4.4)
Russian Federation	74 (4.2)	522 (12.5)	26 (4.2)	520 (19.1)
Slovenia	0 (0.0)	~ ~	100 (0.0)	535 (1.9)
Sweden	2 (1.0)	~ ~	98 (1.0)	498 (6.0)

Data provided by schools.

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

A dash (–) indicates comparable data are not available. A tilde (~) indicates insufficient data to report achievement.

of science (Exhibits 10.14 and 10.15), which would indicate even smaller percentages planning to become teachers. Since there does not seem to be a regular pipeline into the career of teaching physics in a number of the TIMSS Advanced countries, it is not surprising that physics students in some participating countries are attending schools that are having some difficulty recruiting physics teachers for the final year of secondary school.

In several countries, most physics students were in schools with hardly any vacancies for physics teachers in the final year of secondary school, including Armenia (83%), the Russian Federation (80%), and Slovenia (87%). In contrast, however, 46 percent of the Iranian physics students in their final year of secondary school were attending schools with vacancies for physics teachers that were at least somewhat difficult to fill, as were approximately one third (29 to 36%) of the Italian, Lebanese, Dutch, and Norwegian students.

As shown in the lower portion of Exhibit 12.2, schools were asked if they used any incentives (e.g., pay, housing, signing bonuses, smaller classes) to recruit or maintain physics teachers for students in the final year of secondary school. The results indicate that incentives were used most widely in the Russian Federation, and apparently with some success since nearly all vacancies were filled as discussed above. Iran and Lebanon also reported some use of incentives for schools with about one third of their physics students. Neither the percentage of difficult-to-fill vacancies nor the use of incentives was consistently related to average achievement in physics.

Orderly and Safe Schools

Although an orderly and safe school environment does not, in and of itself, guarantee high levels of student achievement, safe schools can be considered a necessary condition for providing a good

learning environment for students. TIMSS 2007 showed that science achievement was related to teachers' and students' perceptions about how safe they felt at school at both the fourth and eighth grades, and it might be anticipated that school discipline and behavior problems in secondary schools might be of even greater concern. However, the TIMSS Advanced 2008 results indicate that school safety generally is not a problem for the select populations of final year students studying physics. According to their principals and teachers, these students generally are in orderly and safe school environments.

To provide an initial context for considering the degree of order and safety in the schools attended by physics students, TIMSS Advanced 2008 asked principals to rate the seriousness of the following behavior problems among final year students in their schools: vandalism, theft, intimidation or verbal abuse among students, students causing physical injury to other students, students intimidating or verbally abusing teachers, and students physically injuring teachers or staff. TIMSS Advanced used the principals' responses about each behavior (i.e., not a problem, minor problem, or serious problem) to create an Index of Good Behavior at School for Students in the Final Year of Secondary School. Students in the high category attended schools where principals reported that *none* of these six behaviors were a problem. In contrast, students in the low category attended schools where principals reported widespread minor and/or serious behavior problems. The medium category included students attending schools where these behaviors were minor problems.

Exhibit 12.3 presents the results for the Index of Good Behavior at School for Students in the Final Year of Secondary School. The countries are presented in order from the largest to smallest percentage of students in the high category. In six countries, the majority of physics students (from 55 to 78%) attended schools where *none* of these student

Exhibit 12.3 Index of Good Behavior at School for Students in the Final Year of Secondary School (GBS)

TIMSSAdvanced 2008 Physics

Country	High GBS		Medium GBS		Low GBS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	78 (0.5)	488 (6.4)	20 (0.5)	519 (8.4)	3 (0.1)	512 (13.2)
Russian Federation	74 (3.3)	523 (11.2)	26 (3.3)	519 (21.5)	0 (0.0)	~ ~
Netherlands	72 (5.0)	584 (4.2)	26 (4.9)	585 (5.6)	2 (1.3)	~ ~
Iran, Islamic Rep. of	71 (4.1)	464 (8.3)	29 (4.1)	447 (12.7)	0 (0.0)	~ ~
Slovenia	58 (0.2)	550 (2.7)	39 (0.2)	513 (2.9)	3 (0.1)	529 (10.2)
Norway	55 (5.7)	539 (4.8)	43 (5.6)	531 (6.7)	1 (0.1)	~ ~
Italy	46 (6.4)	424 (15.1)	48 (6.2)	426 (7.1)	7 (3.2)	381 (24.4)
Sweden	40 (6.6)	507 (9.2)	50 (7.1)	492 (8.5)	10 (4.6)	486 (20.1)
Lebanon	40 (2.4)	440 (5.5)	51 (2.4)	451 (4.1)	9 (0.6)	429 (12.6)

SOURCE: IEA TIMSS Advanced 2008 ©

Based on principals' responses about the seriousness of following behaviors in their school: vandalism, theft, intimidation or verbal abuse of other students, physical injury to other students, students intimidating or verbally abusing teachers or staff, and students causing physical injury to teachers or staff. Principals' responses were averaged across the six statements based on a 3-point scale: 1=Not a Problem, 2=Minor Problem, 3=Serious Problem. Students in the high category attended schools where principals reported none of these problems with students behavior (average of 1). Students in the low category attended schools where principals reported widespread minor and/or serious student behavior problems (average greater than 2). Students in the medium category attended schools where principals reported minor student behavior problems (average greater than 1 and less than or equal to 2).

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

A tilde (~) indicates insufficient data to report achievement.

Exhibit 12.4 Index of Physics Teachers' Perceptions of Safety in Their Schools (TPSS)

TIMSSAdvanced 2008 Physics

Country	High TPSS		Medium TPSS		Low TPSS	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Iran, Islamic Rep. of	99 (0.6)	463 (7.3)	1 (0.0)	~ ~	0 (0.0)	~ ~
Norway	99 (0.7)	534 (4.2)	1 (0.0)	~ ~	0 (0.0)	~ ~
Sweden	94 (2.1)	499 (5.8)	6 (2.1)	471 (24.5)	0 (0.0)	~ ~
Netherlands	94 (2.7)	585 (3.3)	5 (2.4)	542 (28.5)	1 (0.0)	~ ~
Armenia	88 (0.4)	490 (6.0)	8 (0.4)	527 (7.9)	3 (0.1)	506 (10.7)
Slovenia	88 (0.1)	538 (1.9)	8 (0.1)	518 (8.5)	3 (0.0)	482 (12.7)
Lebanon	86 (1.5)	446 (3.1)	13 (1.5)	429 (8.2)	1 (0.3)	~ ~
Russian Federation	80 (3.6)	522 (10.2)	18 (3.5)	512 (24.4)	1 (1.0)	~ ~
Italy	80 (5.0)	431 (8.5)	16 (4.5)	396 (19.1)	4 (2.4)	404 (54.6)

SOURCE: IEA TIMSS Advanced 2008 ©

Based on teachers' responses to three statements about their schools: 1) This school is located in a safe neighborhood; 2) I feel safe at this school; 3) This school's security policies and practices are sufficient. Teachers' responses were averaged across the three statements based on a 4-point Likert scale: 1=Agree a lot; 2=Agree; 3=Disagree; 4=Disagree a lot. Students were assigned to the high level when their teachers agreed or agreed a lot with all three statements and to the low category when their teachers disagreed or disagreed a lot with all three. Students whose teachers provided other response combinations were assigned to the medium category.

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

A tilde (~) indicates insufficient data to report achievement.

behaviors were even minor problems according to principals. Forty-six percent of the physics students attended such "problem-free" schools in Italy, and 40 percent did in Sweden and Lebanon. Most notably, no more than 10 percent of the students in any country were in the low category; that is, attended schools where principals considered these student behaviors—including physical conflicts—to be widespread or serious problems. In Slovenia and Sweden, students in the schools with no behavior problems had higher achievement than their counterparts in schools with minor or major behavior problems. In Italy, the 7 percent of physics students in schools with serious problems had lower achievement than their counterparts in schools with fewer discipline problems.

Exhibit 12.4 presents the results of the Index of Physics Teachers' Perceptions of Safety in Their Schools. The index is based on physics teachers' responses to three statements pertaining directly to the safety of their schools:

- This school is located in a safe neighborhood
- I feel safe at this school
- The school's security policies and practices are sufficient.

Students were assigned to the high level when their teachers agreed with all three statements and to the low category when their teachers disagreed with all three. Students whose teachers provided other response combinations were assigned to the medium category. The results are presented according to the percentage of students in the high category from largest to smallest.

Nearly all teachers of physics students agreed that the schools offering courses in physics were safe. In Iran and Norway, 99 percent of the physics students were attending such schools and 94 percent were in Sweden and the Netherlands. From 86 to 88 percent of the physics

students were attending schools judged to be safe by their teachers in Armenia, Slovenia, and Lebanon, and 80 percent were in the Russian Federation and Italy. The pattern was for physics students in schools where teachers perceived "medium" safety concerns to have lower average achievement than their counterparts attending schools in the high category (except in Armenia).

Principals' and Teachers' Perceptions of School Climate

Beyond an orderly and safe environment, a positive school climate helps to build better morale among teachers and students, encourages students to learn, and creates an expectation for high levels of academic success, all of which lead to higher student achievement. TIMSS Advanced 2008 asked both school principals and teachers to characterize the climate of their school according to important indicators of an environment conducive to learning. The principals and the teachers were asked to rate each of the following school characteristics on a 4-point scale from *very high* to *very low*.

- Teachers' job satisfaction
- Teachers' understanding of the school's curricular goals
- Teachers' degree of success in implementing the school's curriculum
- Teachers' expectations for student achievement
- Parental support for student achievement
- Parental involvement in school activities
- Students' regard for school property
- Students' desire to do well in school.

Based on the responses provided by the principals and teachers, respectively, TIMSS Advanced created two comparable scales: the Index of Principals' Perception of School Climate and the Index of Physics Teachers' Perception of School Climate. In each case, physics students were assigned to the high level if their principals or teachers, respectively, averaged a *high* or *very high* rating on these aspects of school climate, and to the low level if their principals or teachers, respectively, averaged *low* or *very low*. Students in the medium category had principals or teachers with other response combinations.

Exhibit 12.5 presents the results for the Index of Principals' Perception of School Climate, including the percentage of students at each level of the index in each country, together with their average achievement in physics. The countries are ordered according to the percentage of students in the high category. In every country except Armenia, there was a positive association between a climate more supportive of student learning and higher average achievement in physics. In most of the other countries, average physics achievement was highest among students at the high level of the principals' perception of school climate index, next highest at the medium level, and lowest at the low level.

In Slovenia, Sweden, Norway, and the Russian Federation, 90 percent or more of the physics students were in schools whose principals reported learning climates categorized as high or medium. At least one fourth of the students were in schools with learning climates categorized as high in Slovenia, Lebanon, and Iran. Across countries, Italian and Dutch principals had the lowest perceptions of the climates in their schools. According to their principals, only 3 percent of the physics students in either country were in schools with climates categorized as high and, respectively, 34 percent and 25 percent were in schools with climates in the low category.

Exhibit 12.5 **Index of Principals' Perceptions of School Climate (PPSC)**

TIMSSAdvanced2008 Physics

Country	High PPSC		Medium PPSC		Low PPSC	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Slovenia	31 (0.2)	565 (3.1)	61 (0.2)	530 (2.3)	7 (0.2)	447 (4.8)
Lebanon	25 (1.8)	450 (5.3)	59 (2.0)	445 (4.0)	16 (1.4)	424 (5.9)
Iran, Islamic Rep. of	25 (4.0)	496 (16.4)	59 (5.2)	462 (9.9)	17 (3.7)	390 (8.9)
Sweden	15 (4.9)	523 (7.5)	77 (5.5)	496 (6.9)	7 (2.4)	464 (24.7)
Norway	14 (5.8)	545 (10.3)	79 (5.1)	534 (4.5)	6 (3.3)	524 (15.1)
Russian Federation	8 (2.2)	572 (28.9)	82 (3.6)	521 (10.6)	10 (2.8)	479 (35.3)
Italy	3 (2.6)	494 (8.7)	63 (5.4)	436 (9.1)	34 (5.4)	390 (12.4)
Netherlands	3 (2.1)	609 (8.3)	72 (5.1)	583 (4.0)	25 (5.1)	586 (7.7)
Armenia	2 (0.0)	~ ~	83 (0.4)	493 (6.2)	15 (0.4)	516 (7.6)

SOURCE: IEA TIMSS Advanced 2008 ©

Based on principals' responses to the following aspects of school climate in their schools: teachers' job satisfaction, teachers' opportunities for professional development, teachers' understanding of the school's curricular goals, teachers' degree of success in implementing the school's curriculum, teachers' expectations for student achievement, parental support for student achievement, parental involvement in school activities, students' regard for school property, and students' desire to do well in school. Average is computed across the nine statements based on a 5-point scale: 1 = Very High, 2 = High, 3 = Medium, 4 = Low, 5 = Very Low. High level indicates students whose principals' perception of their school climate was very positive (average is less than or equal to 2). Medium level indicates students whose principals' perception of their school climate was moderately positive (average is greater than 2 and less than 3). Low level indicates students whose principals' perception of their school climate was not so positive (average is greater than or equal to 3).

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

A tilde (~) indicates insufficient data to report achievement.

Exhibit 12.6 **Index of Physics Teachers' Perceptions of School Climate (TPSC)**

TIMSSAdvanced2008 Physics

Country	High TPSC		Medium TPSC		Low TPSC	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Lebanon	33 (2.0)	460 (4.5)	44 (2.2)	444 (4.4)	23 (1.8)	419 (6.3)
Iran, Islamic Rep. of	16 (3.3)	501 (16.6)	52 (5.0)	462 (9.9)	32 (4.2)	435 (13.9)
Slovenia	10 (0.2)	600 (8.0)	55 (0.3)	537 (1.8)	35 (0.3)	510 (3.8)
Sweden	9 (3.3)	524 (19.4)	58 (4.8)	505 (5.0)	33 (4.9)	477 (11.0)
Russian Federation	9 (2.7)	543 (30.0)	66 (4.1)	536 (11.1)	24 (4.1)	472 (22.5)
Norway	7 (2.3)	538 (18.6)	73 (3.6)	536 (4.9)	20 (3.4)	529 (9.1)
Armenia	7 (0.4)	479 (9.6)	58 (0.7)	487 (8.2)	35 (0.7)	508 (6.7)
Netherlands	2 (1.7)	~ ~	54 (6.3)	588 (4.9)	44 (6.3)	573 (6.1)
Italy	2 (1.5)	~ ~	46 (5.4)	429 (11.4)	52 (5.3)	420 (12.0)

SOURCE: IEA TIMSS Advanced 2008 ©

Based on teachers' responses to the following aspects of school climate in their schools: teachers' job satisfaction, teachers' understanding of the school's curricular goals, teachers' degree of success in implementing the school's curriculum, teachers' expectations for student achievement, support for teachers' professional development, parental support for student achievement, parental involvement in school activities, students' regard for school property, and students' desire to do well in school. Average is computed across the nine statements based on a 5-point scale: 1 = Very High, 2 = High, 3 = Medium, 4 = Low, 5 = Very Low. High level indicates students whose teachers' perception of their school climate was very positive (average is less than or equal to 2). Medium level indicates students whose teachers' perception of their school climate was moderately positive (average is greater than 2 and less than 3). Low level indicates students whose teachers' perception of their school climate was not so positive (average is greater than or equal to 3).

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

A tilde (~) indicates insufficient data to report achievement.

Exhibit 12.6 presents the results for the Index of Physics Teachers' Perceptions of School Climate and, in general, they correspond to the results for the Index of Principals' Perceptions of School Climate shown above. Similar to the findings for the principals' index of school climate, average achievement in physics was positively related to teachers' perceptions of school climate in all of the countries, with the exception of Armenia.

The three countries with the highest percentages of physics students in the high category according to their teachers are the same as they were according to principals—Lebanon, Iran, and Slovenia—even though Slovenian teachers (10 percent of physics students in the high category) were quite a bit less positive about their school climates than were the Slovenian principals (31 percent in the high category). According to teachers in Iran, Slovenia, Sweden, and Armenia, about one third of the physics students were in schools categorized as low, and even greater percentages were in the Netherlands (44%) and Italy (52%).

As an additional indication of whether the school had an environment supportive of high academic learning, principals were asked whether these schools that were offering courses in physics had policies for encouraging students to choose physics courses. Exhibit 12.7 presents the results for each country for the percent of students in schools with physics courses that specifically encouraged students to study physics. Average achievement in physics is shown for schools with such policies and for schools that did not have such policies.

The majority of the students were in schools expressly encouraging students to study physics in Iran (73%), the Russian Federation (69%), Lebanon (63%), and Armenia (57%). Sweden was at the other end of the continuum, where none of the schools had such a policy, presumably because, as explained in Exhibit 7.1, choices about studying physics

Exhibit 12.7 **Schools' Policies for Encouraging Students to Study Physics**

TIMSSAdvanced 2008 Physics

Country	School Has Policy		School Does Not Have Policy	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	57 (0.8)	487 (5.2)	43 (0.8)	510 (12.0)
Iran, Islamic Rep. of	73 (4.5)	468 (8.9)	27 (4.5)	433 (13.1)
Italy	40 (6.1)	423 (14.4)	60 (6.1)	421 (10.4)
Lebanon	63 (2.1)	442 (4.1)	37 (2.1)	441 (4.9)
Netherlands	26 (5.4)	584 (6.7)	74 (5.4)	585 (3.7)
Norway	30 (5.5)	534 (5.5)	70 (5.5)	535 (5.1)
Russian Federation r	69 (4.3)	535 (13.3)	31 (4.3)	488 (23.0)
Slovenia	36 (0.2)	537 (3.0)	64 (0.2)	534 (2.3)
Sweden	0 (0.0)	~ ~	100 (0.0)	498 (5.7)

SOURCE: IEA TIMSS Advanced 2008 ©

Data provided by schools.

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

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates data are available for at least 70% but less than 85% of the students.

are left to the students. Across the eight countries where some of the schools with students enrolled in physics had "encouraging" policies and others did not, there was no relationship with average achievement in five countries. In Armenia, students in schools with such policies had lower average achievement—perhaps the underlying reason for the policy of encouragement. In Iran and the Russian Federation, the students in schools with specific policies had higher achievement.

School Resources and Technology

The last section of this chapter presents information about the resources available in schools providing instruction to the TIMSS Advanced students in physics. Curriculum implementation can be made easier by ready access to the facilities, materials, and equipment necessary to achieve the specified learning goals. Results from successive TIMSS assessments indicate that fourth and eighth grade students attending schools that are well resourced generally have higher achievement than those in schools where shortages of resources affect teachers' capacity to implement the curriculum. In addition to schools' reports about the adequacy of general resources and resources particularly targeted to physics instruction, this section includes data about school availability of computers and Internet access for final year students.

To gather information about whether the lack of availability of school resources had an adverse impact on instruction in physics, principals were asked the degree to which shortages or inadequacies in six general areas affected their school's capacity to provide instruction: instructional materials (textbooks, for example); budget for supplies (paper, pencils, etc.); school buildings and grounds; heating/cooling and lighting systems; instructional space (classrooms, for example); and special equipment for students with disabilities. Principals also responded to questions about whether shortages or inadequacies in five

resource areas specifically pertaining to physics instruction affected their school's capacity to provide instruction: computers for physics instruction; computer software for physics instruction; calculators for physics instruction; library materials relevant to physics instruction; and audio-visual resources for physics instruction. Responses to both types of questions were provided on a 4-point scale: *no*, *a little*, *some*, and *a lot*. TIMSS Advanced created two indices based on principals' responses to the two groups of questions about school resource shortages—one concerning shortages in general areas and the other concerning shortages in resources specifically related to physics instruction.

To create the Index of Adequacy of General School Resources, principals' responses were averaged across the six questions about shortages in general resources, and to create the Index of Adequacy of Resources Specifically for Physics Instruction, principals' responses were averaged across the five questions about shortages in resources pertaining specifically to physics instruction. For each of the two indices, students were placed in the high category if principals responded that shortages in resources affected the capacity to provide instruction only a little, if at all (average less than 2). In contrast, students were placed in the low category if principals responded that resource shortages had considerable impact on the schools' capacity to provide instruction (i.e., across all resource areas to some degree and/or shortages in several areas adversely affected instruction a lot (average 3 or higher)). Students in the medium category were in schools where the capacity to provide instruction was somewhat adversely affected by the lack of some resources.

Exhibit 12.8 displays the results for the Index of Adequacy of General School Resources for each country ordered by the percentage of student in the high category. As would be anticipated based on

the range in the economic indicators for the participating countries, there was some variability in the principals' responses across countries. Nevertheless, according to their principals, the majority of students studying physics in their final year of secondary school were in schools where shortages in general resources had little or no impact on instruction. Approximately three fourths (74 to 75%) of the students studying physics attended schools in the high category in Armenia, Sweden, and the Russian Federation, as did 70 percent of the Norwegian students. Approximately three fifths (59 to 64%) of the students attended schools generally well-resourced in the Netherlands, Lebanon, Slovenia, Italy, and Iran. Slovenia and Iran had the strongest relationship between adequacy of general resources and average achievement in physics.

Exhibit 12.9 shows the results for the Index of Adequacy of Resources Specifically for Physics Instruction. There was more variability in the results for resources specifically for physics instruction than for general school resources. In a number of the TIMSS Advanced 2008 countries, principals reported more adverse affects on instruction from shortages in resources specifically for physics instruction than from shortages in general resources. Because the physics related resource areas primarily were technology related (i.e., computer hardware and software, calculators, and audio-visual resources), it makes sense that schools would have more difficulty keeping up-to-date in these areas. Sweden (79%), Norway (70%), and the Netherlands (68%) reported the largest percentages of physics students to be in schools well-resourced in physics-related instructional materials and equipment. In contrast, from 23 to 25 percent of the physics students in Lebanon and Iran were in the low category for physics instructional resources as were 18 percent in Armenia and 14 percent in the Russian Federation.

Exhibit 12.8 Index of Adequacy of General School Resources (Shortages Do Not Affect Capacity to Provide Instruction) (AGSR)

TIMSSAdvanced2008 Physics

Country	High AGSR		Medium AGSR		Low AGSR	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	75 (0.5)	493 (6.4)	17 (0.3)	488 (8.7)	9 (0.3)	521 (20.4)
Sweden	74 (6.2)	496 (7.4)	23 (5.9)	504 (10.0)	3 (2.0)	493 (51.3)
Russian Federation	74 (4.1)	515 (10.9)	21 (3.8)	556 (21.4)	5 (2.1)	481 (6.9)
Norway	70 (5.0)	533 (5.0)	29 (5.0)	539 (6.5)	1 (0.4)	~ ~
Netherlands	64 (5.1)	582 (4.0)	35 (4.8)	590 (5.7)	2 (1.1)	~ ~
Lebanon	62 (2.3)	443 (4.0)	27 (2.1)	444 (5.5)	11 (1.4)	443 (8.8)
Slovenia	61 (0.2)	541 (2.3)	28 (0.2)	524 (3.3)	11 (0.2)	527 (5.1)
Italy	61 (6.4)	426 (8.3)	34 (6.1)	410 (13.8)	6 (2.1)	454 (24.0)
Iran, Islamic Rep. of	59 (5.1)	471 (10.7)	29 (4.6)	451 (15.2)	12 (3.3)	415 (13.1)

SOURCE: IEA TIMSS Advanced 2008 ©

Based on principals' responses to how much the school's capacity to provide instruction is affected by shortages or inadequacies of the following: instructional materials (e.g., textbooks), budget for supplies (e.g., paper, pencils), school buildings and grounds, heating/cooling and lighting systems, instructional space (e.g., classrooms), and special equipment for students with disabilities. Principals' responses were averaged across the six statements based on a 4-point scale: 1 = No, 2 = A little, 3 = Some, 4 = A lot. Students were placed in the high category if principals responded that shortages in general resources affected only a little, if at all (average is less than 2). Students were placed in the low category if principals responded that shortages in all the general resource areas had some adverse affect on capacity to provide instruction and/or shortages in several general resource areas adversely affected instruction a lot (average is greater than or equal to 3). Students in the medium category were in schools where the capacity to provide instruction was adversely affected somewhat by the lack of general resources (average is greater than or equal to 2 and less than 3).

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

A tilde (~) indicates insufficient data to report achievement.

Exhibit 12.9 Index of Adequacy of Resources Specifically for Physics Instruction (Shortages Do Not Affect Capacity to Provide Instruction) (ARPI)

TIMSSAdvanced2008 Physics

Country	High ARPI		Medium ARPI		Low ARPI	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Sweden	79 (4.2)	502 (6.1)	17 (4.4)	482 (16.0)	4 (2.1)	483 (35.0)
Norway	70 (6.4)	537 (4.5)	29 (6.4)	531 (6.5)	1 (0.4)	~ ~
Netherlands	68 (4.6)	586 (4.0)	31 (4.5)	582 (5.1)	2 (1.2)	~ ~
Slovenia	57 (0.2)	538 (3.0)	36 (0.2)	538 (2.8)	7 (0.1)	490 (4.0)
Italy	52 (6.1)	422 (10.4)	42 (5.8)	422 (12.2)	6 (2.4)	420 (37.5)
Russian Federation	46 (4.2)	521 (15.6)	40 (4.5)	526 (14.6)	14 (3.3)	514 (18.9)
Lebanon	45 (2.1)	447 (4.7)	31 (2.4)	444 (6.0)	23 (2.4)	434 (6.8)
Armenia	38 (0.8)	511 (11.7)	44 (0.7)	486 (6.5)	18 (0.4)	482 (7.5)
Iran, Islamic Rep. of	32 (4.3)	484 (14.0)	43 (5.0)	454 (10.2)	25 (3.9)	434 (14.3)

SOURCE: IEA TIMSS Advanced 2008 ©

Based on principals' responses to how much the school's capacity to provide physics instruction is affected by shortage or inadequacy of the following: physics laboratory equipment and materials, computers for physics instruction, computer software for physics instruction, calculators for physics instruction, library materials relevant to physics instruction, audio-visual resources for physics instruction. Average is computed across the six responses based on a 4-point scale: 1 = No, 2 = A little, 3 = Some, 4 = A lot. High Level indicates that instruction is not affected or affected a little by a shortage of resources (average is less than 2). Medium level indicates that instruction is affected some by a shortage of resources (average is greater than or equal to 2 and less than 3). Low level indicates that instruction is affected a lot by a shortage of resources (average is greater than or equal to 3).

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

A tilde (~) indicates insufficient data to report achievement.

Exhibit 12.10 presents information about the degree to which schools offering physics courses in the final year of secondary school had computers and access to the Internet. The first data column for each country provides the average number of computers per school available for use by final year students. Care should be taken in interpreting these results because these computers most likely are not for the exclusive use of final year students and could also be used by other students attending the schools, and the total number of students having access to computers most like varies considerably depending on such factors as the type of school and school enrollment.

Taking the above caveats into consideration, there still was a considerable range in the results. Sweden reported 221 computers per school, on average, available for use by final year students. The average number of computers per school available was closer to 100 in the Netherlands (91) and Norway (107). For the remaining countries, the averages dropped considerably to 59 in Italy, 43 in Slovenia, 30 in the Russian Federation, and 27 in Lebanon. The lowest averages were 15 computers per school on average in Armenia and 8 on average in Iran.

The remaining data columns in Exhibit 12.10 provide information about the percentages of physics students in each country attending schools where "all", "most", "some", or "none" of the school computers available for their use had Internet access, together with the average achievement for students in each category. In Italy, the Netherlands, Norway, Slovenia, and Sweden, 80 to 93 percent of the physics students were attending schools where all of the computers had Internet access, and (except for 4% in Italy) the rest of the students were in schools where most computers had Internet access. In these five countries, there was little difference in average physics achievement between schools with all computers having Internet access and schools with most computers having Internet access.

Exhibit 12.10 **Computer Availability and Internet Access in School**

TIMSSAdvanced2008 Physics

Country	Average Number of Computers Available for Use by Final Year Students	Internet Access for Educational Purposes							
		All Computers		Most Computers		Some Computers		No Computers	
		Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Armenia	15 (0.2)	40 (0.6)	516 (5.4)	19 (0.8)	496 (21.2)	16 (0.4)	470 (13.1)	25 (0.6)	477 (6.5)
Iran, Islamic Rep. of	8 (0.7)	33 (4.6)	475 (12.8)	8 (2.7)	536 (31.9)	29 (4.7)	456 (13.9)	29 (4.3)	423 (11.8)
Italy	59 (5.9)	82 (4.1)	421 (9.3)	14 (3.7)	427 (10.9)	2 (1.5)	~ ~	2 (1.6)	~ ~
Lebanon	27 (0.7)	34 (2.3)	462 (5.5)	15 (1.5)	456 (6.3)	22 (2.4)	447 (6.7)	29 (2.4)	419 (5.1)
Netherlands r	91 (5.3)	80 (3.9)	587 (4.0)	20 (3.9)	574 (6.4)	0 (0.0)	~ ~	0 (0.0)	~ ~
Norway	107 (8.9)	93 (2.4)	535 (4.3)	7 (2.4)	537 (8.7)	0 (0.0)	~ ~	0 (0.0)	~ ~
Russian Federation	30 (1.6)	51 (4.4)	520 (11.8)	31 (3.8)	526 (18.3)	16 (2.6)	511 (26.4)	1 (1.0)	~ ~
Slovenia	43 (0.2)	85 (0.2)	536 (1.9)	15 (0.2)	534 (6.1)	0 (0.0)	~ ~	0 (0.0)	~ ~
Sweden r	221 (29.2)	84 (5.5)	497 (7.0)	16 (5.5)	500 (15.3)	0 (0.0)	~ ~	0 (0.0)	~ ~

SOURCE: IEA TIMSS Advanced 2008 ©

Data provided by schools.

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

A tilde (~) indicates insufficient data to report achievement.

An "r" indicates data are available for at least 70% but less than 85% of the students.

In Iran and Lebanon, the two participating countries reporting the least Internet access in schools, one third of the physics students were in schools where all the computers had Internet access and a few more (8% and 15%, respectively) were in schools where most computers had Internet access. However, according to the last column in Exhibit 12.10, in Iran and Lebanon 29 percent of the physics students as well as 25 percent in Armenia attended schools where no computers had Internet access, and these students had lower average achievement than their counterparts in schools where all or most of the computers had Internet access.