

# Chapter 12



## *Creating the TIMSS 2007 Background Indices*

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### **12.1 Overview**

The TIMSS 2007 international reports (Martin, Mullis, & Foy, 2008; Mullis, Martin, & Foy, 2008) presented factors related to teaching and learning mathematics and science helpful in understanding the achievement results. To describe the educational context for mathematics and science achievement and to provide useful information to policy-makers, curriculum specialists, and researchers, data on hundreds of background variables were collected from students, teachers, schools, and National Research Coordinators (NRCs). These questionnaire data were summarized in a concise manner in the exhibits (pictures and tables) of the international reports to make them as accessible and useful as possible. One of the principal ways of doing this was through the computation of index variables, multiple-item indicators that combined data from several questions in the TIMSS 2007 questionnaires.

As described in Chapter 3, TIMSS contextual data were collected through four sets of questionnaires: student, teacher, school, and curriculum. The present chapter describes the TIMSS 2007 background indices used to summarize and report these data, and provides information on the reliability and validity of the scales underlying these indices.

### **12.2 Computing Background Indices**

In the TIMSS reports, an index is a composite variable that assigns students to one of three levels—high, medium, and low—on the basis of responses to a series of component variables. The high category of an index is defined in terms of the student responses (or those responses of teachers or school principals) that are expected to be most characteristic of a supportive learning environment, whereas the low category is defined in terms of the responses

expected to characterize the least supportive learning environment. The medium level is somewhere in between. The TIMSS indices are intended to describe factors fostering mathematics and science achievement in terms of responses to the questions that were actually asked, thereby preserving a high degree of direct interpretability.

As an example, the Index of Students' Perception of Being Safe in School (SPBSS) (described later in this chapter) groups students according to their reports of the frequency of incidents affecting their safety: 1) Something of mine was stolen; 2) I was hit or hurt by other student(s) (for example, shoving, hitting, kicking); 3) I was made to do things that I didn't want to do by other students; 4) I was made fun of or called names; and 5) I was left out of activities by other students. Students at the high level of the index (i.e., those that perceived school to be very safe) reported that no such incidents happened to them during the past month. In contrast, students at the low level of this index reported three or more such incidents.

TIMSS used two different methods to create composite scales: the combined response method and the scale method. The combined response method was used to directly classify cases into the high, medium, or low level of an index, depending on the combination of responses to the source questions. For example, the Index of Good Attendance at School (GAS) (described later in this chapter) classified students into the three index levels based on principals' reports on frequency of occurrence and seriousness of three aspects of attendance problems: 1) Arriving late at school; 2) Absenteeism (i.e., unjustified absences); and 3) Skipping class. Responses were assigned to the high level of the index if the school principal reported that all three behaviors either never occur or that they are not a serious problem. Responses were assigned to the low level if the principal indicated that two or more of the behaviors were a serious problem, or two behaviors were minor problems and a third behavior a serious problem. All other response combinations were assigned to the medium category. The scale method was used when the construct of interest had an underlying quantitative continuum. The index scores were computed by averaging the numerical values associated with each response option. Following this, students were assigned to the three levels based on cutoff points. This method often was employed for items that made use of Likert scale format (e.g., response options are *agree a lot* coded 1, *agree a little* coded 2, *disagree a little* coded 3, and *disagree a lot* coded 4). Examples of this type of index

are the measures of students' attitudes toward mathematics and science presented in Chapter 4 of the international reports.

Underlying each TIMSS background index was a scale made up of the component variables of the index. In constructing an index, it was important that the component variables of the underlying scale were intercorrelated so that together they formed a reliable scale and also that they were correlated to some extent with students' mathematics and science achievement. The process of identifying the response combinations that defined the high, medium, and low level of the index was informed by the relationship with achievement, but where possible these combinations were chosen based on a judgment of which responses could be expected to most effectively capture constructs describing environments supportive for learning mathematics and science.

### 12.3 Developing the Background Indices

Planning for reporting the questionnaire data and creating the TIMSS 2007 background indices began with a review of the questionnaires that had been administered in TIMSS 2007 and in previous TIMSS cycles. Staff at the TIMSS & PIRLS International Study Center identified TIMSS 2007 variables that also had been used in 2003, 1999, and 1995 to determine if they could be used to measure trends. They also checked to see if improvements could be made to indices developed in previous cycles by adding new items from the TIMSS 2007 questionnaires. Newly developed questions were reviewed in the context of the TIMSS 2007 framework to identify variables for creating new indices.

Countries following a Southern Hemisphere school year administered the TIMSS 2007 assessment at the end of 2006 (the end of their school year), and so data from some of these—Australia, Botswana, El Salvador, New Zealand, Malaysia, and Singapore— were available for use in exploratory analyses before the data from Northern Hemisphere countries became available. These exploratory analyses had three primary purposes: identifying new indices that could be created from variables added in the 2007 cycle, ensuring that indices used in previous cycles still performed similarly in 2007, and exploring the impact of improving indices created in previous cycles by adding extra component variables. These analyses used principal component analysis to explore the dimensionality of proposed indices using different combinations of variables, and also examined the reliability of each

underlying scale and the relationship between its component variables and mathematics and science achievement.

Based on the exploratory analyses, specifications were developed for the construction of all indices. These described the source variables to be used, how they should be recoded and combined, and how the resulting indices should be presented in the international reports. The analysis specifications guided the programmers and production staff who implemented these analyses and created exhibits for the international reports, and were made available to NRCs to aid their reviews of the exhibits. The final report exhibits were produced using custom-designed SAS programs that calculated student achievement averages using all five imputed scores (plausible values) for each student, including standard errors calculated using the jackknife procedure (see Chapter 11).

Representatives from participating countries had several opportunities to review proposed exhibits and make suggestions for additions and modifications. The draft exhibits first were reviewed in conjunction with the TIMSS 2007 international reports outline, background data almanacs, and analysis notes, at the seventh NRC meeting in Salzburg, Austria in December 2007. Based on NRCs' comments, the exhibits and data were further refined for a second review at the eighth NRC meeting in Gaborone, Botswana in June 2008. At this meeting, NRCs were provided with a draft of the TIMSS 2007 international reports containing complete versions of the report exhibits. NRCs approved these final exhibits, including index definitions.

As a final step, all indices were made available for secondary analysis as part of the TIMSS 2007 International Database. Supplement 3 of the *TIMSS 2007 User Guide for the International Database* (Foy & Olson, 2009) provides a detailed description of all indices included in the international database.

Background indices were presented throughout Chapters 4–8 of the TIMSS 2007 international reports. In all these exhibits, the student was the unit of analysis even if the information had been supplied by teachers or principals. Results always were presented in terms of the percentage of students possessing a particular characteristic. This approach presents the data from the perspective of students' educational experiences and is consistent with the TIMSS sampling and assessment design. In many exhibits, the average mathematics or science achievement of the students at each index level also was presented.

Since one of the major benefits of TIMSS is the ability to measure trends over time, background indices, which spanned across assessment cycles (1995, 1999, 2003, and 2007), were included whenever possible. In these exhibits, for example, the change from 2003 in the percentage of students at each index level was displayed for countries that participated in the 2003 assessment, with an arrow indicating if the percent in 2007 was significantly higher or lower.

#### **12.4 Reliability and Validity of Background Indices**

In this section, the composition of each index variable reported in the TIMSS 2007 international reports is briefly described and indicators of reliability and validity for the component variables of these indices are presented. The reliability of the underlying scales is assessed using Cronbach's alpha, and the relationship with achievement is summarized by the multiple correlation between the component variables of the scales underlying the indices and achievement (multiple R), and the percent of variance in achievement accounted for by the component variables (R-square). These statistics provide a sense of how well the component variables are related to mathematics and science achievement, which is an aspect of the validity of the index. In addition, confirmatory factor analysis was used to examine the dimensionality of the scales underlying the indices and to present a latent trait measurement model of each scale and its component variables.

In the exhibits in this chapter, reliability and validity indicators are presented for each TIMSS 2007 participant, together with the median indicator across countries. Indicators are presented separately for mathematics and science at fourth and eighth grades. For countries teaching science as a single integrated subject, a single index was created for each science exhibit. For countries where the sciences are taught as separate subjects (biology, earth science, chemistry, and physics) at the eighth grade, students were asked separately about each subject. Thus, separate indices were created for each science subject, and the reliability and validity indicators for separate science countries are presented in a separate panel (e.g., Exhibit 12.1).

The factor analyses were conducted using the Mplus software package (Muthén & Muthén, 2007). Mplus was chosen because of its ability to model complex survey data and use information efficiently in the presence of missing data. The Mplus analyses reported in this chapter were conducted

using a variation of the TIMSS sampling weight (SENWGT; see Foy & Olson, 2009) that weights each country equally, while taking into account the complex TIMSS sampling design and correcting for unequal selection probabilities as necessary. The analyses were conducted using data from 49 countries at the eighth grade and 36 countries at the fourth grade. The benchmarking participants were not included in the analyses.

#### 12.4.1 Student-level Indices

In the *TIMSS 2007 Student Questionnaire*, students were asked about their home environments and school experiences, and their attitudes toward mathematics and science. At the fourth grade, two indices were constructed representing different aspects of students' attitudes toward mathematics and science: positive affect and self-confidence. An index of time students spend on homework in mathematics and science and an index of students' perceptions of being safe in school also were constructed at the fourth grade. At the eighth grade, three indices were constructed representing three aspects of students' attitudes toward mathematics and science: positive affect, self-confidence, and valuing the subject. The eighth grade also included an index of time students spend on homework in mathematics and science and an index of students' perceptions of being safe in school. Reliability and validity indicators for the attitudinal indices are presented in Exhibits 12.1 to 12.3. The results from confirmatory factor analysis, representing further evidence of the validity of the TIMSS attitude scales, are presented in Exhibit 12.4.

The Index of Students' Positive Affect Toward Mathematics (PATM) and the Index of Students' Positive Affect Toward Science (PATS) examined students' general affect toward mathematics and science. The index was presented in Exhibit 4.8 of the TIMSS 2007 international reports. The exhibit shows trends from 1995 at the fourth grade, and from 1995 and 1999 at the eighth grade (comparable data were not available from 2003).

For mathematics the index is based on students' responses to three statements about mathematics: 1) I enjoy learning mathematics; 2) Mathematics is boring; and 3) I like mathematics. For science the index is based on students' responses to three statements about science: 1) I enjoy learning science; 2) Science is boring; and 3) I like science. The negatively worded statements "mathematics is boring" and "science is boring" were reverse coded. An average was computed across the three items based on a 4-point scale: *agree a lot* = 1, *agree a little* = 2, *disagree a little* = 3, and *disagree a lot* = 4. A high level indicates an average score of less than or equal to 2, corresponding to students agreeing a little or a lot, on average. A low

level indicates an average score equal to or greater than 3, corresponding to students disagreeing a little or a lot, on average. A medium level indicates an average score of greater than 2 but less than 3. For countries that taught biology, earth science, chemistry, and physics as separate subjects at the eighth grade, the questions were asked about each individual science subject, and students responded with respect to each science course they were taking. Thus, separate indices were created for each science subject and the reliability and validity indicators for separate science countries are presented in a separate panel for eighth grade in Exhibit 12.1.

A similar index of students' general attitudes toward mathematics and science was presented in the TIMSS 1999 international reports (Martin, M.O., Mullis, I.V.S., Gonzales, E.J., Gregory, K.D., Smith, T.A., Chrostowski, S.J., Garden, R.A., & O'Connor, K.M., 2000; Mullis, I.V.S., Martin, M.O., Gonzales, E.J., Gregory, K.D., Garden, R.A., O'Connor, K.M., Chrostowski, S.J., & Smith, T.A., 2000), including two more variables. For mathematics these were "mathematics is important to everyone's life" and "I would like a job that involved using mathematics", which were not part of the *TIMSS 2007 Student Questionnaire*. Thus, the percentage of students at each index level in 1999 was recomputed based on the TIMSS 2007 index definition.

The three index components also were part of the *TIMSS 1995 Student Questionnaire*. At the eighth grade the *TIMSS 1995 Student Questionnaire*, however, asked about physical science and not about chemistry and physics. Thus, the same data were presented in the "difference in percent from 1995" column of the physics and chemistry panels in the *TIMSS 2007 International Science Report*.

As shown in Exhibit 12.1, the three component variables (statements) form a fairly reliable scale, with median reliability coefficients (Cronbach's alpha) across countries of 0.82 and 0.81 for mathematics and science, respectively, at the fourth grade, and 0.81 and 0.78, respectively, at the eighth grade. At the fourth grade, the median multiple correlation between the three component variables and student achievement was 0.18 for mathematics and 0.16 for science, corresponding to an R-square of 0.03 in each case, after rounding. At the eighth grade, the median multiple correlation between the three component variables and student achievement was 0.28 for mathematics and 0.24 for general science, corresponding to R-squares of 0.08 and 0.06, respectively. For the separate sciences, the reliabilities were similar to those for general science, although the correlations were somewhat lower, with the median multiple correlations ranging between 0.12 and 0.15, corresponding to R-squares between 0.01 and 0.02.

**Exhibit 12.1 Index of Students' Positive Affect Toward Mathematics (PATM) / Science (PATS)—Reliability and Validity Indicators**

Countries	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.42	0.42	0.32	0.30	0.10	0.09	0.66	—	0.29	—	0.09	—
Armenia	0.61	0.65	0.11	0.16	0.01	0.02	0.73	—	0.14	—	0.02	—
Australia	0.85	0.86	0.18	0.15	0.03	0.02	0.85	0.88	0.27	0.24	0.07	0.06
Austria	0.85	0.82	0.17	0.16	0.03	0.03	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	0.81	0.78	0.21	0.18	0.05	0.03
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	0.85	—	0.23	—	0.05	—
Botswana	◇	◇	◇	◇	◇	◇	0.69	0.65	0.32	0.45	0.10	0.20
Bulgaria	◇	◇	◇	◇	◇	◇	0.83	—	0.20	—	0.04	—
Chinese Taipei	0.83	0.78	0.28	0.22	0.08	0.05	0.89	0.88	0.49	0.39	0.24	0.15
Colombia	0.50	0.47	0.31	0.32	0.10	0.10	0.71	0.69	0.13	0.17	0.02	0.03
Cyprus	◇	◇	◇	◇	◇	◇	0.83	—	0.34	—	0.11	—
Czech Republic	0.84	0.85	0.16	0.08	0.03	0.01	0.84	—	0.30	—	0.09	—
Denmark	0.85	0.88	0.05	0.13	0.00	0.02	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	0.62	0.60	0.24	0.30	0.06	0.09
El Salvador	0.47	0.41	0.31	0.33	0.10	0.11	0.69	0.64	0.25	0.29	0.06	0.08
England	0.87	0.88	0.12	0.09	0.01	0.01	0.86	0.88	0.22	0.27	0.05	0.07
Georgia	0.57	0.64	0.26	0.19	0.07	0.04	0.73	—	0.24	—	0.06	—
Germany	0.83	0.82	0.14	0.15	0.02	0.02	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	0.45	0.39	0.34	0.40	0.12	0.16
Hong Kong SAR	0.87	0.83	0.28	0.24	0.08	0.06	0.86	0.85	0.36	0.28	0.13	0.08
Hungary	0.86	0.86	0.16	0.17	0.03	0.03	0.84	—	0.33	—	0.11	—
Indonesia	◇	◇	◇	◇	◇	◇	0.66	—	0.22	—	0.05	—
Iran, Islamic Rep. of	0.74	0.76	0.35	0.35	0.12	0.12	0.80	0.80	0.29	0.17	0.09	0.03
Israel	◇	◇	◇	◇	◇	◇	0.82	0.82	0.10	0.20	0.01	0.04
Italy	0.82	0.81	0.16	0.15	0.02	0.02	0.86	0.85	0.30	0.20	0.09	0.04
Japan	0.84	0.83	0.29	0.16	0.08	0.03	0.84	0.85	0.39	0.30	0.15	0.09
Jordan	◇	◇	◇	◇	◇	◇	0.75	0.75	0.29	0.21	0.08	0.04
Kazakhstan	0.55	0.56	0.25	0.19	0.06	0.04	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	0.89	0.88	0.47	0.39	0.22	0.15
Kuwait	0.57	0.54	0.28	0.35	0.08	0.12	0.81	0.77	0.20	0.15	0.04	0.02
Latvia	0.81	0.81	0.12	0.05	0.02	0.00	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.69	—	0.27	—	0.07	—
Lithuania	0.81	0.80	0.24	0.12	0.06	0.02	0.77	—	0.36	—	0.13	—
Malaysia	◇	◇	◇	◇	◇	◇	0.82	0.81	0.30	0.26	0.09	0.07
Malta	◇	◇	◇	◇	◇	◇	0.87	—	0.27	—	0.07	—
Morocco	0.47	0.44	0.28	0.35	0.08	0.13	0.64	—	0.29	—	0.09	—
Netherlands	0.89	0.92	0.09	0.10	0.01	0.01	◇	◇	◇	◇	◇	◇
New Zealand	0.82	0.82	0.12	0.23	0.01	0.05	◇	◇	◇	◇	◇	◇
Norway	0.88	0.89	0.10	0.14	0.01	0.02	0.88	0.90	0.30	0.17	0.09	0.03
Oman	◇	◇	◇	◇	◇	◇	0.66	0.59	0.37	0.35	0.14	0.12
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.69	0.67	0.27	0.25	0.07	0.06
Qatar	0.62	0.62	0.32	0.28	0.10	0.08	0.81	0.74	0.15	0.14	0.02	0.02
Romania	◇	◇	◇	◇	◇	◇	0.81	—	0.23	—	0.05	—
Russian Federation	0.73	0.75	0.24	0.16	0.06	0.03	0.81	—	0.28	—	0.08	—
Saudi Arabia	◇	◇	◇	◇	◇	◇	0.72	0.70	0.15	0.21	0.02	0.05
Scotland	0.85	0.86	0.06	0.11	0.00	0.01	0.86	0.87	0.18	0.33	0.03	0.11
Serbia	◇	◇	◇	◇	◇	◇	0.86	—	0.31	—	0.10	—
Singapore	0.87	0.84	0.21	0.22	0.04	0.05	0.88	0.86	0.33	0.30	0.11	0.09
Slovak Republic	0.80	0.78	0.17	0.16	0.03	0.03	◇	◇	◇	◇	◇	◇
Slovenia	0.83	0.83	0.17	0.14	0.03	0.02	0.84	—	0.25	—	0.06	—
Sweden	0.88	0.87	0.05	0.13	0.00	0.02	0.88	—	0.34	—	0.11	—
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.71	—	0.28	—	0.08	—
Thailand	◇	◇	◇	◇	◇	◇	0.73	0.69	0.25	0.18	0.06	0.03
Tunisia	0.37	0.41	0.44	0.44	0.20	0.20	0.76	0.71	0.30	0.18	0.09	0.03
Turkey	◇	◇	◇	◇	◇	◇	0.76	0.74	0.31	0.18	0.10	0.03
Ukraine	0.75	0.77	0.24	0.19	0.06	0.03	0.82	—	0.23	—	0.05	—
United States	0.85	0.85	0.14	0.14	0.02	0.02	0.86	0.86	0.24	0.20	0.06	0.04
Yemen	0.27	0.37	0.18	0.28	0.03	0.08	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.82</b>	<b>0.81</b>	<b>0.18</b>	<b>0.16</b>	<b>0.03</b>	<b>0.03</b>	<b>0.81</b>	<b>0.78</b>	<b>0.28</b>	<b>0.24</b>	<b>0.08</b>	<b>0.06</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.85	0.85	0.18	0.11	0.03	0.01	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.86	0.85	0.34	0.28	0.12	0.08
British Columbia, Canada	0.85	0.87	0.16	0.10	0.03	0.01	0.85	0.88	0.31	0.25	0.10	0.06
Dubai, UAE	0.75	0.76	0.16	0.27	0.03	0.07	0.84	0.82	0.22	0.22	0.05	0.05
Massachusetts, US	0.87	0.87	0.18	0.12	0.03	0.01	0.87	0.87	0.26	0.20	0.07	0.04
Minnesota, US	0.85	0.85	0.16	0.10	0.02	0.01	0.86	0.87	0.30	0.27	0.09	0.07
Ontario, Canada	0.87	0.87	0.17	0.13	0.03	0.02	0.86	0.87	0.32	0.29	0.10	0.08
Quebec, Canada	0.85	0.86	0.20	0.16	0.04	0.03	0.88	0.90	0.27	0.18	0.07	0.03

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007



**Exhibit 12.1 Index of Students' Positive Affect Toward Mathematics (PATM) / Science (PATS)—Reliability and Validity Indicators (Continued)**

Countries	Grade 8 Separate Science											
	Cronbach's Alpha Between the Component Variables				Multiple R Between Student Achievement and Component Variables				Percent of Variance in Student Achievement Accounted for by the Component Variables			
	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics
Algeria	0.64	0.61	0.64	0.66	0.17	0.13	0.15	0.14	0.03	0.02	0.02	0.02
Armenia	0.70	0.67	0.68	0.68	0.08	0.07	0.07	0.12	0.01	0.01	0.01	0.01
Bosnia and Herzegovina	0.84	0.83	0.83	0.80	0.05	0.04	0.05	0.08	0.00	0.00	0.00	0.01
Bulgaria	0.78	0.75	0.78	0.74	0.19	0.19	0.18	0.17	0.04	0.04	0.03	0.03
Cyprus	0.19	0.82	0.81	0.79	0.26	0.11	0.19	0.25	0.07	0.01	0.04	0.06
Czech Republic	0.85	0.85	0.86	0.84	0.06	0.08	0.05	0.12	0.00	0.01	0.00	0.02
Georgia	0.73	0.64	0.71	0.71	0.19	0.13	0.14	0.18	0.04	0.02	0.02	0.03
Hungary	0.87	0.87	0.85	0.83	0.03	0.07	0.06	0.15	0.00	0.00	0.00	0.02
Indonesia	0.62	–	–	0.65	0.22	–	–	0.24	0.05	–	–	0.06
Lebanon	0.68	–	0.67	0.67	0.27	–	0.19	0.16	0.08	–	0.04	0.03
Lithuania	0.81	0.79	0.78	0.76	0.06	0.08	0.12	0.14	0.00	0.01	0.01	0.02
Malta	0.88	0.88	0.88	0.88	0.34	0.16	0.32	0.21	0.12	0.03	0.10	0.04
Morocco	0.59	0.62	0.64	0.64	0.27	0.19	0.28	0.27	0.07	0.04	0.08	0.07
Romania	0.80	0.81	0.79	0.75	0.09	0.14	0.09	0.07	0.01	0.02	0.01	0.00
Russian Federation	0.82	0.81	0.81	0.79	0.03	0.09	0.10	0.15	0.00	0.01	0.01	0.02
Serbia	0.85	0.85	0.85	0.81	0.08	0.04	0.09	0.08	0.01	0.00	0.01	0.01
Slovenia	0.87	0.87	0.87	0.83	0.09	0.12	0.21	0.15	0.01	0.01	0.05	0.02
Sweden	0.88	0.87	0.88	0.86	0.17	0.12	0.22	0.22	0.03	0.02	0.05	0.05
Syrian Arab Republic	0.62	0.63	0.67	0.65	0.23	0.19	0.17	0.19	0.05	0.03	0.03	0.04
Ukraine	0.80	0.79	0.82	0.79	0.10	0.09	0.12	0.12	0.01	0.01	0.01	0.01
International Median	0.80	0.81	0.81	0.78	0.14	0.12	0.14	0.15	0.02	0.01	0.02	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◊) indicates the country did not participate in the assessment.

A dash (–) indicates comparable data are not available or country administered separate science version of the student questionnaire.

The Index of Students' Self-Confidence in Learning Mathematics (SCM) and the Index of Students' Self-Confidence in Learning Science (SCS) examined how students think about their abilities in mathematics and science. The index, first developed in 2003, is presented with trends in Exhibit 4.10 of the TIMSS 2007 international reports. In addition, Exhibit 4.11 reports the percentage of students at each index level by gender.

For mathematics, the index is based on students' responses to four statements about mathematics: 1) I usually do well in mathematics; 2) I learn things quickly in mathematics; 3) Mathematics is more difficult for me than for many of my classmates (eighth grade version) and mathematics is harder for me than for many of my classmates (fourth grade version); and 4) Mathematics is not one of my strengths (eighth grade version) and I'm just not good at mathematics (fourth grade version). For science the index is based on students' responses to four statements about science: 1) I usually do well in science; 2) I learn things quickly in science; 3) Science is more difficult for me than for many of my classmates (eighth grade version) and science is harder for me than for many of my classmates (fourth grade version); and 4) Science is not one of my strengths (eighth grade version) and I'm just not good at science (fourth grade version). The two negatively worded statements were reverse coded.

An average was computed across the four items based on a 4-point scale: *agree a lot* = 1, *agree a little* = 2, *disagree a little* = 3, and *disagree a lot* = 4. A high level indicates an average score of less than or equal to 2, corresponding to students agreeing a little or a lot, on average. A low level indicates an average score equal to or greater than 3, corresponding to students disagreeing a little or a lot, on average. A medium level indicates an average score of greater than 2 but less than 3. For countries that taught biology, earth science, chemistry, and physics as separate subjects at the eighth grade, the questions were asked about each individual science subject, and students responded with respect to each science course they were taking. Thus, separate indices were created for each science subject, and the reliability and validity indicators for separate science countries are presented in a separate panel for eighth grade in Exhibit 12.2.

As shown in Exhibit 12.2, the four component variables (statements) form a fairly reliable scale, with median reliability coefficients (Cronbach's alpha) across countries of 0.72 for both mathematics and science at the

fourth grade and 0.73 and 0.66, respectively, at the eighth grade. At the fourth grade, the median multiple correlation between the four component variables and student achievement was 0.43 for mathematics and 0.31 for science, corresponding to R-squares of 0.18 and 0.10, respectively. At the eighth grade, the median multiple correlation between the four component variables and student achievement was 0.46 for mathematics and 0.37 for general science, corresponding to R-squares of 0.21 and 0.14, respectively. For the separate sciences, the reliabilities were similar, but the correlations were somewhat lower than for general science, with the median multiple correlations ranging between 0.28 and 0.33, corresponding to R-squares between 0.08 and 0.11.

The Index of Students' Valuing Mathematics (SVM) and the Index of Students' Valuing Science (SVS) summarize eighth grade students' reports of their motivation to learn and their perception of mathematics and science as advantageous for their future lives. There was not a comparable index at fourth grade. The index, modified from the 2003 index, is presented in Exhibit 4.9 of the TIMSS 2007 international reports, including trends from 2003.

For mathematics, the index is based on eighth grade students' responses to four statements about mathematics: 1) I think learning mathematics will help me in my daily life; 2) I need mathematics to learn other school subjects; 3) I need to do well in mathematics to get into the university of my choice; and 4) I would like to do well in mathematics to get the job I want. For science the index is based on students' responses to four similar statements about science: 1) I think learning science will help me in my daily life; 2) I need science to learn other school subjects; 3) I need to do well in science to get into the university of my choice; and 4) I would like to do well in science to get the job I want. An average was computed across the four items based on a 4-point scale: *agree a lot* = 1, *agree a little* = 2, *disagree a little* = 3, and *disagree a lot* = 4. A high level indicates an average score of less than or equal to 2, corresponding to students agreeing with the statements a little or a lot, on average. A low level indicates an average score equal to or greater than 3, corresponding to students disagreeing a little or a lot, on average. A medium level indicates an average score of greater than 2 but less than 3. For countries that taught biology, earth science, chemistry, and physics as separate subjects at the eighth grade, the questions were asked about each individual science

**Exhibit 12.2 Index of Students' Self-Confidence in Learning Mathematics (SCM) / Science (SCS)—Reliability and Validity Indicators**

Countries	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.36	0.41	0.28	0.27	0.08	0.08	0.54	—	0.44	—	0.20	—
Armenia	0.60	0.61	0.17	0.17	0.03	0.03	0.66	—	0.21	—	0.04	—
Australia	0.75	0.74	0.46	0.27	0.22	0.07	0.81	0.81	0.55	0.37	0.30	0.14
Austria	0.78	0.75	0.47	0.34	0.22	0.12	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	0.67	0.58	0.51	0.46	0.26	0.21
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	0.78	—	0.51	—	0.27	—
Botswana	◇	◇	◇	◇	◇	◇	0.46	0.43	0.29	0.36	0.09	0.13
Bulgaria	◇	◇	◇	◇	◇	◇	0.70	—	0.42	—	0.18	—
Chinese Taipei	0.73	0.73	0.47	0.26	0.22	0.07	0.84	0.81	0.55	0.41	0.31	0.17
Colombia	0.43	0.46	0.36	0.35	0.13	0.12	0.68	0.63	0.37	0.30	0.14	0.09
Cyprus	◇	◇	◇	◇	◇	◇	0.79	—	0.52	—	0.28	—
Czech Republic	0.75	0.77	0.43	0.31	0.18	0.10	0.85	—	0.53	—	0.28	—
Denmark	0.78	0.76	0.43	0.26	0.18	0.07	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	0.46	0.53	0.35	0.40	0.12	0.16
El Salvador	0.35	0.33	0.33	0.36	0.11	0.13	0.57	0.37	0.36	0.34	0.13	0.12
England	0.75	0.79	0.44	0.29	0.20	0.08	0.79	0.84	0.46	0.37	0.21	0.14
Georgia	0.51	0.56	0.34	0.25	0.12	0.06	0.66	—	0.38	—	0.14	—
Germany	0.81	0.76	0.49	0.35	0.24	0.13	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	0.51	0.52	0.33	0.35	0.11	0.12
Hong Kong SAR	0.72	0.68	0.40	0.29	0.16	0.09	0.80	0.75	0.38	0.26	0.15	0.07
Hungary	0.78	0.79	0.51	0.39	0.26	0.15	0.84	—	0.56	—	0.31	—
Indonesia	◇	◇	◇	◇	◇	◇	0.43	—	0.30	—	0.09	—
Iran, Islamic Rep. of	0.73	0.78	0.48	0.44	0.23	0.19	0.74	0.73	0.46	0.35	0.21	0.13
Israel	◇	◇	◇	◇	◇	◇	0.73	0.74	0.41	0.44	0.17	0.20
Italy	0.69	0.68	0.35	0.24	0.12	0.06	0.84	0.81	0.48	0.31	0.23	0.10
Japan	0.76	0.75	0.47	0.28	0.22	0.08	0.78	0.79	0.50	0.40	0.25	0.16
Jordan	◇	◇	◇	◇	◇	◇	0.65	0.62	0.52	0.42	0.27	0.18
Kazakhstan	0.79	0.79	0.28	0.21	0.08	0.04	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	0.86	0.86	0.64	0.48	0.40	0.23
Kuwait	0.35	0.42	0.38	0.39	0.14	0.15	0.59	0.53	0.43	0.34	0.18	0.11
Latvia	0.72	0.71	0.50	0.32	0.25	0.10	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.65	—	0.46	—	0.21	—
Lithuania	0.71	0.70	0.54	0.34	0.29	0.12	0.79	—	0.58	—	0.33	—
Malaysia	◇	◇	◇	◇	◇	◇	0.64	0.66	0.40	0.28	0.16	0.08
Malta	◇	◇	◇	◇	◇	◇	0.78	—	0.47	—	0.22	—
Morocco	0.44	0.42	0.28	0.28	0.08	0.08	0.63	—	0.45	—	0.20	—
Netherlands	0.82	0.78	0.43	0.29	0.18	0.08	◇	◇	◇	◇	◇	◇
New Zealand	0.69	0.68	0.48	0.35	0.23	0.12	◇	◇	◇	◇	◇	◇
Norway	0.68	0.72	0.39	0.32	0.15	0.10	0.80	0.79	0.61	0.37	0.38	0.13
Oman	◇	◇	◇	◇	◇	◇	0.49	0.49	0.46	0.43	0.21	0.19
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.54	0.53	0.46	0.45	0.21	0.20
Qatar	0.41	0.47	0.36	0.36	0.13	0.13	0.61	0.53	0.40	0.34	0.16	0.12
Romania	◇	◇	◇	◇	◇	◇	0.63	—	0.46	—	0.21	—
Russian Federation	0.74	0.75	0.38	0.28	0.14	0.08	0.84	—	0.52	—	0.27	—
Saudi Arabia	◇	◇	◇	◇	◇	◇	0.49	0.48	0.44	0.44	0.19	0.19
Scotland	0.72	0.74	0.32	0.25	0.10	0.06	0.77	0.83	0.45	0.48	0.20	0.23
Serbia	◇	◇	◇	◇	◇	◇	0.82	—	0.64	—	0.41	—
Singapore	0.76	0.75	0.50	0.31	0.25	0.10	0.82	0.82	0.45	0.26	0.20	0.07
Slovak Republic	0.73	0.73	0.45	0.36	0.21	0.13	◇	◇	◇	◇	◇	◇
Slovenia	0.66	0.65	0.50	0.32	0.25	0.10	0.76	—	0.54	—	0.30	—
Sweden	0.72	0.73	0.38	0.29	0.15	0.09	0.82	—	0.58	—	0.33	—
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.57	—	0.42	—	0.17	—
Thailand	◇	◇	◇	◇	◇	◇	0.58	0.61	0.28	0.24	0.08	0.06
Tunisia	0.45	0.49	0.47	0.43	0.22	0.19	0.73	0.62	0.48	0.39	0.23	0.16
Turkey	◇	◇	◇	◇	◇	◇	0.76	0.71	0.50	0.38	0.25	0.14
Ukraine	0.69	0.68	0.46	0.33	0.21	0.11	0.79	—	0.53	—	0.28	—
United States	0.76	0.78	0.46	0.34	0.21	0.12	0.84	0.82	0.46	0.34	0.21	0.12
Yemen	0.09	0.31	0.22	0.23	0.05	0.05	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.72</b>	<b>0.72</b>	<b>0.43</b>	<b>0.31</b>	<b>0.18</b>	<b>0.10</b>	<b>0.73</b>	<b>0.66</b>	<b>0.46</b>	<b>0.37</b>	<b>0.21</b>	<b>0.14</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.77	0.77	0.46	0.33	0.21	0.11	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.80	0.75	0.56	0.45	0.31	0.21
British Columbia, Canada	0.77	0.76	0.46	0.32	0.21	0.10	0.86	0.84	0.56	0.40	0.32	0.16
Dubai, UAE	0.62	0.64	0.38	0.36	0.14	0.13	0.69	0.68	0.46	0.38	0.21	0.14
Massachusetts, US	0.78	0.80	0.46	0.29	0.21	0.09	0.84	0.85	0.53	0.40	0.28	0.16
Minnesota, US	0.76	0.77	0.51	0.30	0.26	0.09	0.85	0.85	0.56	0.46	0.31	0.21
Ontario, Canada	0.76	0.78	0.48	0.31	0.23	0.10	0.87	0.85	0.61	0.45	0.37	0.20
Quebec, Canada	0.78	0.77	0.55	0.30	0.30	0.09	0.87	0.85	0.56	0.32	0.31	0.10

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

**Exhibit 12.2 Index of Students' Self-Confidence in Learning Mathematics (SCM) / Science (SCS)—Reliability and Validity Indicators (Continued)**

Countries	Grade 8 Separate Science											
	Cronbach's Alpha Between the Component Variables				Multiple R Between Student Achievement and Component Variables				Percent of Variance in Student Achievement Accounted for by the Component Variables			
	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics
Algeria	0.56	0.33	0.48	0.50	0.27	0.22	0.21	0.24	0.07	0.05	0.04	0.06
Armenia	0.53	0.55	0.48	0.56	0.14	0.15	0.08	0.18	0.02	0.02	0.01	0.03
Bosnia and Herzegovina	0.72	0.70	0.73	0.70	0.30	0.28	0.27	0.29	0.09	0.08	0.07	0.09
Bulgaria	0.66	0.66	0.65	0.62	0.26	0.29	0.28	0.25	0.07	0.08	0.08	0.06
Cyprus	-0.46	0.73	0.75	0.74	0.30	0.37	0.37	0.43	0.09	0.13	0.14	0.18
Czech Republic	0.81	0.83	0.85	0.84	0.22	0.20	0.21	0.28	0.05	0.04	0.04	0.08
Georgia	0.66	0.49	0.60	0.61	0.37	0.34	0.29	0.30	0.14	0.12	0.09	0.09
Hungary	0.81	0.83	0.82	0.83	0.26	0.27	0.24	0.35	0.07	0.08	0.06	0.12
Indonesia	0.43	—	—	0.42	0.34	—	—	0.34	0.12	—	—	0.12
Lebanon	0.56	—	0.57	0.54	0.42	—	0.35	0.35	0.17	—	0.12	0.12
Lithuania	0.75	0.75	0.79	0.77	0.28	0.29	0.25	0.29	0.08	0.09	0.06	0.09
Malta	0.79	0.75	0.80	0.77	0.45	0.33	0.37	0.32	0.20	0.11	0.14	0.10
Morocco	0.55	0.46	0.52	0.52	0.35	0.31	0.35	0.34	0.12	0.10	0.12	0.12
Romania	0.56	0.65	0.58	0.53	0.30	0.29	0.21	0.16	0.09	0.09	0.04	0.02
Russian Federation	0.81	0.80	0.83	0.81	0.30	0.35	0.28	0.37	0.09	0.12	0.08	0.14
Serbia	0.72	0.72	0.76	0.72	0.33	0.32	0.30	0.34	0.11	0.11	0.09	0.11
Slovenia	0.79	0.78	0.80	0.77	0.35	0.34	0.41	0.36	0.12	0.11	0.16	0.13
Sweden	0.78	0.79	0.79	0.78	0.34	0.25	0.36	0.38	0.12	0.06	0.13	0.14
Syrian Arab Republic	0.50	0.43	0.49	0.46	0.37	0.32	0.24	0.28	0.14	0.10	0.06	0.08
Ukraine	0.77	0.77	0.79	0.77	0.35	0.35	0.28	0.35	0.12	0.12	0.08	0.12
International Median	0.69	0.73	0.75	0.71	0.32	0.30	0.28	0.33	0.10	0.09	0.08	0.11

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◊) indicates the country did not participate in the assessment.

A dash (—) indicates comparable data are not available or country administered separate science version of the student questionnaire.

subject, and students responded with respect to each science course they were taking. Thus, separate indices were created for each science subject, and the reliability and validity indicators for separate science countries are presented in a separate panel for eighth grade in Exhibit 12.3.

A similar index of students' valuing mathematics and science was presented in the TIMSS 2003 international reports (Martin, M.O., Mullis I.V.S., Gonzales, E.J., & Chrostowski, S.J., 2004; Mullis I.V.S., Martin, M.O., Gonzales, E.J., & Chrostowski, S.J., 2004) that included three more variables for both subjects. "I would like to take more mathematics in school", "I enjoy learning mathematics", and "I would like a job that involved using mathematics" were included in the TIMSS 2003 index calculations for mathematics but not in the TIMSS 2007 index calculations. The percentage of students at each index level in 2003 was recomputed based on the TIMSS 2007 index definition.

As shown in Exhibit 12.3, the four components form a fairly reliable scale, with a median reliability coefficient (Cronbach's alpha) of 0.70 for mathematics and 0.78 for general science. For the separate sciences, reliabilities ranged from 0.76 to 0.83. The median multiple correlation between the four statements and student achievement was 0.19 for mathematics and 0.21 for general science, corresponding to an R-square of 0.04, after rounding. For the separate sciences, the median multiple correlations ranged from 0.15 to 0.20, corresponding to R-squares of 0.02 to 0.04.

**Exhibit 12.3 Index of Students’ Valuing Mathematics (SVM) / Science (SVS)—Reliability and Validity Indicators**

Countries	Grade 8					
	Cronbach’s Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.64	–	0.18	–	0.03	–
Armenia	0.66	–	0.07	–	0.00	–
Australia	0.79	0.88	0.15	0.23	0.02	0.05
Bahrain	0.73	0.78	0.16	0.15	0.02	0.02
Bosnia and Herzegovina	0.70	–	0.09	–	0.01	–
Botswana	0.58	0.64	0.31	0.39	0.10	0.15
Bulgaria	0.73	–	0.16	–	0.02	–
Chinese Taipei	0.76	0.83	0.35	0.40	0.12	0.16
Colombia	0.66	0.76	0.04	0.14	0.00	0.02
Cyprus	0.72	–	0.21	–	0.04	–
Czech Republic	0.66	–	0.13	–	0.02	–
Egypt	0.58	0.64	0.21	0.20	0.04	0.04
El Salvador	0.64	0.76	0.12	0.18	0.02	0.03
England	0.72	0.83	0.12	0.20	0.01	0.04
Georgia	0.60	–	0.14	–	0.02	–
Ghana	0.63	0.69	0.24	0.27	0.06	0.07
Hong Kong SAR	0.82	0.84	0.28	0.32	0.08	0.10
Hungary	0.64	–	0.22	–	0.05	–
Indonesia	0.63	–	0.07	–	0.00	–
Iran, Islamic Rep. of	0.65	0.73	0.18	0.14	0.03	0.02
Israel	0.73	0.85	0.25	0.19	0.06	0.04
Italy	0.68	0.76	0.17	0.17	0.03	0.03
Japan	0.70	0.79	0.23	0.32	0.05	0.10
Jordan	0.70	0.74	0.21	0.21	0.04	0.04
Korea, Rep. of	0.74	0.80	0.33	0.34	0.11	0.12
Kuwait	0.80	0.83	0.20	0.16	0.04	0.03
Lebanon	0.68	–	0.20	–	0.04	–
Lithuania	0.72	–	0.20	–	0.04	–
Malaysia	0.75	0.80	0.26	0.39	0.07	0.15
Malta	0.69	–	0.26	–	0.07	–
Morocco	0.62	–	0.22	–	0.05	–
Norway	0.77	0.84	0.17	0.15	0.03	0.02
Oman	0.69	0.69	0.29	0.23	0.08	0.05
Palestinian Nat’l Auth.	0.73	0.74	0.28	0.27	0.08	0.07
Qatar	0.82	0.85	0.19	0.14	0.04	0.02
Romania	0.72	–	0.12	–	0.02	–
Russian Federation	0.71	–	0.21	–	0.05	–
Saudi Arabia	0.69	0.74	0.14	0.13	0.02	0.02
Scotland	0.74	0.85	0.15	0.25	0.02	0.06
Serbia	0.70	–	0.10	–	0.01	–
Singapore	0.76	0.83	0.22	0.38	0.05	0.14
Slovenia	0.69	–	0.18	–	0.03	–
Sweden	0.74	–	0.17	–	0.03	–
Syrian Arab Republic	0.65	–	0.17	–	0.03	–
Thailand	0.69	0.75	0.22	0.21	0.05	0.05
Tunisia	0.67	0.72	0.19	0.08	0.04	0.01
Turkey	0.60	0.72	0.19	0.17	0.04	0.03
Ukraine	0.70	–	0.15	–	0.02	–
United States	0.73	0.82	0.18	0.22	0.03	0.05
<b>International Median</b>	<b>0.70</b>	<b>0.78</b>	<b>0.19</b>	<b>0.21</b>	<b>0.04</b>	<b>0.04</b>
<b>Benchmarking Participants</b>						
Basque Country, Spain	0.75	0.85	0.25	0.17	0.06	0.03
British Columbia, Canada	0.75	0.83	0.23	0.26	0.05	0.07
Dubai, UAE	0.70	0.80	0.17	0.16	0.03	0.02
Massachusetts, US	0.73	0.82	0.21	0.21	0.04	0.05
Minnesota, US	0.73	0.84	0.24	0.22	0.06	0.05
Ontario, Canada	0.72	0.83	0.20	0.28	0.04	0.08
Quebec, Canada	0.71	0.82	0.15	0.25	0.02	0.06

SOURCE: IEA’s Trends in International Mathematics and Science Study (TIMSS) 2007

A dash (–) indicates comparable data are not available or country administered separate science version of the student questionnaire.

**Exhibit 12.3 Index of Students' Valuing Mathematics (SVM) / Science (SVS)—Reliability and Validity Indicators (Continued)**

Countries	Grade 8 Separate Science											
	Cronbach's Alpha Between the Component Variables				Multiple R Between Student Achievement and Component Variables				Percent of Variance in Student Achievement Accounted for by the Component Variables			
	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics
Algeria	0.67	0.78	0.78	0.76	0.10	0.09	0.05	0.03	0.01	0.01	0.00	0.00
Armenia	0.69	0.72	0.79	0.78	0.06	0.06	0.06	0.10	0.00	0.00	0.00	0.01
Bosnia and Herzegovina	0.76	0.81	0.85	0.86	0.19	0.24	0.19	0.15	0.04	0.06	0.03	0.02
Bulgaria	0.76	0.81	0.83	0.84	0.20	0.16	0.15	0.10	0.04	0.03	0.02	0.01
Cyprus	0.88	0.81	0.84	0.86	0.20	0.23	0.13	0.18	0.04	0.05	0.02	0.03
Czech Republic	0.77	0.78	0.81	0.82	0.08	0.18	0.15	0.18	0.01	0.03	0.02	0.03
Georgia	0.75	0.80	0.83	0.82	0.22	0.23	0.20	0.19	0.05	0.05	0.04	0.04
Hungary	0.78	0.79	0.83	0.83	0.17	0.20	0.19	0.13	0.03	0.04	0.03	0.02
Indonesia	0.68	—	—	0.79	0.17	—	—	0.07	0.03	—	—	0.01
Lebanon	0.74	—	0.79	0.81	0.20	—	0.11	0.10	0.04	—	0.01	0.01
Lithuania	0.82	0.83	0.85	0.86	0.17	0.23	0.16	0.15	0.03	0.05	0.02	0.02
Malta	0.80	0.81	0.84	0.83	0.27	0.20	0.33	0.25	0.07	0.04	0.11	0.06
Morocco	0.73	0.81	0.80	0.81	0.11	0.17	0.11	0.09	0.01	0.03	0.01	0.01
Romania	0.78	0.80	0.84	0.86	0.28	0.31	0.23	0.26	0.08	0.09	0.05	0.07
Russian Federation	0.81	0.81	0.84	0.83	0.19	0.17	0.13	0.14	0.03	0.03	0.02	0.02
Serbia	0.76	0.80	0.85	0.86	0.16	0.24	0.16	0.15	0.03	0.06	0.02	0.02
Slovenia	0.78	0.80	0.84	0.86	0.13	0.20	0.18	0.24	0.02	0.04	0.03	0.06
Sweden	0.82	0.82	0.87	0.87	0.22	0.22	0.19	0.22	0.05	0.05	0.04	0.05
Syrian Arab Republic	0.67	0.75	0.76	0.77	0.11	0.08	0.08	0.08	0.01	0.01	0.01	0.01
Ukraine	0.78	0.81	0.83	0.84	0.21	0.22	0.17	0.15	0.04	0.05	0.03	0.02
International Median	0.76	0.80	0.83	0.83	0.18	0.20	0.16	0.15	0.03	0.04	0.02	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007



Exhibit 12.4 presents latent factor models for the mathematics and science attitudinal indices at fourth and eighth grades. At each grade level, the mathematics model is presented graphically, while the corresponding models for the sciences are presented in tabular form to conserve space. The latent factors corresponding to the TIMSS 2007 indices are represented graphically by large darkened ovals, with correlations between the latent constructs represented by curved double-headed arrows. The fourth grade section of Exhibit 12.4 has two latent factors: *Positive Affect Toward Mathematics* and *Self-Confidence in Learning Mathematics*, and the estimated correlation between them is 0.662. Each latent factor is shown with arrows pointing to its observed component variables. For example, *Positive Affect Toward Mathematics* has three observed component variables, “I enjoy learning mathematics”, “Mathematics is boring (reversed)”, and “I like mathematics.” The figure next to each arrow is the estimated factor loading, or the correlation between the latent factor and the component variable. The greater the loading, the stronger is the relationship between the observed variable and the latent factor. The loadings of the three component variables of *Positive Affect Toward Mathematics* were 0.864, 0.664, and 0.943, respectively. Also shown in the small ovals on the right hand side are the standardized residuals corresponding to each observed variable. The residuals are a function of the factor loadings; the greater the loading, the smaller the residual.

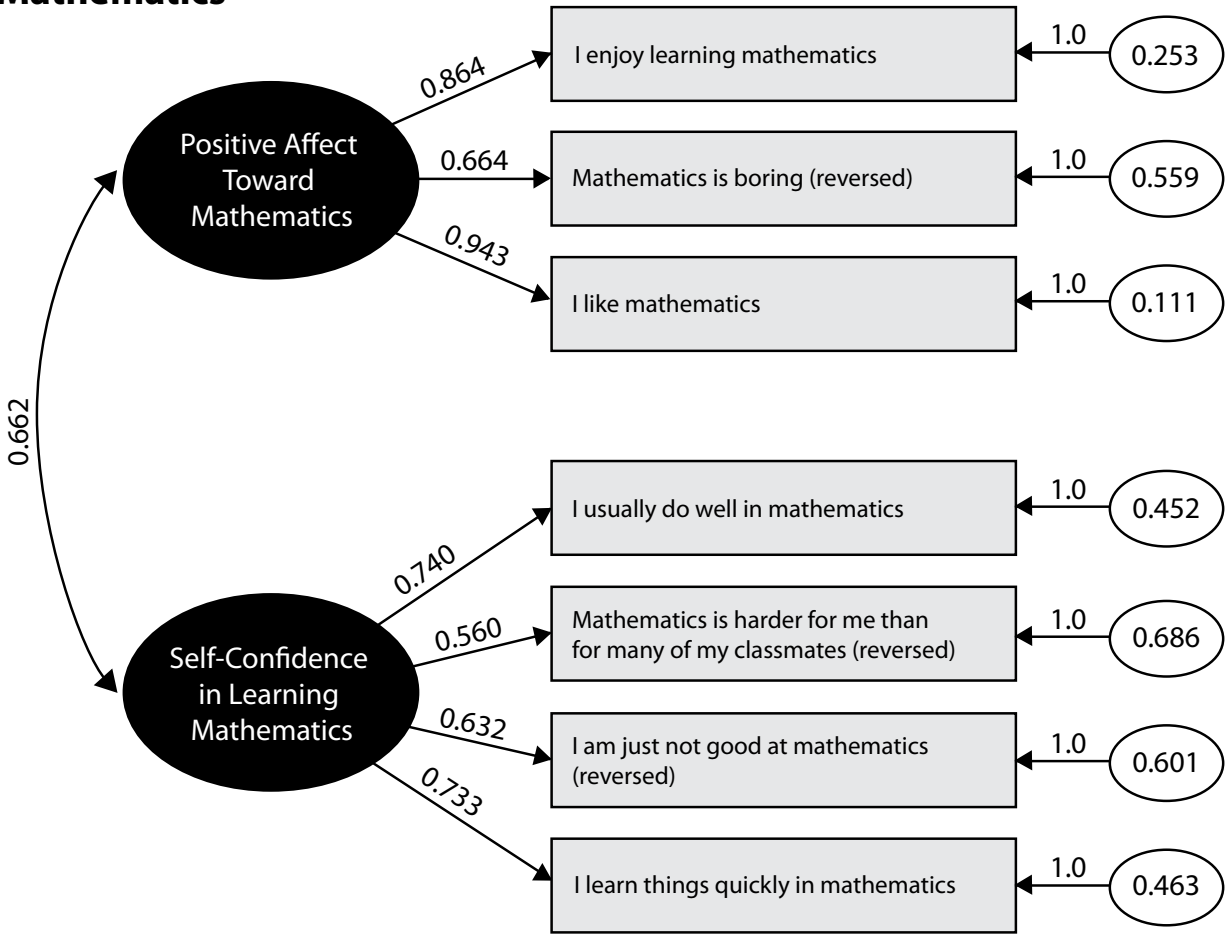
The confirmatory factor analyses reported in this chapter provide two commonly-used indicators of how well the factor models account for the TIMSS data: the Chi-square and the Root Mean Square Error Approximation (RMSEA). The Chi-square is not very useful for large sample-studies such as TIMSS, as it is sensitive to large sample size. However, the Root Mean Square Error Approximation is a more informative criterion, with values up to 0.10 indicating reasonable fit (Byrne, 2001).

Exhibit 12.4 also shows the measurement model for the eighth grade attitudinal indices. There were three latent factors for mathematics at the eighth grade: *Positive Affect Toward Mathematics*, *Self-Confidence in Learning Mathematics*, and *Valuing Mathematics*, based on 11 observed component variables. There were three corresponding factors in science, although these were fitted separately for countries teaching general science as well as individually for each science for countries teaching the sciences as separate subjects. In all instances, the correlations between these latent factors were strongly positive. For example, the correlation between *Positive Affect Toward Mathematics* and *Self-Confidence in Learning Mathematics* was 0.724; the correlation between *Positive Affect Toward Mathematics* and *Valuing Mathematics* was 0.589; and the correlation between *Self-Confidence in Learning Mathematics* and *Valuing Mathematics* was 0.421. Correlations among the latent factors for science were of similar magnitude.

The RMSEA value indicated quite good model fit for mathematics and general science (0.087 and 0.049, respectively) at the eighth grade, but somewhat less good at fourth grade and for the separate science subjects.

**Exhibit 12.4 Latent Variable Model of Students' Attitudes Toward Mathematics/Science, Grade 4**

### Mathematics



Chi-square = 28161.726 ; Df = 9 ; RMSEA = 0.141

### Science

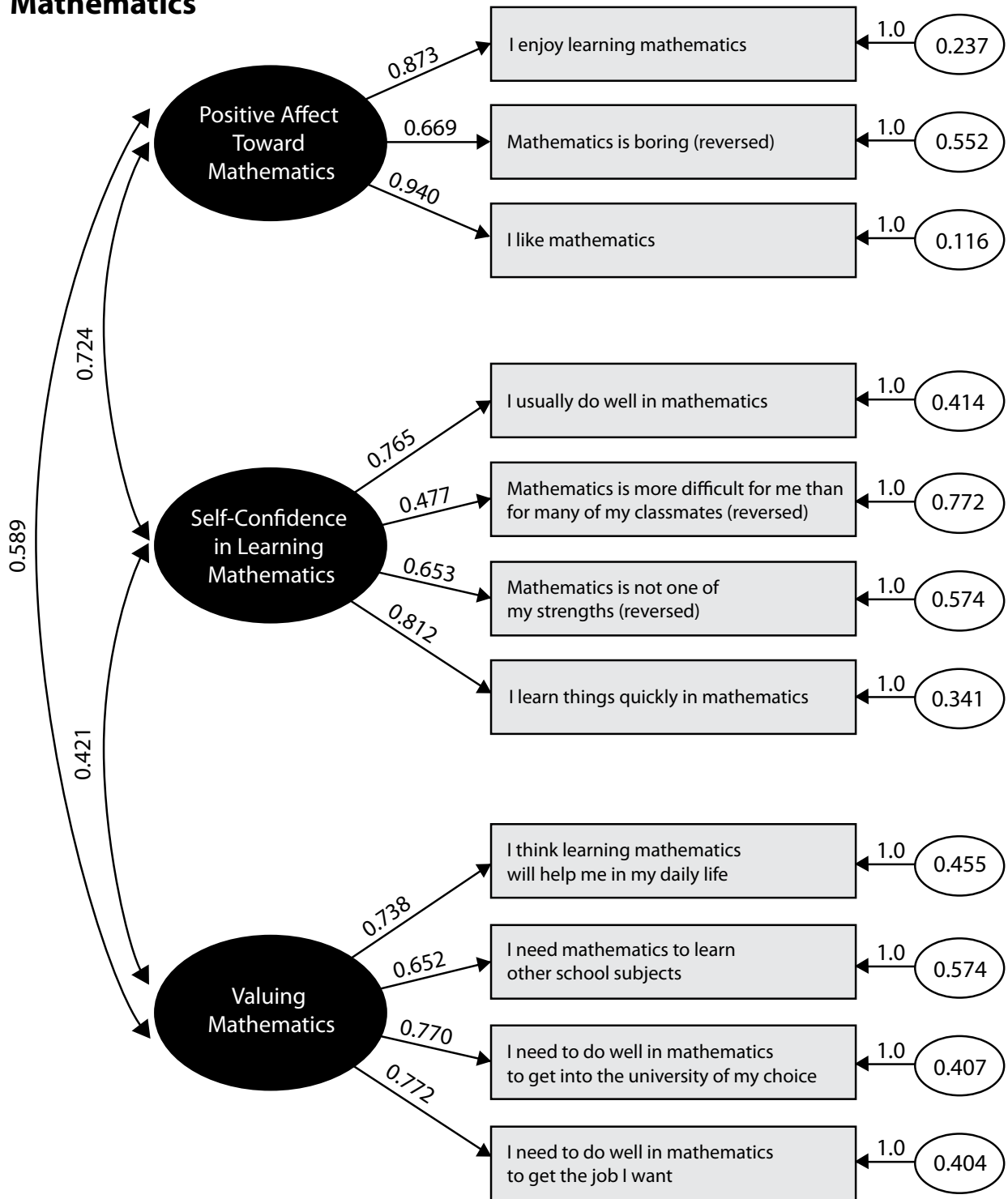
**Factors: Positive Affect Toward Science, Self-confidence in Learning Science**

	Positive Affect Toward Science	Self-Confidence in Learning Science
<i>Observed Variable</i>	<i>Factor Loadings</i>	
I enjoy learning science	0.883	—
Science is boring (reversed)	0.685	—
I like science	0.921	—
I usually do well in science	—	0.719
Science is harder for me than for many of my classmates (reversed)	—	0.580
I am just not good at science (reversed)	—	0.640
I learn things quickly in science	—	0.766
	Positive Affect Toward Science	Self-Confidence in Learning Science
<i>Factors</i>	<i>Factor Intercorrelations</i>	
Positive Affect Toward Science	1.0	0.776
Self-Confidence in Learning Science	0.776	1.0

Chi-square= 37051.229; Df= 8; RMSEA= 0.172

Exhibit 12.4 Latent Variable Model of Students' Attitudes Toward Mathematics/Science, Grade 8 (Continued)

### Mathematics



Chi-square = 45116.031 ; Df = 27 ; RMSEA = 0.087

**Exhibit 12.4 Latent Variable Model of Students’ Attitudes Toward Mathematics/Science, Grade 8 (Continued)**

**General Science**

**Factors: Positive Affect Toward Science, Self-Confidence in Learning Science, Valuing Science**

	Positive Affect Toward Science	Self-Confidence in Learning Science	Valuing Science
<i>Observed Variable</i>	<i>Factor Loadings</i>		
I enjoy learning science	0.826	—	—
Science is boring (reversed)	0.663	—	—
I like science	0.875	—	—
I usually do well in science	—	0.692	—
Science is more difficult for me than for many of my classmates (reversed)	—	0.515	—
Science is not one of my strengths (reversed)	—	0.663	—
I learn things quickly in science	—	0.757	—
I think learning science will help me in my daily life	—	—	0.705
I need science to learn other school subjects	—	—	0.660
I need to do well in science to get into the university of my choice	—	—	0.787
I need to do well in science to get the job I want	—	—	0.762
	Positive Affect Toward Science	Self-Confidence in Learning Science	Valuing Science
<i>Factors</i>	<i>Factor Intercorrelations</i>		
Positive Affect Toward Science	1.0	0.883	0.625
Self-Confidence in Learning Science	0.883	1.0	0.497
Valuing Science	0.625	0.497	1.0

Chi-square= 7149.560; Df= 26; RMSEA= 0.049

**Biology**

**Factors: Positive Affect Toward Biology, Self-Confidence in Learning Biology, Valuing Biology**

	Positive Affect Toward Biology	Self-Confidence in Learning Biology	Valuing Biology
<i>Observed Variable</i>	<i>Factor Loadings</i>		
I enjoy learning biology	0.878	—	—
Biology is boring (reversed)	0.659	—	—
I like biology	0.926	—	—
I usually do well in biology	—	0.755	—
Biology is more difficult for me than for many of my classmates (reversed)	—	0.452	—
Biology is not one of my strengths (reversed)	—	0.535	—
I learn things quickly in biology	—	0.822	—
I think learning biology will help me in my daily life	—	—	0.700
I need biology to learn other school subjects	—	—	0.687
I need to do well in biology to get into the university of my choice	—	—	0.860
I need to do well in biology to get the job I want	—	—	0.862
	Positive Affect Toward Biology	Self-Confidence in Learning Biology	Valuing Biology
<i>Factors</i>	<i>Factor Intercorrelations</i>		
Positive Affect Toward Biology	1.0	0.742	0.622
Self-Confidence in Learning Biology	0.742	1.0	0.323
Valuing Biology	0.622	0.323	1.0

Chi-square= 30009.949; Df=23; RMSEA= 0.131

**Exhibit 12.4 Latent Variable Model of Students' Attitudes Toward Mathematics/Science, Grade 8 (Continued)****Earth Science****Factors: Positive Affect Toward Earth Science, Self-Confidence in Learning Earth Science, Valuing Earth Science**

	Positive Affect Toward Earth Science	Self-Confidence in Learning Earth Science	Valuing Earth Science
<i>Observed Variable</i>	<i>Factor Loadings</i>		
I enjoy learning earth science	0.889	—	—
Earth science is boring (reversed)	0.637	—	—
I like earth science	0.931	—	—
I usually do well in earth science	—	0.773	—
Earth science is more difficult for me than for many of my classmates (reversed)	—	0.474	—
Earth science is not one of my strengths (reversed)	—	0.529	—
I learn things quickly in earth science	—	0.864	—
I think learning earth science will help me in my daily life	—	—	0.705
I need earth science to learn other school subjects	—	—	0.751
I need to do well in earth science to get into the university of my choice	—	—	0.878
I need to do well in earth science to get the job I want	—	—	0.864
	Positive Affect Toward Earth Science	Self-Confidence in Learning Earth Science	Valuing Earth Science
<i>Factors</i>	<i>Factor Intercorrelations</i>		
Positive Affect Toward Earth Science	1.0	0.752	0.557
Self-Confidence in Learning Earth Science	0.752	1.0	0.265
Valuing Earth Science	0.557	0.265	1.0

Chi-square= 34479.811; Df= 18; RMSEA= 0.162

**Chemistry****Factors: Positive Affect Toward Chemistry, Self-Confidence in Learning Chemistry, Valuing Chemistry**

	Positive Affect Toward Chemistry	Self-Confidence in Learning Chemistry	Valuing Chemistry
<i>Observed Variable</i>	<i>Factor Loadings</i>		
I enjoy learning chemistry	0.918	—	—
Chemistry is boring (reversed)	0.595	—	—
I like chemistry	0.928	—	—
I usually do well in chemistry	—	0.828	—
Chemistry is more difficult for me than for many of my classmates (reversed)	—	0.405	—
Chemistry is not one of my strengths (reversed)	—	0.498	—
I learn things quickly in chemistry	—	0.874	—
I think learning chemistry will help me in my daily life	—	—	0.781
I need chemistry to learn other school subjects	—	—	0.775
I need to do well in chemistry to get into the university of my choice	—	—	0.890
I need to do well in chemistry to get the job I want	—	—	0.883
	Positive Affect Toward Chemistry	Self-Confidence in Learning Chemistry	Valuing Chemistry
<i>Factors</i>	<i>Factor Intercorrelations</i>		
Positive Affect Toward Chemistry	1.0	0.828	0.631
Self-Confidence in Learning Chemistry	0.828	1.0	0.445
Valuing Chemistry	0.631	0.445	1.0

Chi-square= 42363.636; Df= 18; RMSEA= 0.175



**Exhibit 12.4 Latent Variable Model of Students' Attitudes Toward Mathematics/Science, Grade 8 (Continued)****Physics****Factors: Positive Affect Toward Physics, Self-Confidence in Learning Physics, Valuing Physics**

	Positive Affect Toward Physics	Self-Confidence in Learning Physics	Valuing Physics
<i>Observed Variable</i>	<i>Factor Loadings</i>		
I enjoy learning physics	0.918	—	—
Physics is boring (reversed)	0.588	—	—
I like physics	0.933	—	—
I usually do well in physics	—	0.813	—
Physics is more difficult for me than for many of my classmates (reversed)	—	0.368	—
Physics is not one of my strengths (reversed)	—	0.459	—
I learn things quickly in physics	—	0.877	—
I think learning physics will help me in my daily life	—	—	0.807
I need physics to learn other school subjects	—	—	0.796
I need to do well in physics to get into the university of my choice	—	—	0.880
I need to do well in physics to get the job I want	—	—	0.884
	Positive Affect Toward Physics	Self-Confidence in Learning Physics	Valuing Physics
<i>Factors</i>	<i>Factor Intercorrelations</i>		
Positive Affect Toward Physics	1.0	0.834	0.631
Self-Confidence in Learning Physics	0.834	1.0	0.460
Valuing Physics	0.631	0.460	1.0

Chi-square= 51693.532; Df= 18 RMSEA= 0.187

In constructing the Index of Time Students Spend on Doing Mathematics Homework (TMH) and the Index of Time Students Spend on Doing Science Homework (TSH), students were categorized according to their responses to two questions on the frequency of homework they are given and the amount of time they spend on that homework. A high level indicates homework in mathematics or science assigned at least 3 or 4 times a week and students spend more than 30 minutes on that homework. A low level indicates homework in these subjects assigned no more than twice a week, and students spend no more than 30 minutes on that homework. A medium level indicates all other combinations of frequencies.

These TIMSS indices are unique for two reasons: they are comprised of only two variables, and the way the categories of the two variables are combined does not lend itself well to the Cronbach Alpha measure of reliability. Also, the categories for grouping students are sensitive to differences across countries in the role of homework in mathematics and science instruction. The index is presented in Exhibit 4.7 of the TIMSS 2007 international reports. Similar indices were reported in previous TIMSS cycles, but the questions and the index definition have been refined over time. Thus, no trends were reported for this index.

As shown in Exhibit 12.5, the variables comprising this index have relatively low reliability (international median Cronbach's alpha ranging between 0.05 and 0.14 for mathematics and general science) and only a weak relationship with achievement (international median multiple-R of 0.16 or less, corresponding to R-squares less than 0.02) as compared to other indices. These statistics suggest that while homework may be an important part of instruction in many countries, there is great variation across countries in how homework is used, and often students receiving the greatest amounts of homework or spending most time on it may not be the high performers.

The Index of Students' Perception of Being Safe in School (SPBSS) summarizes students' reports of how safe and secure they feel in their schools. The index, developed in 2003, is presented in Exhibit 8.14 of the *TIMSS 2007 International Mathematics Report* and Exhibit 8.15 of the *TIMSS 2007 International Science Report*. The index groups students according to their reports about the frequency of incidents affecting their safety: 1) Something of mine was stolen; 2) I was hit or hurt by other student(s) (for example, shoving, hitting, kicking); 3) I was made to do things that I didn't want to do by other students; 4) I was made fun of or called names; and 5) I was left



out of activities by other students. Because this index had no components specific to particular branches of science, it was not necessary to construct separate indices for separate sciences countries. Students at the high level of the index reported that no such incidents occurred during the past month. Students at the low level reported three or more incidents during this period. Students at the medium level reported at least one but no more than two such incidents.

As shown in Exhibit 12.6 the five component variables form a fairly reliable scale, with a median reliability coefficient across countries of 0.61 at fourth grade and 0.62 at eighth grade. The median multiple correlation between the component variables and student achievement was 0.20 for both mathematics and science at fourth grade and 0.16 and 0.18 for mathematics and science, respectively, at eighth grade.

As shown in Exhibit 12.7, factor loadings ranged from 0.551 for “something of mine was stolen” to 0.737 for “I was made fun of or called names” at the fourth grade. At the eighth grade, the factor structure was similar, with factor loadings ranging from 0.550 for “something of mine was stolen” to 0.754 for “I was made to do things I didn’t want to do by other students.” With an RMSEA value of less than 0.05 the model fits the data well at both grades.

**Exhibit 12.5 Index of Time Students Spend on Doing Mathematics Homework (TMH) / Science Homework (TSH) in a Normal School Week—Reliability and Validity Indicators**

Countries	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.19	0.08	0.09	0.08	0.01	0.01	∅	–	∅	–	∅	–
Armenia	–0.03	0.02	0.05	0.08	0.00	0.01	–0.01	–	0.03	–	0.00	–
Australia	–0.16	–0.09	0.09	0.28	0.01	0.08	0.28	0.20	0.23	0.10	0.05	0.01
Austria	–0.03	0.28	0.11	0.27	0.01	0.07	∅	∅	∅	∅	∅	∅
Bahrain	∅	∅	∅	∅	∅	∅	0.14	0.22	0.09	0.07	0.01	0.00
Bosnia and Herzegovina	∅	∅	∅	∅	∅	∅	0.27	–	0.08	–	0.01	–
Botswana	∅	∅	∅	∅	∅	∅	0.02	0.02	0.09	0.09	0.01	0.01
Bulgaria	∅	∅	∅	∅	∅	∅	0.20	–	0.01	–	0.00	–
Chinese Taipei	0.07	0.21	0.13	0.24	0.02	0.06	0.21	0.18	0.19	0.18	0.04	0.03
Colombia	0.05	–0.01	0.11	0.19	0.01	0.04	0.03	0.10	0.06	0.12	0.00	0.02
Cyprus	∅	∅	∅	∅	∅	∅	0.07	–	0.13	–	0.02	–
Czech Republic	0.11	0.13	0.12	0.13	0.01	0.02	0.00	–	0.19	–	0.04	–
Denmark	0.15	0.35	0.15	0.18	0.02	0.03	∅	∅	∅	∅	∅	∅
Egypt	∅	∅	∅	∅	∅	∅	0.02	–0.10	0.15	0.23	0.02	0.05
El Salvador	–0.07	–0.21	0.13	0.11	0.02	0.01	–0.01	–0.05	0.09	0.14	0.01	0.02
England	0.08	0.02	0.07	0.19	0.01	0.04	0.23	0.29	0.16	0.22	0.02	0.05
Georgia	–0.03	–0.02	0.09	0.15	0.01	0.02	0.05	–	0.15	–	0.02	–
Germany	0.05	0.20	0.14	0.15	0.02	0.02	∅	∅	∅	∅	∅	∅
Ghana	∅	∅	∅	∅	∅	∅	–0.15	–0.09	0.16	0.15	0.02	0.02
Hong Kong SAR	0.01	0.15	0.19	0.13	0.04	0.02	0.29	–0.08	0.11	0.17	0.01	0.03
Hungary	0.07	0.20	0.01	0.10	0.00	0.01	0.13	–	0.06	–	0.00	–
Indonesia	∅	∅	∅	∅	∅	∅	–0.09	–	0.13	–	0.02	–
Iran, Islamic Rep. of	0.07	0.03	0.14	0.12	0.02	0.01	0.09	0.24	0.20	0.08	0.04	0.01
Israel	∅	∅	∅	∅	∅	∅	0.14	0.30	0.07	0.17	0.01	0.03
Italy	0.09	0.03	0.11	0.14	0.01	0.02	0.05	0.22	0.12	0.09	0.02	0.01
Japan	0.09	0.02	0.21	0.18	0.04	0.03	0.07	0.05	0.14	0.14	0.02	0.02
Jordan	∅	∅	∅	∅	∅	∅	0.11	0.11	0.16	0.14	0.02	0.02
Kazakhstan	0.06	0.18	0.02	0.19	0.00	0.04	∅	∅	∅	∅	∅	∅
Korea, Rep. of	∅	∅	∅	∅	∅	∅	0.12	0.05	0.10	0.08	0.01	0.01
Kuwait	0.12	0.17	0.16	0.18	0.02	0.03	0.21	0.17	0.22	0.10	0.05	0.01
Latvia	0.03	0.11	0.13	0.15	0.02	0.02	∅	∅	∅	∅	∅	∅
Lebanon	∅	∅	∅	∅	∅	∅	0.05	–	0.15	–	0.02	–
Lithuania	0.08	0.21	0.12	0.16	0.01	0.03	0.15	–	0.10	–	0.01	–
Malaysia	∅	∅	∅	∅	∅	∅	0.06	0.14	0.10	0.04	0.01	0.00
Malta	∅	∅	∅	∅	∅	∅	0.15	–	0.16	–	0.03	–
Morocco	0.09	–0.03	0.05	0.10	0.00	0.01	0.04	–	0.09	–	0.01	–
Netherlands	0.14	0.07	0.23	0.27	0.05	0.07	∅	∅	∅	∅	∅	∅
New Zealand	0.05	0.03	0.16	0.27	0.03	0.07	∅	∅	∅	∅	∅	∅
Norway	–0.03	0.16	0.10	0.19	0.01	0.04	–0.01	0.11	0.07	0.07	0.01	0.00
Oman	∅	∅	∅	∅	∅	∅	0.03	0.05	0.08	0.13	0.01	0.02
Palestinian Nat'l Auth.	∅	∅	∅	∅	∅	∅	0.10	0.14	0.11	0.10	0.01	0.01
Qatar	0.05	0.08	0.11	0.14	0.01	0.02	0.12	0.14	0.09	0.08	0.01	0.01
Romania	∅	∅	∅	∅	∅	∅	0.21	–	0.28	–	0.08	–
Russian Federation	0.04	0.09	0.06	0.15	0.00	0.02	–0.01	–	0.11	–	0.01	–
Saudi Arabia	∅	∅	∅	∅	∅	∅	0.21	0.14	0.10	0.18	0.01	0.03
Scotland	–0.02	0.11	0.12	0.24	0.02	0.06	0.02	0.14	0.21	0.13	0.05	0.02
Serbia	∅	∅	∅	∅	∅	∅	0.34	–	0.01	–	0.00	–
Singapore	0.05	0.07	0.10	0.05	0.01	0.00	0.20	0.23	0.18	0.12	0.03	0.01
Slovak Republic	0.14	0.26	0.13	0.20	0.02	0.04	∅	∅	∅	∅	∅	∅
Slovenia	–0.08	0.04	0.15	0.10	0.02	0.01	0.24	–	0.07	–	0.00	–
Sweden	0.08	0.19	0.15	0.20	0.02	0.04	0.17	–	0.11	–	0.01	–
Syrian Arab Republic	∅	∅	∅	∅	∅	∅	–0.02	–	0.16	–	0.02	–
Thailand	∅	∅	∅	∅	∅	∅	0.15	0.05	0.18	0.20	0.03	0.04
Tunisia	0.01	0.01	0.06	0.05	0.00	0.00	0.22	0.25	0.04	0.13	0.00	0.02
Turkey	∅	∅	∅	∅	∅	∅	0.09	0.18	0.17	0.14	0.03	0.02
Ukraine	–0.01	0.01	0.07	0.20	0.01	0.04	0.02	–	0.10	–	0.01	–
United States	0.05	0.03	0.05	0.18	0.00	0.03	0.29	0.26	0.15	0.08	0.02	0.01
Yemen	0.01	0.14	0.10	0.09	0.01	0.01	∅	∅	∅	∅	∅	∅
<b>International Median</b>	<b>0.05</b>	<b>0.08</b>	<b>0.11</b>	<b>0.16</b>	<b>0.01</b>	<b>0.02</b>	<b>0.10</b>	<b>0.14</b>	<b>0.11</b>	<b>0.13</b>	<b>0.01</b>	<b>0.02</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.18	0.18	0.09	0.19	0.01	0.04	∅	∅	∅	∅	∅	∅
Basque Country, Spain	∅	∅	∅	∅	∅	∅	0.13	0.18	0.10	0.06	0.01	0.00
British Columbia, Canada	0.22	0.15	0.13	0.21	0.02	0.04	0.26	0.34	0.07	0.08	0.01	0.01
Dubai, UAE	0.11	0.24	0.12	0.24	0.02	0.06	0.24	0.38	0.16	0.13	0.03	0.02
Massachusetts, US	–0.11	0.12	0.02	0.14	0.00	0.02	0.35	0.32	0.18	0.04	0.03	0.00
Minnesota, US	0.12	0.17	0.10	0.24	0.01	0.06	0.21	0.15	0.17	0.09	0.03	0.01
Ontario, Canada	0.21	–0.03	0.07	0.18	0.00	0.03	0.26	0.15	0.14	0.05	0.02	0.00
Quebec, Canada	0.05	0.08	0.21	0.21	0.04	0.05	0.32	0.30	0.14	0.06	0.02	0.00

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

**Exhibit 12.5 Index of Time Students Spend on Doing Mathematics Homework (TMH) / Science Homework (TSH) in a Normal School Week—Reliability and Validity Indicators (Continued)**

Countries	Grade 8 Separate Science											
	Cronbach's Alpha Between the Component Variables				Multiple R Between Student Achievement and Component Variables				Percent of Variance in Student Achievement Accounted for by the Component Variables			
	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics	Biology	Earth Science	Chemistry	Physics
Algeria	–	–	–	–	–	–	–	–	–	–	–	–
Armenia	0.18	0.17	0.09	0.06	0.05	0.04	0.04	0.07	0.00	0.00	0.00	0.00
Bosnia and Herzegovina	0.24	0.25	0.29	0.28	0.21	0.24	0.21	0.18	0.04	0.06	0.04	0.03
Bulgaria	0.29	0.29	0.31	0.28	0.16	0.11	0.13	0.13	0.03	0.01	0.02	0.02
Cyprus	0.10	0.20	0.17	0.17	0.22	0.17	0.19	0.20	0.05	0.03	0.04	0.04
Czech Republic	0.09	0.17	0.21	0.24	0.18	0.15	0.17	0.19	0.03	0.02	0.03	0.04
Georgia	–0.02	–0.04	0.00	0.04	0.09	0.11	0.02	0.04	0.01	0.01	0.00	0.00
Hungary	0.26	0.17	0.24	0.22	0.16	0.17	0.15	0.17	0.03	0.03	0.02	0.03
Indonesia	–0.08	–	–	–0.07	0.07	–	–	0.07	0.00	–	–	0.00
Lebanon	0.14	–	0.15	0.05	0.14	–	0.14	0.14	0.02	–	0.02	0.02
Lithuania	0.23	0.25	0.27	0.23	0.15	0.16	0.18	0.16	0.02	0.03	0.03	0.03
Malta	0.09	0.10	0.12	0.18	0.18	0.21	0.15	0.16	0.03	0.04	0.02	0.03
Morocco	–0.07	0.00	–0.08	0.05	0.13	0.11	0.14	0.15	0.02	0.01	0.02	0.02
Romania	0.38	0.41	0.37	0.23	0.21	0.17	0.17	0.21	0.04	0.03	0.03	0.04
Russian Federation	0.13	0.12	0.15	0.14	0.14	0.16	0.13	0.13	0.02	0.02	0.02	0.02
Serbia	0.32	0.31	0.33	0.33	0.18	0.24	0.20	0.21	0.03	0.06	0.04	0.04
Slovenia	0.14	0.19	0.19	0.20	0.18	0.16	0.19	0.17	0.03	0.02	0.04	0.03
Sweden	0.03	0.07	0.08	0.09	0.12	0.13	0.12	0.13	0.01	0.02	0.01	0.02
Syrian Arab Republic	0.09	0.08	0.03	0.02	0.04	0.07	0.02	0.08	0.00	0.01	0.00	0.01
Ukraine	0.08	0.08	0.13	0.04	0.10	0.10	0.10	0.12	0.01	0.01	0.01	0.01
International Median	0.13	0.17	0.16	0.17	0.15	0.16	0.14	0.15	0.02	0.02	0.02	0.02

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◊) indicates the country did not participate in the assessment.

A dash (–) indicates comparable data are not available or country administered separate science version of the student questionnaire.

**Exhibit 12.6 Index of Students' Perception of Being Safe in School (SPBSS)—Reliability and Validity Indicators**

Country	Grade 4				Grade 8					
	Cronbach's Alpha Between the Component Variables	Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables	Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
		Mathematics	Science	Mathematics	Science		Mathematics	Science	Mathematics	Science
Algeria	0.48	0.24	0.24	0.06	0.06	0.56	0.14	0.13	0.02	0.02
Armenia	0.60	0.06	0.11	0.00	0.01	0.68	0.08	0.07	0.01	0.01
Australia	0.64	0.20	0.18	0.04	0.03	0.65	0.10	0.10	0.01	0.01
Austria	0.68	0.18	0.20	0.03	0.04	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	0.61	0.20	0.26	0.04	0.07
Bosnia and Herzegovina	◇	◇	◇	◇	◇	0.65	0.17	0.17	0.03	0.03
Botswana	◇	◇	◇	◇	◇	0.20	0.41	0.49	0.17	0.24
Bulgaria	◇	◇	◇	◇	◇	0.64	0.19	0.20	0.04	0.04
Chinese Taipei	0.70	0.18	0.17	0.03	0.03	0.70	0.07	0.09	0.01	0.01
Colombia	0.59	0.21	0.24	0.04	0.06	0.52	0.11	0.10	0.01	0.01
Cyprus	◇	◇	◇	◇	◇	0.66	0.20	0.20	0.04	0.04
Czech Republic	0.58	0.19	0.16	0.03	0.03	0.59	0.13	0.11	0.02	0.01
Denmark	0.59	0.14	0.14	0.02	0.02	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	0.62	0.27	0.30	0.08	0.09
El Salvador	0.59	0.20	0.22	0.04	0.05	0.54	0.08	0.10	0.01	0.01
England	0.63	0.20	0.22	0.04	0.05	0.62	0.12	0.11	0.01	0.01
Georgia	0.53	0.23	0.24	0.06	0.06	0.70	0.12	0.20	0.02	0.04
Germany	0.65	0.21	0.20	0.04	0.04	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	0.41	0.24	0.30	0.06	0.09
Hong Kong SAR	0.65	0.16	0.16	0.03	0.03	0.66	0.16	0.15	0.03	0.02
Hungary	0.64	0.26	0.26	0.07	0.07	0.64	0.15	0.14	0.02	0.02
Indonesia	◇	◇	◇	◇	◇	0.58	0.19	0.20	0.04	0.04
Iran, Islamic Rep. of	0.54	0.14	0.14	0.02	0.02	0.54	0.22	0.21	0.05	0.04
Israel	◇	◇	◇	◇	◇	0.70	0.26	0.27	0.07	0.07
Italy	0.63	0.14	0.17	0.02	0.03	0.58	0.11	0.09	0.01	0.01
Japan	0.67	0.14	0.14	0.02	0.02	0.66	0.10	0.11	0.01	0.01
Jordan	◇	◇	◇	◇	◇	0.62	0.21	0.25	0.05	0.06
Kazakhstan	0.60	0.06	0.08	0.00	0.01	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	0.55	0.09	0.11	0.01	0.01
Kuwait	0.66	0.31	0.33	0.09	0.11	0.70	0.22	0.24	0.05	0.06
Latvia	0.55	0.21	0.22	0.04	0.05	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	0.65	0.28	0.32	0.08	0.10
Lithuania	0.60	0.24	0.23	0.06	0.06	0.59	0.14	0.14	0.02	0.02
Malaysia	◇	◇	◇	◇	◇	0.55	0.17	0.24	0.03	0.06
Malta	◇	◇	◇	◇	◇	0.63	0.23	0.22	0.05	0.05
Morocco	0.40	0.22	0.23	0.05	0.05	0.52	0.19	0.20	0.04	0.04
Netherlands	0.62	0.22	0.20	0.05	0.04	◇	◇	◇	◇	◇
New Zealand	0.65	0.23	0.26	0.05	0.07	◇	◇	◇	◇	◇
Norway	0.66	0.23	0.22	0.05	0.05	0.58	0.10	0.09	0.01	0.01
Oman	◇	◇	◇	◇	◇	0.63	0.24	0.27	0.06	0.07
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	0.60	0.23	0.27	0.05	0.07
Qatar	0.66	0.25	0.24	0.06	0.06	0.68	0.23	0.22	0.05	0.05
Romania	◇	◇	◇	◇	◇	0.63	0.20	0.20	0.04	0.04
Russian Federation	0.52	0.15	0.14	0.02	0.02	0.54	0.14	0.12	0.02	0.01
Saudi Arabia	◇	◇	◇	◇	◇	0.58	0.17	0.20	0.03	0.04
Scotland	0.67	0.15	0.17	0.02	0.03	0.64	0.14	0.15	0.02	0.02
Serbia	◇	◇	◇	◇	◇	0.64	0.13	0.15	0.02	0.02
Singapore	0.59	0.25	0.26	0.06	0.07	0.63	0.20	0.19	0.04	0.03
Slovak Republic	0.61	0.26	0.27	0.07	0.08	◇	◇	◇	◇	◇
Slovenia	0.64	0.19	0.19	0.04	0.04	0.65	0.13	0.16	0.02	0.03
Sweden	0.62	0.21	0.18	0.04	0.03	0.72	0.17	0.16	0.03	0.03
Syrian Arab Republic	◇	◇	◇	◇	◇	0.69	0.16	0.20	0.03	0.04
Thailand	◇	◇	◇	◇	◇	0.62	0.19	0.19	0.04	0.04
Tunisia	0.49	0.25	0.22	0.06	0.05	0.59	0.12	0.15	0.01	0.02
Turkey	◇	◇	◇	◇	◇	0.58	0.16	0.18	0.02	0.03
Ukraine	0.60	0.19	0.18	0.04	0.03	0.60	0.15	0.16	0.02	0.03
United States	—	—	—	—	—	—	—	—	—	—
Yemen	0.58	0.15	0.13	0.02	0.02	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.61</b>	<b>0.20</b>	<b>0.20</b>	<b>0.04</b>	<b>0.04</b>	<b>0.62</b>	<b>0.16</b>	<b>0.18</b>	<b>0.03</b>	<b>0.03</b>
<b>Benchmarking Participants</b>										
Alberta, Canada	0.65	0.18	0.21	0.03	0.05	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	0.62	0.20	0.14	0.04	0.02
British Columbia, Canada	0.65	0.19	0.20	0.04	0.04	0.65	0.12	0.15	0.02	0.02
Dubai, UAE	0.55	0.23	0.27	0.05	0.08	0.62	0.18	0.18	0.03	0.03
Massachusetts, US	—	—	—	—	—	—	—	—	—	—
Minnesota, US	—	—	—	—	—	—	—	—	—	—
Ontario, Canada	0.65	0.19	0.20	0.04	0.04	0.63	0.07	0.07	0.00	0.01
Quebec, Canada	0.64	0.19	0.18	0.04	0.03	0.59	0.12	0.10	0.01	0.01

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

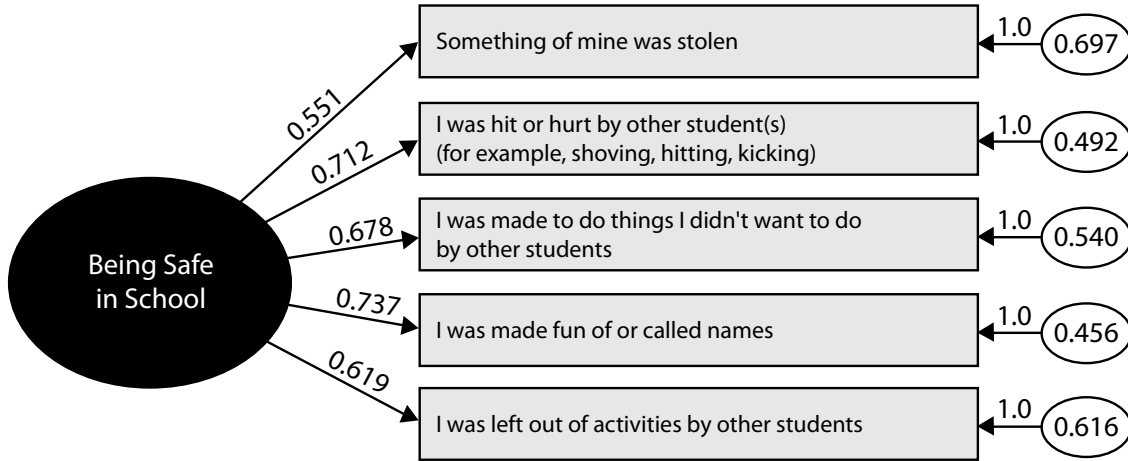
A diamond (◇) indicates the country did not participate in the assessment.

A dash (—) indicates comparable data are not available.

**Exhibit 12.7 Latent Variable Model of Students' Perception of Being Safe in School**

**Grade 4**

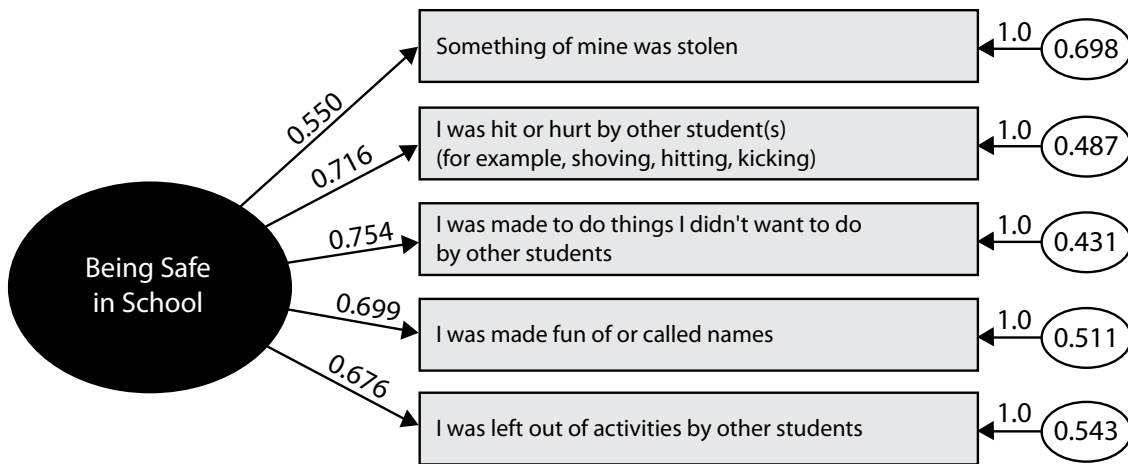
*Students' reports on things happening in their school during the last month*



Chi-square = 1393.399 ; Df = 5 ; RMSEA = 0.043

**Grade 8**

*Students' reports on things happening in their school during the last month*



Chi-square = 1549.347 ; Df = 5 ; RMSEA = 0.038

### 12.4.2 Teacher-level Indices

The *TIMSS 2007 Teacher Questionnaires* collected information about teachers' education and training, instructional practices, and the implemented curriculum in mathematics and science. At the fourth grade, a single questionnaire addressed both subjects, whereas there were separate versions for mathematics and science teachers at the eighth grade. Five indices presented in the TIMSS 2007 international reports were based on questions in the teacher questionnaires.

The Index of Teachers' Reports on Teaching Mathematics Classes with Few or No Limitations (MCFL) and the Index of Teachers' Reports on Teaching Science Classes with Few or No Limitations (SCFL) group students according to their teachers' reports on the instructional impact of five characteristics of their students: 1) Students with different academic abilities; 2) Students who come from a wide range of backgrounds; 3) Students with special needs; 4) Uninterested students; and 5) Disruptive students. The index, modified from an earlier version from 2003, is presented in Exhibit 7.3 of the TIMSS 2007 international reports, including trends from 2003 at the eighth grade. The item "low morale among students" was included in the TIMSS 2003 index calculations but not in the 2007 index calculations. Thus, the percentage of students at each index level in 2003 was recomputed excluding this item. Trends were not reported at the fourth grade because the component variables were not part of the fourth grade teacher questionnaire in 2003.

Teachers rated the impact of the five statements about student factors limiting mathematics and science instruction on a 4-point scale: *not at all/not applicable* = 1; *a little* = 2; *some* = 3; and *a lot* = 4. An average was computed across the five items. Students were placed in the high category, if the average was less than or equal to 2. If the average across the five items was greater than 3, students were placed in the low category. A medium level indicates averages greater than 2 but less than 3.

As shown in Exhibit 12.8, the five components form a fairly reliable scale, with median reliability coefficients (Cronbach's alpha) across countries of 0.71 and 0.73 for mathematics and science, respectively, at the fourth grade, and 0.69 and 0.68 at the eighth grade. The median multiple correlation between the five statements and student achievement was 0.15 and 0.12 for mathematics and science at the fourth grade, and 0.19 and 0.14, respectively, at the eighth grade.

From the latent factor measurement model shown in Exhibit 12.9, it appears that, for both mathematics and science at both grades, “uninterested students” and “disruptive students” are the dominant student characteristics, having the highest factor loadings on all four scales. It may be that for teachers everywhere, such students pose a challenge for instruction in the classroom. By comparison, “students with different academic abilities”, “students who come from a wide range of backgrounds”, and “students with special needs” had somewhat lower loadings, implying that the challenge posed by such students is of a different nature, and may vary more from classroom to classroom and country to country.

The Index of Teachers’ Emphasis on Mathematics Homework (EMH) and the Index of Teachers’ Emphasis on Science Homework (ESH) categorize fourth and eighth grade students according to their teachers’ responses to two questions about the frequency of assigning homework and the amount of homework assigned. By describing teachers’ practices in assigning mathematics and science homework, these indices complement the indices on students’ reports of the time they actually spend on homework (Exhibit 12.5). Students at the high level of the teacher indices had teachers who reported assigning more than 30 minutes of homework in half of the lessons or more. Students at the low level had teachers who reported assigning less than 30 minutes of homework in fewer than half of the lessons. A medium level indicates all other combinations of amount and frequency of homework assignments. Like the student indices described earlier, the teacher indices are sensitive to differences across countries in the role of homework in mathematics and science instruction. These indices were presented in Exhibit 7.12 of the *TIMSS 2007 International Mathematics Report* and Exhibit 7.11 of the *TIMSS 2007 International Science Report*.

As shown in Exhibit 12.10, the variables comprising this index have relatively low reliability (international median Cronbach’s alpha of 0.08 or less) and show no substantive relationship with achievement. This underlines the different purpose homework serves in instructional contexts and particularly its use for remedial instruction.

The Index of Teachers’ Adequate Working Conditions (TAWC) summarizes teachers’ perspectives on the availability of school resources and how these affect their capacity to provide effective mathematics and science instruction. Teachers were asked to rate problems in their school by severity on a 3-point scale: *not a problem* = 1; *minor problem* = 2; and

**Exhibit 12.8 Index of Teachers' Reports on Teaching Mathematics (MFCL) / Science (SFCL) Classes with Few or No Limitations on Instruction Due to Student Factors—Reliability and Validity Indicators**

Country	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.71	0.75	0.18	0.09	0.03	0.01	0.63	0.59	0.05	0.08	0.00	0.01
Armenia	0.76	0.81	0.12	0.09	0.01	0.01	0.61	0.63	0.13	0.06	0.02	0.00
Australia	0.76	0.83	0.19	0.14	0.03	0.02	0.81	0.77	0.42	0.22	0.17	0.05
Austria	0.71	0.76	0.15	0.19	0.02	0.04	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	0.63	0.64	0.13	0.14	0.02	0.02
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	0.68	0.68	0.06	0.04	0.00	0.00
Botswana	◇	◇	◇	◇	◇	◇	0.64	0.62	0.11	0.12	0.01	0.01
Bulgaria	◇	◇	◇	◇	◇	◇	0.55	0.67	0.27	0.20	0.07	0.04
Chinese Taipei	0.72	0.72	0.08	0.07	0.01	0.00	0.63	0.66	0.21	0.13	0.04	0.02
Colombia	0.69	0.69	0.12	0.11	0.02	0.01	0.69	0.69	0.19	0.17	0.04	0.03
Cyprus	◇	◇	◇	◇	◇	◇	0.70	0.73	0.06	0.03	0.00	0.00
Czech Republic	0.72	0.74	0.18	0.08	0.03	0.01	0.74	0.69	0.28	0.16	0.08	0.03
Denmark	0.73	0.76	0.11	0.12	0.01	0.01	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	0.69	0.60	0.19	0.13	0.04	0.02
El Salvador	0.66	0.69	0.13	0.13	0.02	0.02	0.71	0.70	0.14	0.13	0.02	0.02
England	0.79	0.79	0.18	0.18	0.03	0.03	0.67	0.76	0.51	0.37	0.26	0.14
Georgia	0.71	0.68	0.12	0.13	0.01	0.02	0.70	0.73	0.14	0.09	0.02	0.01
Germany	0.68	0.74	0.24	0.24	0.06	0.06	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	0.57	0.68	0.25	0.21	0.06	0.04
Hong Kong SAR	0.72	0.72	0.34	0.12	0.12	0.01	0.79	0.74	0.47	0.38	0.23	0.15
Hungary	0.76	0.77	0.28	0.32	0.08	0.10	0.70	0.71	0.24	0.21	0.06	0.04
Indonesia	◇	◇	◇	◇	◇	◇	0.71	0.61	0.17	0.11	0.03	0.01
Iran, Islamic Rep. of	0.72	0.75	0.18	0.14	0.03	0.02	0.65	0.69	0.19	0.14	0.04	0.02
Israel	◇	◇	◇	◇	◇	◇	0.71	0.77	0.23	0.19	0.05	0.04
Italy	0.64	0.72	0.15	0.12	0.02	0.01	0.65	0.67	0.07	0.09	0.00	0.01
Japan	0.67	0.68	0.05	0.05	0.00	0.00	0.75	0.74	0.18	0.22	0.03	0.05
Jordan	◇	◇	◇	◇	◇	◇	0.75	0.68	0.21	0.13	0.04	0.02
Kazakhstan	0.67	0.68	0.18	0.11	0.03	0.01	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	0.66	0.66	0.10	0.03	0.01	0.00
Kuwait	0.77	0.73	0.13	0.12	0.02	0.01	0.71	0.61	0.06	0.13	0.00	0.02
Latvia	0.59	0.65	0.10	0.08	0.01	0.01	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.71	0.65	0.23	0.18	0.05	0.03
Lithuania	0.66	0.74	0.14	0.10	0.02	0.01	0.67	0.72	0.20	0.14	0.04	0.02
Malaysia	◇	◇	◇	◇	◇	◇	0.76	0.67	0.36	0.37	0.13	0.13
Malta	◇	◇	◇	◇	◇	◇	0.83	0.75	0.37	0.34	0.13	0.11
Morocco	0.62	0.72	0.17	0.11	0.03	0.01	0.51	0.59	0.09	0.17	0.01	0.03
Netherlands	0.75	0.81	0.21	0.19	0.04	0.04	◇	◇	◇	◇	◇	◇
New Zealand	0.76	0.79	0.21	0.20	0.05	0.04	◇	◇	◇	◇	◇	◇
Norway	0.74	0.78	0.16	0.11	0.03	0.01	0.52	0.68	0.07	0.10	0.00	0.01
Oman	◇	◇	◇	◇	◇	◇	0.55	0.54	0.18	0.14	0.03	0.02
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.74	0.60	0.07	0.09	0.00	0.01
Qatar	0.68	0.67	0.15	0.16	0.02	0.03	0.73	0.59	0.12	0.24	0.01	0.06
Romania	◇	◇	◇	◇	◇	◇	0.68	0.72	0.09	0.08	0.01	0.01
Russian Federation	0.69	0.71	0.12	0.16	0.01	0.02	0.72	0.72	0.22	0.16	0.05	0.03
Saudi Arabia	◇	◇	◇	◇	◇	◇	0.69	0.71	0.09	0.08	0.01	0.01
Scotland	0.75	0.71	0.18	0.19	0.03	0.04	0.80	0.80	0.48	0.25	0.23	0.06
Serbia	◇	◇	◇	◇	◇	◇	0.52	0.73	0.13	0.07	0.02	0.00
Singapore	0.81	0.82	0.30	0.23	0.09	0.05	0.76	0.77	0.44	0.40	0.19	0.16
Slovak Republic	0.64	0.73	0.18	0.19	0.03	0.04	◇	◇	◇	◇	◇	◇
Slovenia	0.68	0.72	0.09	0.07	0.01	0.00	0.70	0.65	0.14	0.04	0.02	0.00
Sweden	0.75	0.83	0.17	0.18	0.03	0.03	0.76	0.74	0.19	0.14	0.03	0.02
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.69	0.68	0.12	0.03	0.01	0.00
Thailand	◇	◇	◇	◇	◇	◇	0.58	0.65	0.33	0.27	0.11	0.07
Tunisia	0.65	0.69	0.15	0.06	0.02	0.00	0.55	0.67	0.08	0.04	0.01	0.00
Turkey	◇	◇	◇	◇	◇	◇	0.64	0.72	0.25	0.28	0.06	0.08
Ukraine	0.61	0.72	0.10	0.07	0.01	0.01	0.74	0.72	0.22	0.10	0.05	0.01
United States	0.81	0.83	0.20	0.17	0.04	0.03	0.78	0.81	0.36	0.25	0.13	0.06
Yemen	0.46	0.53	0.12	0.11	0.02	0.01	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.71</b>	<b>0.73</b>	<b>0.15</b>	<b>0.12</b>	<b>0.02</b>	<b>0.01</b>	<b>0.69</b>	<b>0.68</b>	<b>0.19</b>	<b>0.14</b>	<b>0.03</b>	<b>0.02</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.79	0.83	0.22	0.21	0.05	0.04	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.76	0.65	0.21	0.18	0.04	0.03
British Columbia, Canada	0.69	0.75	0.10	0.09	0.01	0.01	0.77	0.83	0.30	0.12	0.09	0.01
Dubai, UAE	0.60	0.73	0.14	0.30	0.02	0.09	0.74	0.61	0.34	0.17	0.12	0.03
Massachusetts, US	0.77	0.80	0.14	0.19	0.02	0.04	0.83	0.84	0.42	0.33	0.18	0.11
Minnesota, US	0.74	0.87	0.27	0.20	0.07	0.04	0.74	0.71	0.44	0.14	0.19	0.02
Ontario, Canada	0.77	0.77	0.17	0.17	0.03	0.03	0.76	0.82	0.12	0.16	0.02	0.03
Quebec, Canada	0.75	0.80	0.18	0.12	0.03	0.01	0.78	0.71	0.39	0.29	0.15	0.09

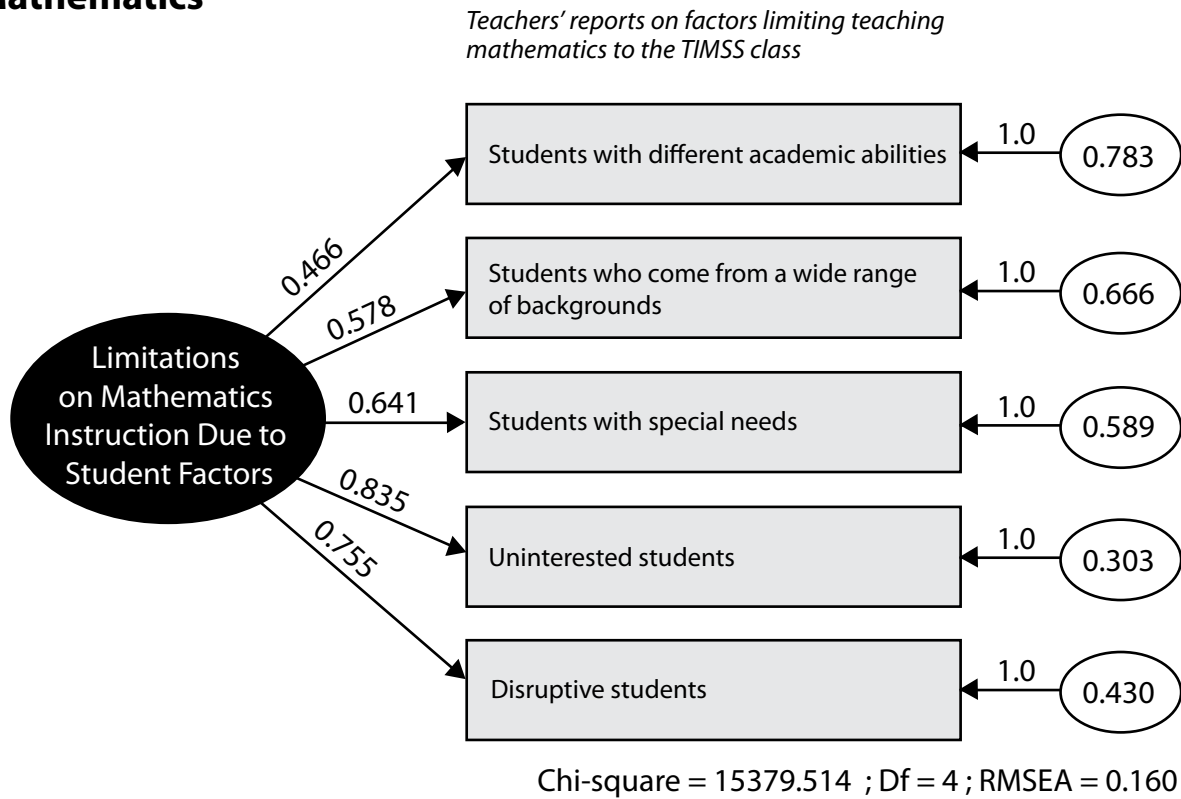
SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◇) indicates the country did not participate in the assessment.



**Exhibit 12.9 Latent Variable Model of Teachers' Reports on Limitations on Instruction Due to Student Factors, Grade 4**

### Mathematics



### Science

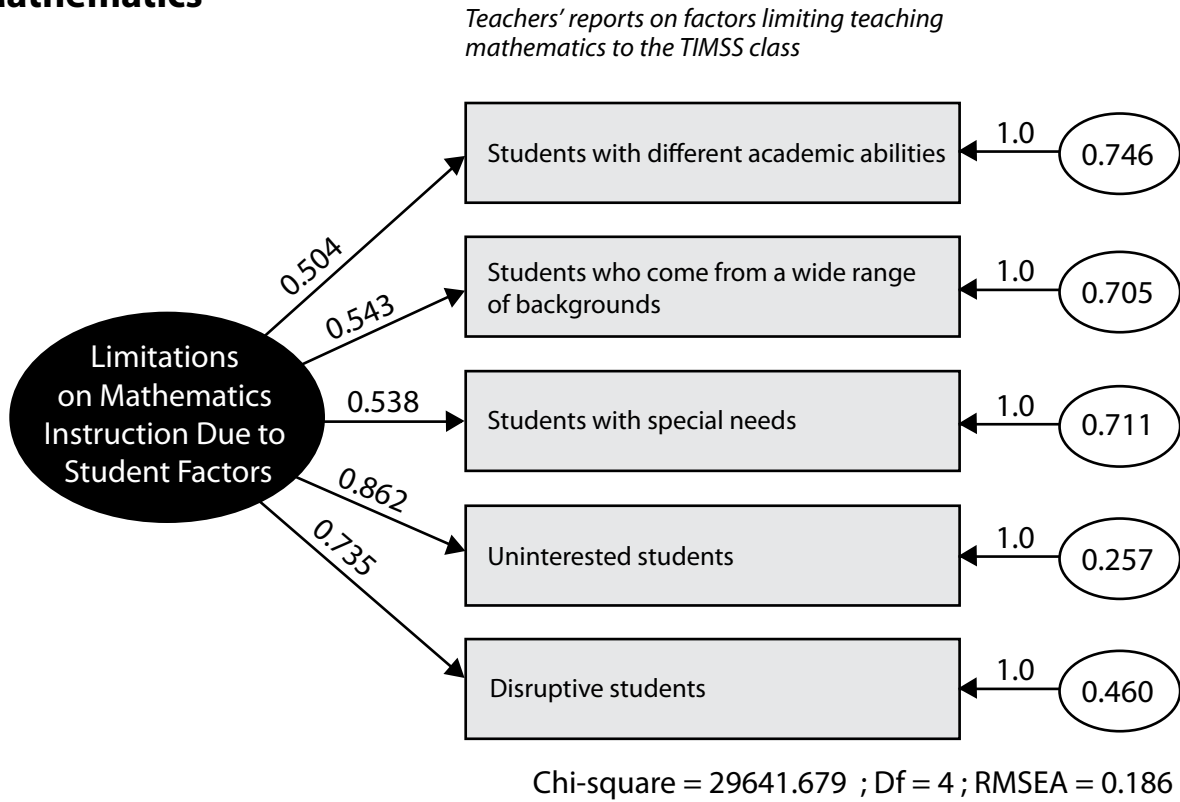
**Factor: Limitations on Science Instruction Due to Student Factors**

		Limitations on Science Instruction Due to Student Factors
Teachers' reports on factors limiting teaching science to the TIMSS class	<i>Observed Variable</i>	<i>Factor Loadings</i>
	Students with different academic abilities	0.603
	Students who come from a wide range of backgrounds	0.675
	Students with special needs	0.686
	Uninterested students	0.851
	Disruptive students	0.785

Chi-square=23354.600; Df=4; RMSEA=0.200

**Exhibit 12.9 Latent Variable Model of Teachers' Reports on Limitations on Instruction Due to Student Factors, Grade 8 (Continued)**

### Mathematics



### Science

**Factor: Limitations on Science Instruction Due to Student Factors**

		Limitations on Science Instruction Due to Student Factors
Teachers' reports on factors limiting teaching science to the TIMSS class	<i>Observed Variable</i>	<i>Factor Loadings</i>
	Students with different academic abilities	0.520
	Students who come from a wide range of backgrounds	0.555
	Students with special needs	0.521
	Uninterested students	0.830
	Disruptive students	0.754

Chi-square= 56470.929; Df=4; RMSEA=0.190

**Exhibit 12.10 Index of Teachers' Emphasis on Mathematics (EMH) / Science (ESH) Homework—Reliability and Validity Indicators**

Country	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.13	0.07	0.04	0.06	0.00	0.00	-0.41	-0.37	0.02	0.04	0.00	0.00
Armenia	0.08	-0.10	0.04	0.02	0.00	0.00	0.02	0.22	0.06	0.03	0.00	0.00
Australia	0.02	0.01	0.13	0.18	0.02	0.03	-0.27	-0.29	0.28	0.16	0.08	0.03
Austria	-0.11	-0.05	0.05	0.06	0.00	0.00	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	-0.03	-0.31	0.13	0.12	0.02	0.01
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	-0.07	0.04	0.16	0.04	0.02	0.00
Botswana	◇	◇	◇	◇	◇	◇	0.11	-0.20	0.12	0.07	0.01	0.01
Bulgaria	◇	◇	◇	◇	◇	◇	0.16	-0.22	0.19	0.04	0.04	0.00
Chinese Taipei	0.04	-0.18	0.06	0.04	0.00	0.00	-0.02	-0.01	0.20	0.13	0.04	0.02
Colombia	-0.46	-0.07	0.04	0.13	0.00	0.02	-0.05	0.21	0.12	0.05	0.01	0.00
Cyprus	◇	◇	◇	◇	◇	◇	0.02	-0.27	0.05	0.02	0.00	0.00
Czech Republic	0.04	0.21	0.04	0.07	0.00	0.00	-0.02	0.06	0.14	0.05	0.02	0.00
Denmark	-0.33	0.26	0.04	0.10	0.00	0.01	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	-0.21	-0.03	0.04	0.06	0.00	0.00
El Salvador	0.14	0.09	0.02	0.06	0.00	0.00	0.09	-0.39	0.05	0.13	0.00	0.02
England	-0.03	-0.07	0.10	0.07	0.01	0.01	-0.26	0.01	0.31	0.28	0.09	0.08
Georgia	-0.04	0.08	0.05	0.11	0.00	0.01	0.26	0.32	0.07	0.05	0.00	0.00
Germany	0.19	0.06	0.06	0.04	0.00	0.00	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	-0.27	-0.53	0.11	0.12	0.01	0.02
Hong Kong SAR	0.41	0.07	0.15	0.02	0.02	0.00	-0.34	-0.36	0.29	0.09	0.08	0.01
Hungary	0.14	0.32	0.03	0.07	0.00	0.01	0.15	0.39	0.14	0.05	0.02	0.00
Indonesia	◇	◇	◇	◇	◇	◇	-0.04	-0.30	0.09	0.06	0.01	0.00
Iran, Islamic Rep. of	0.06	0.25	0.06	0.13	0.00	0.02	0.29	0.27	0.02	0.07	0.00	0.00
Israel	◇	◇	◇	◇	◇	◇	0.26	0.11	0.22	0.06	0.05	0.00
Italy	0.25	0.20	0.08	0.10	0.01	0.01	-0.07	0.30	0.06	0.02	0.00	0.00
Japan	0.08	0.06	0.03	0.06	0.00	0.00	-0.19	-0.02	0.09	0.04	0.01	0.00
Jordan	◇	◇	◇	◇	◇	◇	-0.16	-0.03	0.08	0.11	0.01	0.01
Kazakhstan	0.07	-0.14	0.10	0.06	0.01	0.00	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	-0.43	-0.42	0.05	0.05	0.00	0.00
Kuwait	-0.24	0.16	0.08	0.08	0.01	0.01	0.22	-0.04	0.05	0.09	0.00	0.01
Latvia	-0.16	0.15	0.03	0.03	0.00	0.00	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.17	0.25	0.10	0.07	0.01	0.01
Lithuania	0.25	0.09	0.05	0.02	0.00	0.00	0.24	0.27	0.10	0.05	0.01	0.00
Malaysia	◇	◇	◇	◇	◇	◇	0.00	0.21	0.09	0.18	0.01	0.03
Malta	◇	◇	◇	◇	◇	◇	0.32	-0.50	0.24	0.26	0.06	0.07
Morocco	0.12	0.18	0.11	0.10	0.01	0.01	-0.85	-0.19	0.13	0.03	0.02	0.00
Netherlands	0.11	0.20	0.15	0.05	0.02	0.00	◇	◇	◇	◇	◇	◇
New Zealand	0.12	0.10	0.06	0.02	0.00	0.00	◇	◇	◇	◇	◇	◇
Norway	-0.34	0.17	0.03	0.06	0.00	0.00	0.08	-0.20	0.06	0.04	0.00	0.00
Oman	◇	◇	◇	◇	◇	◇	0.23	-0.33	0.08	0.04	0.01	0.00
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.24	-0.42	0.10	0.04	0.01	0.00
Qatar	0.09	-0.35	0.06	0.08	0.00	0.01	-0.64	-0.03	0.09	0.14	0.01	0.02
Romania	◇	◇	◇	◇	◇	◇	0.02	0.28	0.12	0.07	0.01	0.00
Russian Federation	0.23	-0.09	0.07	0.14	0.00	0.02	-0.01	0.10	0.07	0.03	0.00	0.00
Saudi Arabia	◇	◇	◇	◇	◇	◇	0.00	-0.76	0.08	0.17	0.01	0.03
Scotland	-0.04	0.16	0.08	0.16	0.01	0.03	-0.45	-0.15	0.42	0.19	0.18	0.04
Serbia	◇	◇	◇	◇	◇	◇	0.09	-0.13	0.03	0.03	0.00	0.00
Singapore	-0.05	-0.08	0.07	0.01	0.01	0.00	0.05	-0.25	0.25	0.11	0.06	0.01
Slovak Republic	0.09	-0.03	0.09	0.06	0.01	0.00	◇	◇	◇	◇	◇	◇
Slovenia	0.16	0.18	0.02	0.03	0.00	0.00	0.01	-0.08	0.10	0.03	0.01	0.00
Sweden	0.06	0.11	0.06	0.10	0.00	0.01	0.04	-0.17	0.05	0.06	0.00	0.00
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.07	0.17	0.06	0.09	0.00	0.01
Thailand	◇	◇	◇	◇	◇	◇	0.09	-0.02	0.11	0.05	0.01	0.00
Tunisia	-0.18	0.10	0.04	0.04	0.00	0.00	-0.23	0.02	0.02	0.03	0.00	0.00
Turkey	◇	◇	◇	◇	◇	◇	0.20	0.05	0.07	0.05	0.00	0.00
Ukraine	-0.19	0.17	0.09	0.04	0.01	0.00	-0.02	0.06	0.04	0.02	0.00	0.00
United States	0.23	0.05	0.04	0.02	0.00	0.00	0.30	0.04	0.22	0.05	0.05	0.00
Yemen	-0.08	-0.36	0.13	0.05	0.02	0.00	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.07</b>	<b>0.08</b>	<b>0.06</b>	<b>0.06</b>	<b>0.00</b>	<b>0.00</b>	<b>0.01</b>	<b>-0.03</b>	<b>0.09</b>	<b>0.05</b>	<b>0.01</b>	<b>0.00</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	-0.40	-0.04	0.02	0.03	0.00	0.00	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.10	0.20	0.07	0.06	0.01	0.00
British Columbia, Canada	0.15	-0.09	0.05	0.10	0.00	0.01	0.34	0.29	0.15	0.05	0.02	0.00
Dubai, UAE	0.06	-0.16	0.34	0.11	0.11	0.01	0.25	0.05	0.10	0.16	0.01	0.03
Massachusetts, US	-0.15	-0.09	0.11	0.08	0.01	0.01	0.15	-0.72	0.30	0.18	0.09	0.03
Minnesota, US	0.15	0.26	0.11	0.18	0.01	0.03	0.16	-0.37	0.24	0.10	0.06	0.01
Ontario, Canada	0.17	0.22	0.05	0.10	0.00	0.01	0.33	-0.11	0.11	0.11	0.01	0.01
Quebec, Canada	0.24	-0.09	0.12	0.07	0.01	0.01	0.05	0.02	0.24	0.21	0.06	0.04

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◇) indicates the country did not participate in the assessment.

*serious problems* = 3. For mathematics, an average was computed across three statements: 1) The school building needs significant repair; 2) Classrooms are overcrowded; and 3) Teachers do not have adequate workspace outside of their classroom. For science an additional statement about the “availability of materials to conduct science experiments or investigations” was included in the index computation. Students at the high level of the index had teachers with an average score equal to 1, i.e., their teachers reported that none of the issues presented above constituted a problem. Students at the medium level had teachers with an average response value greater than 1 but less than or equal to 2. Students at the low level had teachers with an average score greater than 2.

Developed in 2007, the index is presented in Exhibit 8.9 of the *TIMSS 2007 International Mathematics Report* and Exhibit 8.10 of the *TIMSS 2007 International Science Report*. The median reliability coefficients for fourth grade mathematics and science were 0.58 and 0.62, respectively, and 0.60 and 0.66 for mathematics and science at the eighth grade. The relationship to mathematics and science achievement varied considerably across countries, perhaps reflecting the status of the teaching profession and the resources available for support. In some countries, such as El Salvador and Morocco, where teaching conditions may not be optimal, the index was positively related to achievement whereas in others (e.g., Chinese Taipei and Japan) there was no relationship. This is reflected in a relatively low international median multiple correlation between the component variables (ranging between 0.08 and 0.13) and R-square values less than 0.02, as shown in Exhibit 12.11.

Exhibit 12.12 presents the latent factor models corresponding to these indices. The models are similar for mathematics and science, except that science includes an extra statement about the availability of materials for conducting science experiments or investigations. In all models, factor loadings were strongly positive, 0.5 or greater, with the highest loading associated with the statement “teachers do not have adequate workspace outside of their classroom”. For science, the RMSEA value of 0.065 indicates reasonable fit at the fourth grade but somewhat less fit at the eighth grade (0.105). For mathematics no fit statistics could be computed because the model was just identified yielding trivially perfect fit.<sup>1</sup>

1 A model is just-identified if all the parameters are uniquely determined because there is just enough information in the sample variance-covariance matrix (Schumacker & Lonax, 2004)

**Exhibit 12.11 Index of Teachers' Adequate Working Conditions (TAWC)—Reliability and Validity Indicators**

Country	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.57	0.63	0.05	0.05	0.00	0.00	0.62	0.56	0.05	0.05	0.00	0.00
Armenia	0.20	0.43	0.10	0.14	0.01	0.02	0.70	0.56	0.06	0.05	0.00	0.00
Australia	0.56	0.67	0.09	0.13	0.01	0.02	0.71	0.72	0.18	0.19	0.03	0.04
Austria	0.63	0.56	0.08	0.12	0.01	0.01	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	0.60	0.70	0.13	0.18	0.02	0.03
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	0.54	0.64	0.07	0.07	0.01	0.01
Botswana	◇	◇	◇	◇	◇	◇	0.60	0.66	0.11	0.12	0.01	0.01
Bulgaria	◇	◇	◇	◇	◇	◇	0.49	0.60	0.07	0.06	0.01	0.00
Chinese Taipei	0.72	0.78	0.03	0.06	0.00	0.00	0.78	0.71	0.11	0.12	0.01	0.01
Colombia	0.70	0.76	0.25	0.20	0.06	0.04	0.66	0.72	0.25	0.28	0.06	0.08
Cyprus	◇	◇	◇	◇	◇	◇	0.55	0.66	0.04	0.02	0.00	0.00
Czech Republic	0.22	0.43	0.07	0.08	0.01	0.01	0.29	0.49	0.11	0.14	0.01	0.02
Denmark	0.56	0.60	0.07	0.09	0.00	0.01	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	0.57	0.67	0.13	0.08	0.02	0.01
El Salvador	0.58	0.63	0.21	0.31	0.04	0.10	0.51	0.65	0.17	0.20	0.03	0.04
England	0.58	0.64	0.12	0.12	0.01	0.01	0.64	0.72	0.16	0.18	0.03	0.03
Georgia	0.63	0.60	0.08	0.06	0.01	0.00	0.64	0.54	0.06	0.05	0.00	0.00
Germany	0.59	0.56	0.08	0.14	0.01	0.02	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	0.65	0.53	0.08	0.17	0.01	0.03
Hong Kong SAR	0.73	0.78	0.09	0.12	0.01	0.01	0.74	0.72	0.19	0.12	0.04	0.01
Hungary	0.60	0.66	0.06	0.06	0.00	0.00	0.65	0.68	0.16	0.13	0.03	0.02
Indonesia	◇	◇	◇	◇	◇	◇	0.67	0.68	0.12	0.15	0.01	0.02
Iran, Islamic Rep. of	0.56	0.59	0.13	0.20	0.02	0.04	0.60	0.61	0.13	0.23	0.02	0.05
Israel	◇	◇	◇	◇	◇	◇	0.59	0.63	0.20	0.17	0.04	0.03
Italy	0.59	0.62	0.11	0.13	0.01	0.02	0.52	0.51	0.11	0.10	0.01	0.01
Japan	0.69	0.72	0.03	0.04	0.00	0.00	0.67	0.70	0.06	0.08	0.00	0.01
Jordan	◇	◇	◇	◇	◇	◇	0.60	0.67	0.16	0.14	0.03	0.02
Kazakhstan	0.76	0.79	0.06	0.07	0.00	0.01	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	0.52	0.60	0.11	0.09	0.01	0.01
Kuwait	0.59	0.77	0.13	0.14	0.02	0.02	0.62	0.75	0.05	0.09	0.00	0.01
Latvia	0.38	0.47	0.14	0.15	0.02	0.02	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.61	0.71	0.07	0.32	0.01	0.11
Lithuania	0.42	0.51	0.08	0.07	0.01	0.00	0.51	0.52	0.13	0.14	0.02	0.02
Malaysia	◇	◇	◇	◇	◇	◇	0.67	0.60	0.09	0.10	0.01	0.01
Malta	◇	◇	◇	◇	◇	◇	0.58	0.71	0.37	0.37	0.14	0.13
Morocco	0.51	0.52	0.31	0.27	0.09	0.07	0.72	0.72	0.13	0.13	0.02	0.02
Netherlands	0.64	0.64	0.08	0.11	0.01	0.01	◇	◇	◇	◇	◇	◇
New Zealand	0.47	0.56	0.07	0.10	0.01	0.01	◇	◇	◇	◇	◇	◇
Norway	0.66	0.65	0.10	0.08	0.01	0.01	0.62	0.68	0.10	0.07	0.01	0.00
Oman	◇	◇	◇	◇	◇	◇	0.72	0.75	0.10	0.13	0.01	0.02
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.52	0.64	0.11	0.17	0.01	0.03
Qatar	0.74	0.74	0.05	0.31	0.00	0.09	0.66	0.66	0.11	0.28	0.01	0.08
Romania	◇	◇	◇	◇	◇	◇	0.52	0.55	0.09	0.13	0.01	0.02
Russian Federation	0.54	0.62	0.14	0.12	0.02	0.01	0.42	0.55	0.04	0.15	0.00	0.02
Saudi Arabia	◇	◇	◇	◇	◇	◇	—	0.70	—	0.11	—	0.01
Scotland	0.58	0.55	0.07	0.10	0.01	0.01	0.57	0.64	0.08	0.17	0.01	0.03
Serbia	◇	◇	◇	◇	◇	◇	0.59	0.69	0.09	0.10	0.01	0.01
Singapore	0.72	0.74	0.01	0.08	0.00	0.01	0.73	0.72	0.18	0.10	0.03	0.01
Slovak Republic	0.48	0.58	0.10	0.13	0.01	0.02	◇	◇	◇	◇	◇	◇
Slovenia	0.58	0.63	0.08	0.08	0.01	0.01	0.54	◇	0.06	◇	0.00	◇
Sweden	0.54	0.60	0.06	0.06	0.00	0.00	0.60	0.64	0.05	0.08	0.00	0.01
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.54	0.59	0.12	0.10	0.02	0.01
Thailand	◇	◇	◇	◇	◇	◇	0.69	0.66	0.32	0.33	0.10	0.11
Tunisia	0.54	0.57	0.07	0.10	0.01	0.01	0.68	0.66	0.09	0.11	0.01	0.01
Turkey	◇	◇	◇	◇	◇	◇	0.51	0.64	0.15	0.26	0.02	0.07
Ukraine	0.50	0.54	0.13	0.12	0.02	0.01	0.48	0.52	0.10	0.09	0.01	0.01
United States	0.62	0.65	0.17	0.18	0.03	0.03	0.65	0.70	0.16	0.16	0.03	0.03
Yemen	0.62	0.52	0.16	0.18	0.03	0.03	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.58</b>	<b>0.62</b>	<b>0.08</b>	<b>0.12</b>	<b>0.01</b>	<b>0.01</b>	<b>0.60</b>	<b>0.66</b>	<b>0.11</b>	<b>0.13</b>	<b>0.01</b>	<b>0.02</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.54	0.64	0.09	0.14	0.01	0.02	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.47	0.53	0.13	0.14	0.02	0.02
British Columbia, Canada	0.66	0.67	0.04	0.05	0.00	0.00	0.59	0.61	0.08	0.07	0.01	0.01
Dubai, UAE	0.51	0.85	0.19	0.29	0.04	0.08	0.65	0.60	0.19	0.23	0.04	0.05
Massachusetts, US	0.56	0.57	0.11	0.08	0.01	0.01	0.66	0.55	0.21	0.28	0.04	0.08
Minnesota, US	0.58	0.53	0.10	0.25	0.01	0.06	0.61	0.69	0.18	0.28	0.03	0.08
Ontario, Canada	0.39	0.54	0.15	0.11	0.02	0.01	0.63	0.69	0.12	0.12	0.01	0.01
Quebec, Canada	0.63	0.59	0.05	0.05	0.00	0.00	0.67	0.57	0.17	0.22	0.03	0.05

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

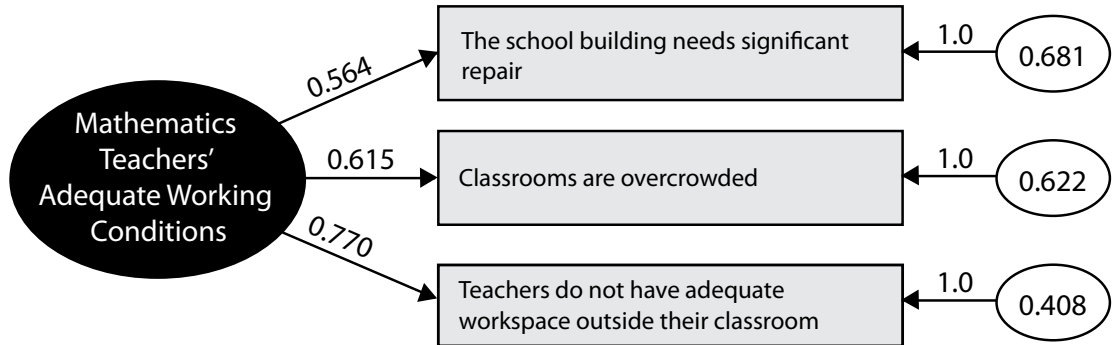
A diamond (◇) indicates the country did not participate in the assessment.

A dash (—) indicates comparable data are not available.

Exhibit 12.12 Latent Variable Model of Teachers' Adequate Working Conditions, Grade 4

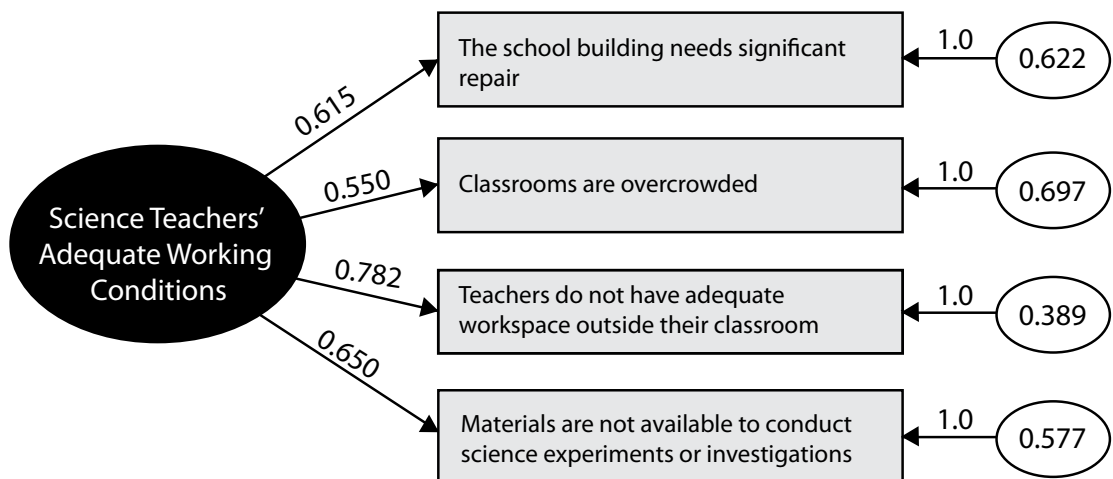
### Mathematics

*Teachers' reports on severity of problems in their school*



### Science

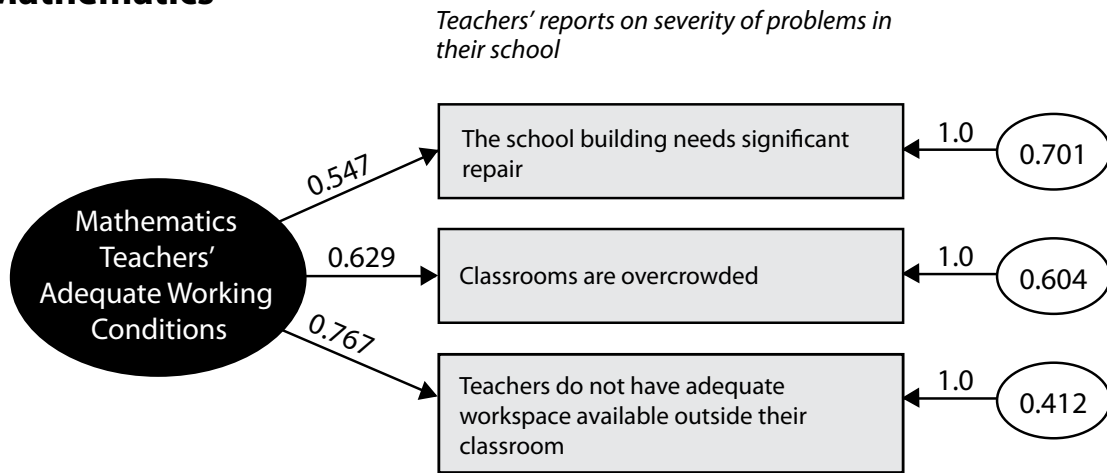
*Teachers' reports on severity of problems in their school*



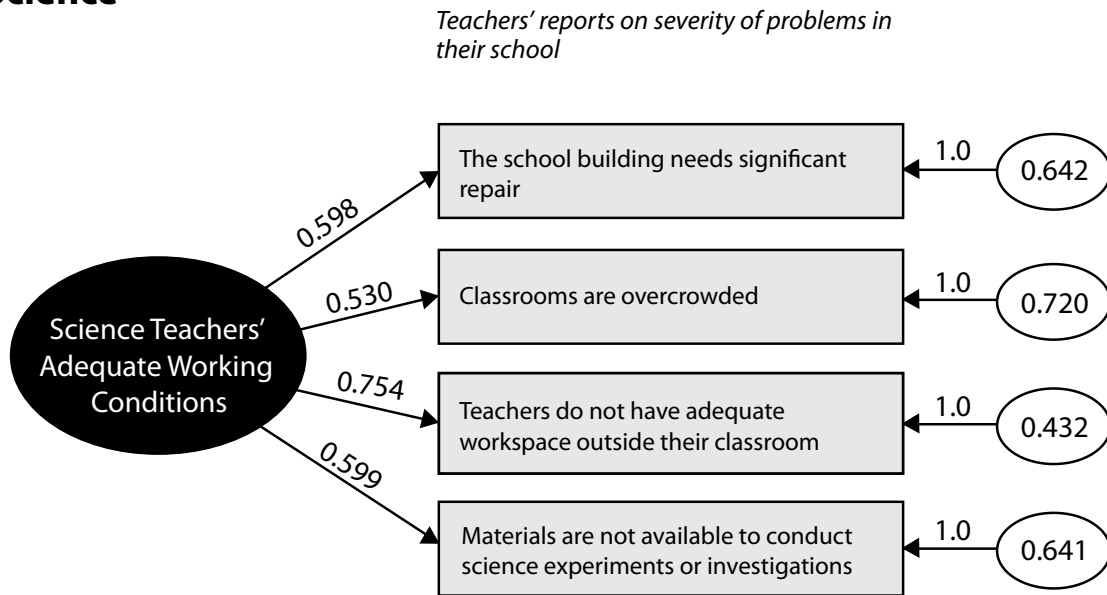
Chi-square = 1344.375 ; Df = 2 ; RMSEA = 0.065

Exhibit 12.12 Latent Variable Model of Teachers' Adequate Working Conditions, Grade 8 (Continued)

### Mathematics



### Science



Chi-square = 8826.390 ; Df = 2 ; RMSEA = 0.105

The Index of Mathematics Teachers' Perception of School Climate (TPSC) and the Index of Science Teachers Perception of School Climate (TPSC) summarize teachers' reports about their school and how supportive the climate is for learning. TIMSS asked teachers to rate their school on eight attributes:<sup>2</sup> 1) Teachers' job satisfaction; 2) Teachers' understanding of the school's curricular goals; 3) Teachers' degree of success in implementing the school's curriculum; 4) Teachers' expectations for student achievement; 5) Parental support for student achievement; 6) Parental involvement in school activities; 7) Students' regard for school property; and 8) Students' desire to do well in school. An average was computed across the eight items on a 5-point scale: *very high* = 1, *high* = 2, *medium* = 3, *low* = 4, and *very low* = 5. Students at the high level of the indices had teachers with an average score less than or equal to 2, meaning that they rated their school to be high or very high, on average, across the eight statements. Teacher ratings averaging greater than 2 but less than or equal to 3 corresponded to the medium level of the index, and teacher ratings greater than 3 corresponded to the low level. The index, developed in 2003, is presented in Exhibit 8.12 of the *TIMSS 2007 International Mathematics Report* and Exhibit 8.13 of the *TIMSS 2007 International Science Report*, including trends from 2003.

As shown in Exhibit 12.13, the eight components form reliable scales, with median reliability coefficients ranging from 0.81 to 0.83 for mathematics and science at fourth and eighth grades. Also, median multiple correlations between the eight statements and student achievement ranged from 0.21 to 0.23, corresponding to R-squares of 0.04 to 0.05, across the subjects and grades.

Exhibit 12.14 presents the latent factor models for the indices for mathematics and science at fourth and eighth grades. In each case, all component variables loaded relatively highly on the teachers' perception of school climate factor. Highest loadings (above 0.7) were associated with "parental support for student achievement", "parental involvement in school activities", and "teachers' degree of success in implementing the school curriculum."

2 TIMSS also asked school principals to rate their schools on these eight attributes. Indices based on principals' ratings are presented in Exhibits 12.21 and 12.22.



**Exhibit 12.13 Index of Mathematics / Science Teachers' Perception of School Climate (TPSC)—Reliability and Validity Indicators**

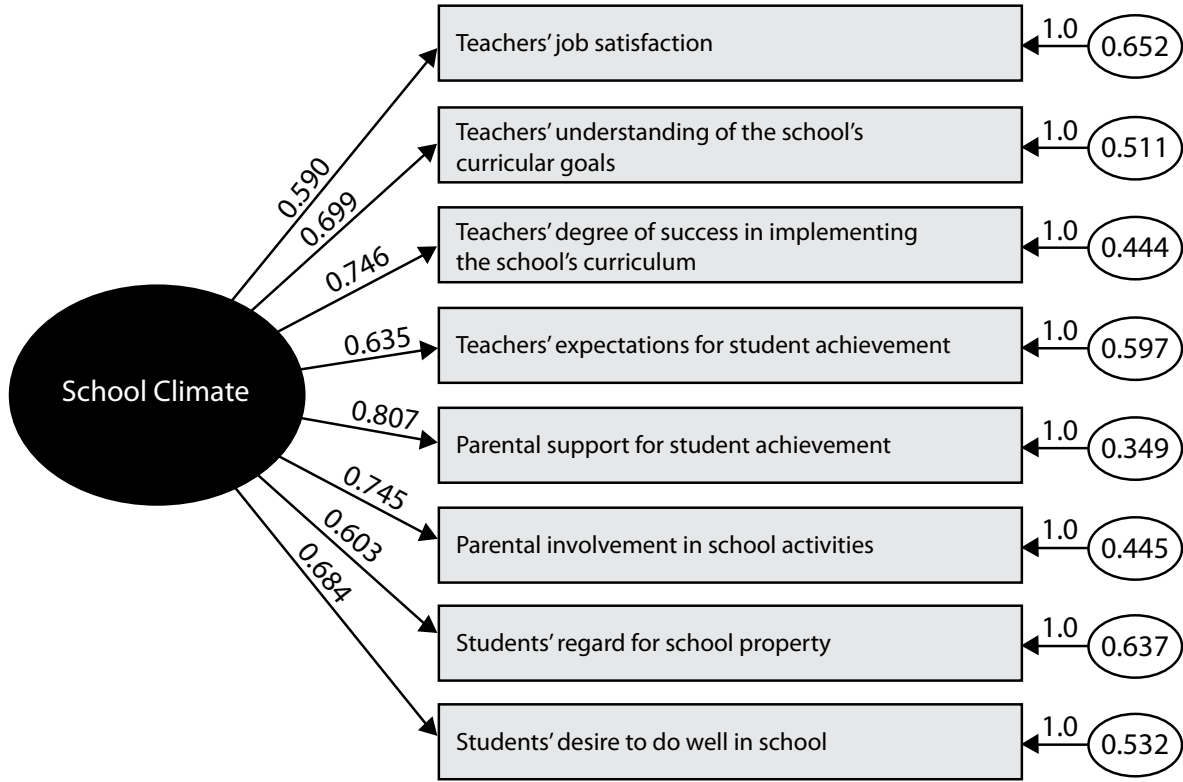
Country	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.79	0.79	0.14	0.15	0.02	0.02	0.75	0.79	0.08	0.05	0.01	0.00
Armenia	0.67	0.67	0.19	0.22	0.04	0.05	0.64	0.67	0.10	0.07	0.01	0.01
Australia	0.85	0.86	0.30	0.29	0.09	0.08	0.89	0.88	0.40	0.35	0.16	0.12
Austria	0.80	0.80	0.18	0.19	0.03	0.04	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	0.84	0.77	0.16	0.15	0.03	0.02
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	0.83	0.81	0.08	0.09	0.01	0.01
Botswana	◇	◇	◇	◇	◇	◇	0.81	0.85	0.27	0.27	0.07	0.08
Bulgaria	◇	◇	◇	◇	◇	◇	0.88	0.83	0.34	0.20	0.12	0.04
Chinese Taipei	0.82	0.86	0.16	0.10	0.02	0.01	0.85	0.86	0.22	0.24	0.05	0.06
Colombia	0.86	0.85	0.28	0.27	0.08	0.07	0.90	0.87	0.25	0.24	0.06	0.06
Cyprus	◇	◇	◇	◇	◇	◇	0.82	0.85	0.06	0.06	0.00	0.00
Czech Republic	0.75	0.77	0.13	0.14	0.02	0.02	0.80	0.77	0.25	0.21	0.06	0.04
Denmark	0.81	0.82	0.17	0.21	0.03	0.04	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	0.85	0.86	0.20	0.24	0.04	0.06
El Salvador	0.85	0.87	0.16	0.17	0.02	0.03	0.85	0.81	0.16	0.23	0.03	0.05
England	0.83	0.82	0.24	0.24	0.06	0.06	0.88	0.88	0.43	0.39	0.19	0.15
Georgia	0.85	0.83	0.21	0.23	0.05	0.05	0.75	0.80	0.15	0.12	0.02	0.01
Germany	0.81	0.81	0.28	0.30	0.08	0.09	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	0.68	0.77	0.27	0.26	0.08	0.07
Hong Kong SAR	0.88	0.86	0.30	0.18	0.09	0.03	0.85	0.85	0.44	0.36	0.19	0.13
Hungary	0.85	0.85	0.35	0.33	0.12	0.11	0.79	0.81	0.29	0.26	0.08	0.07
Indonesia	◇	◇	◇	◇	◇	◇	0.86	0.87	0.14	0.15	0.02	0.02
Iran, Islamic Rep. of	0.81	0.81	0.31	0.32	0.09	0.10	0.89	0.86	0.42	0.31	0.18	0.09
Israel	◇	◇	◇	◇	◇	◇	0.87	0.86	0.44	0.30	0.19	0.09
Italy	0.81	0.81	0.15	0.15	0.02	0.02	0.80	0.80	0.15	0.16	0.02	0.02
Japan	0.79	0.78	0.12	0.10	0.01	0.01	0.82	0.87	0.22	0.23	0.05	0.05
Jordan	◇	◇	◇	◇	◇	◇	0.80	0.84	0.31	0.24	0.09	0.06
Kazakhstan	0.82	0.82	0.21	0.15	0.04	0.02	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	0.81	0.81	0.18	0.13	0.03	0.02
Kuwait	0.75	0.86	0.19	0.20	0.03	0.04	0.75	0.85	0.07	0.16	0.01	0.03
Latvia	0.78	0.80	0.11	0.14	0.01	0.02	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.84	0.86	0.34	0.29	0.12	0.09
Lithuania	0.80	0.80	0.18	0.15	0.03	0.02	0.74	0.78	0.22	0.13	0.05	0.02
Malaysia	◇	◇	◇	◇	◇	◇	0.86	0.87	0.40	0.32	0.16	0.11
Malta	◇	◇	◇	◇	◇	◇	0.90	0.89	0.53	0.57	0.29	0.32
Morocco	0.85	0.82	0.29	0.34	0.08	0.12	0.82	0.85	0.18	0.23	0.03	0.05
Netherlands	0.76	0.76	0.26	0.25	0.07	0.06	◇	◇	◇	◇	◇	◇
New Zealand	0.83	0.83	0.29	0.30	0.09	0.09	◇	◇	◇	◇	◇	◇
Norway	0.77	0.77	0.14	0.13	0.02	0.02	0.75	0.76	0.16	0.14	0.03	0.02
Oman	◇	◇	◇	◇	◇	◇	0.79	0.75	0.22	0.25	0.05	0.06
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.80	0.77	0.15	0.19	0.02	0.04
Qatar	0.82	0.84	0.15	0.31	0.02	0.10	0.77	0.85	0.20	0.37	0.04	0.14
Romania	◇	◇	◇	◇	◇	◇	0.89	0.83	0.26	0.19	0.07	0.03
Russian Federation	0.83	0.83	0.26	0.25	0.07	0.06	0.79	0.81	0.19	0.21	0.04	0.04
Saudi Arabia	◇	◇	◇	◇	◇	◇	0.83	0.82	0.12	0.18	0.01	0.03
Scotland	0.83	0.82	0.22	0.22	0.05	0.05	0.87	0.89	0.30	0.29	0.09	0.08
Serbia	◇	◇	◇	◇	◇	◇	0.78	0.78	0.16	0.13	0.03	0.02
Singapore	0.81	0.83	0.29	0.31	0.08	0.10	0.88	0.87	0.49	0.46	0.24	0.21
Slovak Republic	0.75	0.78	0.24	0.29	0.06	0.09	◇	◇	◇	◇	◇	◇
Slovenia	0.70	0.70	0.08	0.08	0.01	0.01	0.77	0.78	0.17	0.10	0.03	0.01
Sweden	0.77	0.76	0.21	0.25	0.04	0.06	0.79	0.79	0.16	0.16	0.03	0.03
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.76	0.79	0.11	0.16	0.01	0.02
Thailand	◇	◇	◇	◇	◇	◇	0.83	0.87	0.25	0.33	0.06	0.11
Tunisia	0.64	0.62	0.20	0.19	0.04	0.04	0.81	0.77	0.20	0.13	0.04	0.02
Turkey	◇	◇	◇	◇	◇	◇	0.83	0.88	0.38	0.40	0.15	0.16
Ukraine	0.80	0.80	0.09	0.09	0.01	0.01	0.78	0.76	0.24	0.15	0.06	0.02
United States	0.88	0.87	0.37	0.37	0.14	0.14	0.88	0.87	0.37	0.33	0.14	0.11
Yemen	0.79	0.73	0.12	0.19	0.02	0.04	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.81</b>	<b>0.81</b>	<b>0.21</b>	<b>0.22</b>	<b>0.04</b>	<b>0.05</b>	<b>0.82</b>	<b>0.83</b>	<b>0.22</b>	<b>0.23</b>	<b>0.05</b>	<b>0.05</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.84	0.84	0.29	0.28	0.08	0.08	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.87	0.88	0.36	0.20	0.13	0.04
British Columbia, Canada	0.83	0.84	0.23	0.19	0.05	0.04	0.84	0.81	0.21	0.20	0.04	0.04
Dubai, UAE	0.86	0.83	0.37	0.41	0.14	0.17	0.82	0.79	0.44	0.35	0.19	0.12
Massachusetts, US	0.87	0.87	0.29	0.28	0.08	0.08	0.90	0.87	0.36	0.33	0.13	0.11
Minnesota, US	0.87	0.84	0.32	0.24	0.10	0.06	0.82	0.80	0.34	0.34	0.12	0.12
Ontario, Canada	0.81	0.84	0.28	0.25	0.08	0.06	0.86	0.85	0.32	0.30	0.10	0.09
Quebec, Canada	0.83	0.84	0.26	0.26	0.07	0.07	0.89	0.86	0.41	0.38	0.17	0.15

A diamond (◇) indicates the country did not participate in the assessment.

**Exhibit 12.14 Latent Variable Model of Teachers' Perception of School Climate, Grade 4**

## Mathematics

*How teachers characterize each of the following within their school*



Chi-square = 91901.579 ; Df = 10 ; RMSEA = 0.241

## Science

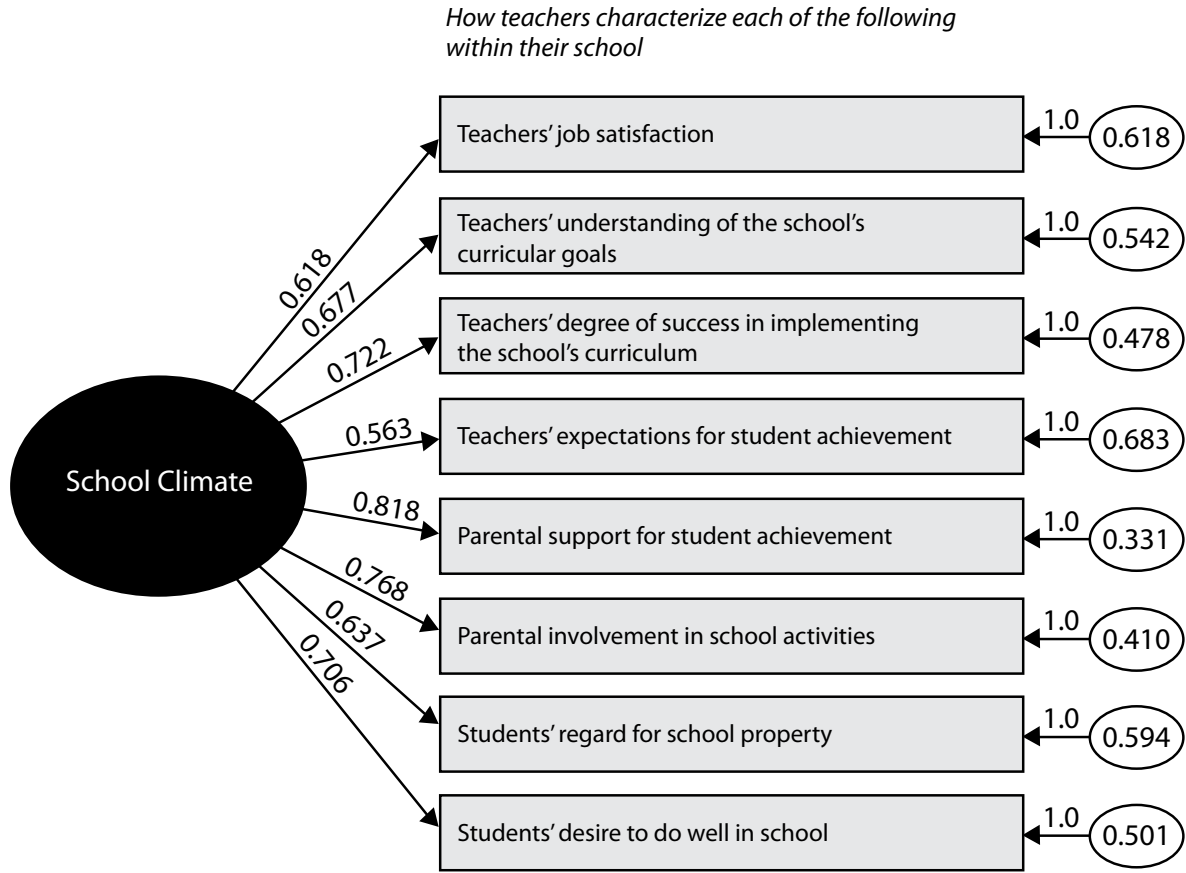
**Factor: School Climate**

		School Climate
How teachers characterize each of the following within their school	Observed Variable	Factor Loadings
	Teachers' job satisfaction	0.593
	Teachers' understanding of the school's curricular goals	0.686
	Teachers' degree of success in implementing the school's curriculum	0.731
	Teachers' expectations for student achievement	0.638
	Parental support for student achievement	0.814
	Parental involvement in school activities	0.752
	Students' regard for school property	0.608
	Students' desire to do well in school	0.694

Chi-square=98349.091; Df=11; RMSEA=0.239

**Exhibit 12.14 Latent Variable Model of Teachers' Perception of School Climate, Grade 8 (Continued)**

### Mathematics



Chi-square = 160637.399 ; Df = 11 ; RMSEA = 0.259

### Science

**Factor: School Climate**

	School Climate	
	Observed Variable	Factor Loadings
How teachers characterize each of the following within their school	Teachers' job satisfaction	0.633
	Teachers' understanding of the school's curricular goals	0.664
	Teachers' degree of success in implementing the school's curriculum	0.713
	Teachers' expectations for student achievement	0.594
	Parental support for student achievement	0.787
	Parental involvement in school activities	0.726
	Students' regard for school property	0.627
	Students' desire to do well in school	0.699

Chi-square=258053.244; Df=11; RMSEA=0.242

The Index of Mathematics Teachers' Perception of Safety in School (TPSS) and the Index of Science Teachers' Perception of Safety in School (TPSS) summarize teachers' reports of how safe and secure they feel in their schools. The indices group students according to their teachers' responses to three statements about their school: 1) This school is located in a safe neighborhood; 2) I feel safe at this school; and 3) This school's security policies and practices are sufficient. Teachers responded on a 4-point scale: *agree a lot* = 1, *agree* = 2, *disagree* = 3, and *disagree a lot* = 4. Students were assigned to the high level of the indices if their teacher agreed with all three statements, on average (i.e., an average score of 2 or less), and to the low level if their teacher disagreed, on average, with the three statements (i.e., an average score of 3 or more). The medium level included all other response combinations. The indices, developed in 2003, are presented in Exhibit 8.13 of the *TIMSS 2007 International Mathematics Report* and Exhibit 8.14 of the *TIMSS 2007 International Science Report*.

For both subjects and at both grades, as shown in Exhibit 12.15, the three components form a reliable scale, with median reliability coefficients of 0.79 and 0.80 for mathematics and science, respectively, at the fourth grade, and 0.83 for both subjects at the eighth grade. The median multiple correlation between the three components and student achievement was 0.12 for both subjects at the fourth grade (R-square of 0.01) and 0.10 and 0.11, respectively, for mathematics and science at the eighth grade (again, R-square of 0.01, after rounding).

As shown in Exhibit 12.16, the three component variables loaded highly on the teachers' perception of safety factor at both grades and for both subjects, with all loadings above 0.8. No fit statistics could be computed because the model was just-identified, yielding trivially perfect fit. Essentially, when teachers report that they "feel safe at school", this summarizes effectively their overall perceptions of safety very well.

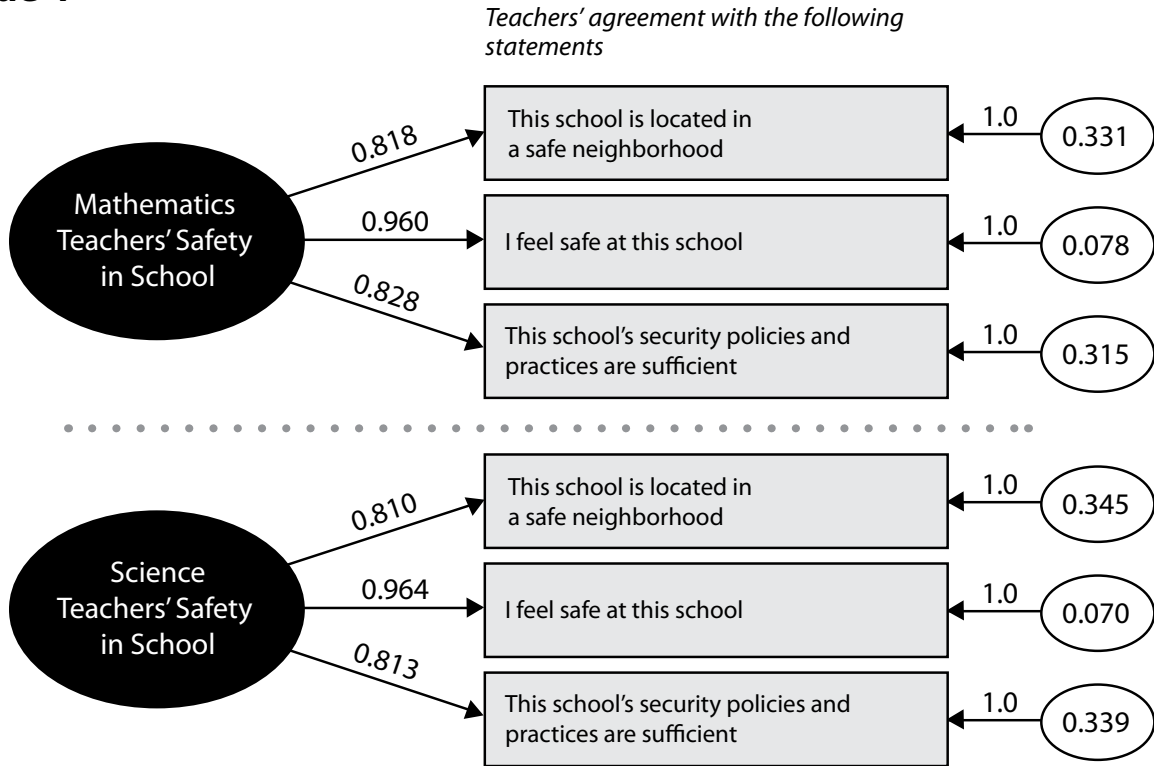
**Exhibit 12.15 Index of Mathematics / Science Teachers' Perception of Safety in School (TPSS)—Reliability and Validity Indicators**

Country	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.83	0.83	0.19	0.17	0.04	0.03	0.84	0.84	0.05	0.04	0.00	0.00
Armenia	0.89	0.89	0.03	0.03	0.00	0.00	0.84	0.89	0.07	0.04	0.00	0.00
Australia	0.79	0.79	0.24	0.24	0.06	0.06	0.86	0.82	0.24	0.21	0.06	0.04
Austria	0.69	0.71	0.06	0.09	0.00	0.01	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	0.90	0.80	0.07	0.05	0.00	0.00
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	0.83	0.84	0.04	0.04	0.00	0.00
Botswana	◇	◇	◇	◇	◇	◇	0.78	0.72	0.09	0.14	0.01	0.02
Bulgaria	◇	◇	◇	◇	◇	◇	0.77	0.84	0.16	0.06	0.03	0.00
Chinese Taipei	0.83	0.84	0.09	0.03	0.01	0.00	0.80	0.79	0.09	0.07	0.01	0.01
Colombia	0.85	0.84	0.20	0.14	0.04	0.02	0.84	0.87	0.19	0.23	0.04	0.05
Cyprus	◇	◇	◇	◇	◇	◇	0.83	0.82	0.04	0.06	0.00	0.00
Czech Republic	0.74	0.71	0.03	0.01	0.00	0.00	0.75	0.79	0.09	0.05	0.01	0.00
Denmark	0.72	0.76	0.16	0.14	0.02	0.02	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	0.79	0.79	0.09	0.09	0.01	0.01
El Salvador	0.88	0.87	0.11	0.13	0.01	0.02	0.86	0.80	0.06	0.14	0.00	0.02
England	0.81	0.82	0.23	0.26	0.05	0.07	0.81	0.79	0.25	0.22	0.06	0.05
Georgia	0.84	0.87	0.13	0.14	0.02	0.02	0.82	0.88	0.10	0.04	0.01	0.00
Germany	0.78	0.75	0.18	0.21	0.03	0.04	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	0.79	0.83	0.20	0.23	0.04	0.05
Hong Kong SAR	0.84	0.82	0.12	0.10	0.02	0.01	0.83	0.91	0.26	0.11	0.07	0.01
Hungary	0.77	0.77	0.16	0.16	0.03	0.03	0.80	0.79	0.09	0.04	0.01	0.00
Indonesia	◇	◇	◇	◇	◇	◇	0.74	0.80	0.16	0.12	0.03	0.01
Iran, Islamic Rep. of	0.85	0.85	0.09	0.09	0.01	0.01	0.88	0.84	0.14	0.21	0.02	0.04
Israel	◇	◇	◇	◇	◇	◇	0.88	0.85	0.24	0.20	0.06	0.04
Italy	0.77	0.77	0.13	0.13	0.02	0.02	0.84	0.84	0.12	0.12	0.02	0.02
Japan	0.66	0.67	0.01	0.03	0.00	0.00	0.78	0.84	0.10	0.11	0.01	0.01
Jordan	◇	◇	◇	◇	◇	◇	0.86	0.87	0.10	0.11	0.01	0.01
Kazakhstan	0.69	0.69	0.20	0.17	0.04	0.03	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	0.80	0.75	0.10	0.05	0.01	0.00
Kuwait	0.74	0.83	0.06	0.08	0.00	0.01	0.87	0.82	0.09	0.12	0.01	0.01
Latvia	0.67	0.59	0.05	0.05	0.00	0.00	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.82	0.86	0.28	0.22	0.08	0.05
Lithuania	0.84	0.84	0.04	0.03	0.00	0.00	0.89	0.83	0.08	0.05	0.01	0.00
Malaysia	◇	◇	◇	◇	◇	◇	0.85	0.84	0.15	0.11	0.02	0.01
Malta	◇	◇	◇	◇	◇	◇	0.86	0.83	0.21	0.25	0.05	0.06
Morocco	0.87	0.87	0.14	0.13	0.02	0.02	0.83	0.87	0.12	0.14	0.01	0.02
Netherlands	0.88	0.88	0.22	0.23	0.05	0.05	◇	◇	◇	◇	◇	◇
New Zealand	0.78	0.78	0.30	0.32	0.09	0.10	◇	◇	◇	◇	◇	◇
Norway	0.81	0.81	0.08	0.08	0.01	0.01	0.76	0.78	0.04	0.02	0.00	0.00
Oman	◇	◇	◇	◇	◇	◇	0.76	0.80	0.07	0.16	0.00	0.02
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.86	0.89	0.09	0.14	0.01	0.02
Qatar	0.80	0.67	0.02	0.10	0.00	0.01	0.87	0.77	0.10	0.10	0.01	0.01
Romania	◇	◇	◇	◇	◇	◇	0.81	0.79	0.14	0.09	0.02	0.01
Russian Federation	0.76	0.76	0.07	0.07	0.00	0.01	0.70	0.73	0.05	0.06	0.00	0.00
Saudi Arabia	◇	◇	◇	◇	◇	◇	0.82	0.83	0.09	0.12	0.01	0.02
Scotland	0.78	0.78	0.19	0.20	0.04	0.04	0.75	0.80	0.19	0.20	0.04	0.04
Serbia	◇	◇	◇	◇	◇	◇	0.78	0.84	0.04	0.04	0.00	0.00
Singapore	0.89	0.87	0.16	0.09	0.03	0.01	0.89	0.89	0.30	0.19	0.09	0.04
Slovak Republic	0.64	0.59	0.10	0.04	0.01	0.00	◇	◇	◇	◇	◇	◇
Slovenia	0.81	0.81	0.02	0.03	0.00	0.00	0.76	0.82	0.06	0.02	0.00	0.00
Sweden	0.77	0.77	0.16	0.19	0.02	0.04	0.76	0.72	0.11	0.10	0.01	0.01
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.83	0.78	0.11	0.10	0.01	0.01
Thailand	◇	◇	◇	◇	◇	◇	0.85	0.84	0.16	0.15	0.03	0.02
Tunisia	0.92	0.90	0.07	0.06	0.00	0.00	0.88	0.84	0.04	0.12	0.00	0.02
Turkey	◇	◇	◇	◇	◇	◇	0.83	0.88	0.16	0.19	0.03	0.04
Ukraine	0.73	0.73	0.05	0.05	0.00	0.00	0.72	0.76	0.10	0.07	0.01	0.01
United States	0.80	0.80	0.33	0.36	0.11	0.13	0.82	0.84	0.27	0.29	0.07	0.08
Yemen	0.78	0.56	0.09	0.16	0.01	0.03	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.79</b>	<b>0.80</b>	<b>0.12</b>	<b>0.12</b>	<b>0.01</b>	<b>0.01</b>	<b>0.83</b>	<b>0.83</b>	<b>0.10</b>	<b>0.11</b>	<b>0.01</b>	<b>0.01</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.84	0.85	0.19	0.20	0.04	0.04	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.76	0.77	0.16	0.11	0.02	0.01
British Columbia, Canada	0.75	0.74	0.14	0.16	0.02	0.02	0.75	0.78	0.08	0.10	0.01	0.01
Dubai, UAE	0.75	0.69	0.14	0.09	0.02	0.01	0.81	0.86	0.13	0.10	0.02	0.01
Massachusetts, US	0.81	0.83	0.24	0.31	0.06	0.10	0.78	0.74	0.28	0.31	0.08	0.09
Minnesota, US	0.75	0.83	0.27	0.29	0.07	0.08	0.73	0.75	0.23	0.16	0.05	0.03
Ontario, Canada	0.81	0.82	0.13	0.13	0.02	0.02	0.72	0.80	0.17	0.20	0.03	0.04
Quebec, Canada	0.85	0.86	0.20	0.18	0.04	0.03	0.80	0.79	0.27	0.16	0.08	0.02

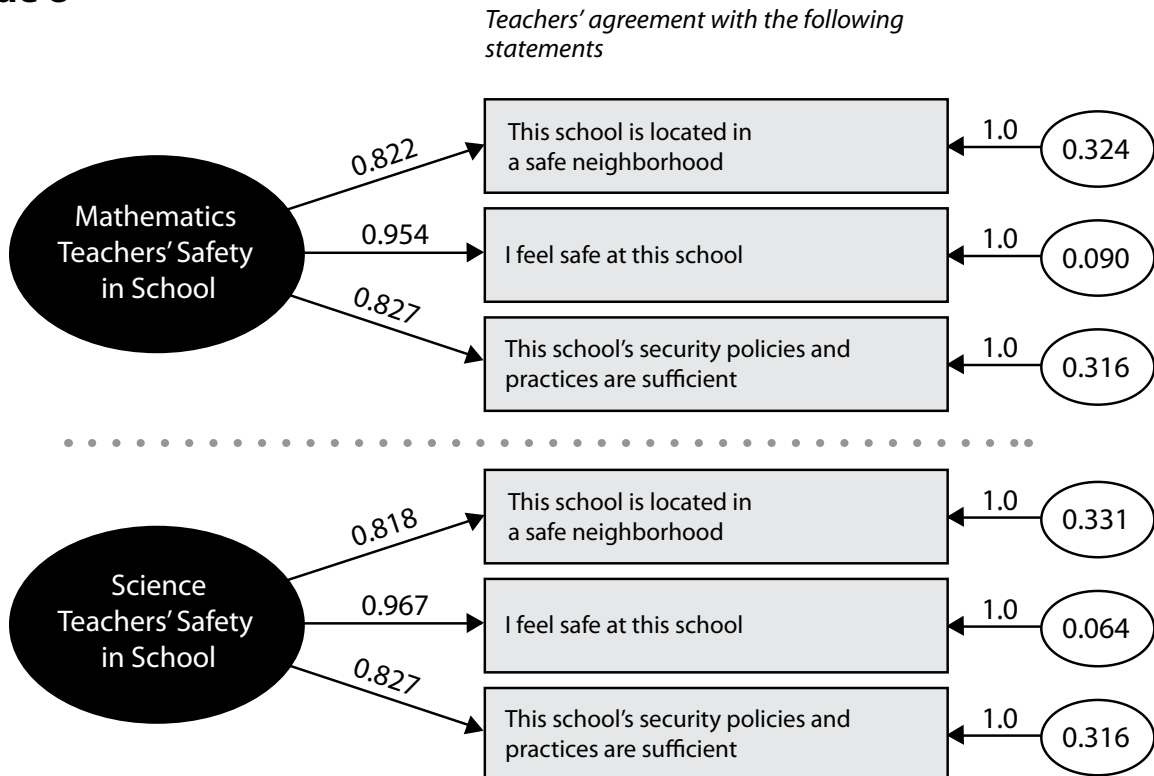
A diamond (◇) indicates the country did not participate in the assessment.

Exhibit 12.16 Latent Variable Model of Teachers' Perception of Safety in School

**Grade 4**



**Grade 8**



### 12.4.3 School-level Indices

In the *TIMSS 2007 School Questionnaire*, school principals were asked to provide information about the school context and the resources available for mathematics and science instruction. Three indices presented in the TIMSS 2007 international reports were based on questions in the school questionnaires.

The Index of Good Attendance at School (GAS) categorizes students according to their school principals' reports on the frequency of students' absenteeism and its severity as a disruptive influence on continuity in the classroom and time for learning. The index was based on principals' reports on the frequency of occurrence (rated on a 5-point scale: 1 = *never*, 2 = *rarely*, 3 = *monthly*, 4 = *weekly*, and 5 = *daily*) and severity (rated on a 3-point scale: 1 = *not a problem*, 2 = *minor problem*, and 3 = *serious problem*) of three aspects of attendance problems: 1) Arriving late at school; 2) Absenteeism (i.e., unjustified absences); and 3) Skipping class. Students were assigned to the high level of the index if their school principal reported that all three behaviors either never occur or that they are not a serious problem. Students were assigned to the low level if their principal indicated that two or more of the behaviors were a serious problem, or two behaviors were minor problems and a third behavior a serious problem. The medium level of the indices included all other response combinations. The percentage of students at each level of the index together with achievement is presented in Exhibit 8.3 of the TIMSS 2007 international reports. Exhibit 8.4 reports the percentage of students at the high level of the index with trends from 2003 and 1999 (for eighth grade). The index, developed in 1999, was originally named Index of Good School and Class Attendance.

As shown in Exhibit 12.17, the six component variables (three addressing frequency and three addressing severity) form a fairly reliable scale, with an international median reliability coefficient of 0.76 at the fourth grade and 0.81 at the eighth grade. The median multiple correlation between the component variables and student achievement was 0.15 at the fourth grade and 0.17 at the eighth grade for both mathematics and science, corresponding to R-squares of 0.02 and 0.03.

The latent factor models presented in Exhibit 12.18 show that the index of good attendance at school may be considered as two correlated factors, one consisting of the three frequency variables and the other of the three severity variables. The correlation is higher at fourth grade than at eighth grade (0.920 compared to 0.791). In general, the component variables loaded relatively highly on the two underlying factors of frequency and severity of

**Exhibit 12.17 Index of Good Attendance at School (GAS)—Reliability and Validity Indicators**

Country	Grade 4					Grade 8				
	Cronbach's Alpha Between the Component Variables	Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables	Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
		Mathematics	Science	Mathematics	Science		Mathematics	Science	Mathematics	Science
Algeria	0.71	0.30	0.28	0.09	0.08	0.80	0.04	0.05	0.00	0.00
Armenia	0.75	0.13	0.14	0.02	0.02	0.73	0.15	0.18	0.02	0.03
Australia	0.69	0.29	0.27	0.09	0.08	0.86	0.44	0.39	0.19	0.15
Austria	0.69	0.11	0.12	0.01	0.01	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	0.77	0.18	0.28	0.03	0.08
Bosnia and Herzegovina	◇	◇	◇	◇	◇	0.86	0.11	0.11	0.01	0.01
Botswana	◇	◇	◇	◇	◇	0.83	0.24	0.23	0.06	0.05
Bulgaria	◇	◇	◇	◇	◇	0.88	0.20	0.15	0.04	0.02
Chinese Taipei	0.63	0.09	0.06	0.01	0.00	0.85	0.15	0.14	0.02	0.02
Colombia	0.80	0.25	0.23	0.06	0.05	0.86	0.24	0.23	0.06	0.05
Cyprus	◇	◇	◇	◇	◇	0.73	0.05	0.09	0.00	0.01
Czech Republic	0.77	0.13	0.13	0.02	0.02	0.78	0.19	0.18	0.04	0.03
Denmark	0.84	0.15	0.15	0.02	0.02	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	0.70	0.13	0.12	0.02	0.02
El Salvador	0.83	0.16	0.19	0.03	0.04	0.83	0.15	0.16	0.02	0.02
England	0.79	0.24	0.25	0.06	0.06	0.87	0.35	0.36	0.13	0.13
Georgia	0.79	0.10	0.09	0.01	0.01	0.80	0.13	0.11	0.02	0.01
Germany	0.79	0.28	0.30	0.08	0.09	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	0.74	0.23	0.24	0.05	0.06
Hong Kong SAR	0.67	0.16	0.14	0.03	0.02	0.79	0.43	0.39	0.18	0.15
Hungary	0.89	0.26	0.25	0.07	0.06	0.86	0.16	0.12	0.03	0.02
Indonesia	◇	◇	◇	◇	◇	0.72	0.25	0.24	0.06	0.06
Iran, Islamic Rep. of	0.69	0.15	0.16	0.02	0.02	0.69	0.21	0.22	0.04	0.05
Israel	◇	◇	◇	◇	◇	0.85	0.17	0.16	0.03	0.03
Italy	0.80	0.11	0.11	0.01	0.01	0.82	0.13	0.14	0.02	0.02
Japan	0.74	0.04	0.05	0.00	0.00	0.82	0.20	0.19	0.04	0.04
Jordan	◇	◇	◇	◇	◇	0.76	0.21	0.23	0.04	0.05
Kazakhstan	0.66	0.16	0.12	0.03	0.01	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	0.81	0.10	0.10	0.01	0.01
Kuwait	0.76	0.17	0.18	0.03	0.03	0.76	0.08	0.12	0.01	0.01
Latvia	0.69	0.14	0.13	0.02	0.02	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	0.70	0.28	0.27	0.08	0.07
Lithuania	0.80	0.15	0.12	0.02	0.02	0.89	0.16	0.14	0.03	0.02
Malaysia	◇	◇	◇	◇	◇	0.81	0.25	0.25	0.06	0.06
Malta	◇	◇	◇	◇	◇	0.78	0.55	0.52	0.30	0.27
Morocco	0.74	0.11	0.11	0.01	0.01	0.78	0.18	0.18	0.03	0.03
Netherlands	0.72	0.21	0.21	0.05	0.04	◇	◇	◇	◇	◇
New Zealand	0.80	0.31	0.32	0.10	0.10	◇	◇	◇	◇	◇
Norway	0.73	0.09	0.08	0.01	0.01	0.86	0.13	0.14	0.02	0.02
Oman	◇	◇	◇	◇	◇	0.76	0.09	0.10	0.01	0.01
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	0.81	0.21	0.21	0.04	0.04
Qatar	0.57	0.12	0.17	0.01	0.03	0.71	0.23	0.28	0.05	0.08
Romania	◇	◇	◇	◇	◇	0.87	0.19	0.17	0.03	0.03
Russian Federation	0.67	0.14	0.14	0.02	0.02	0.84	0.17	0.17	0.03	0.03
Saudi Arabia	◇	◇	◇	◇	◇	0.79	0.15	0.17	0.02	0.03
Scotland	0.71	0.23	0.23	0.05	0.05	0.83	0.29	0.28	0.08	0.08
Serbia	◇	◇	◇	◇	◇	0.89	0.11	0.12	0.01	0.01
Singapore	0.72	0.13	0.14	0.02	0.02	0.80	0.35	0.37	0.12	0.13
Slovak Republic	0.84	0.15	0.17	0.02	0.03	◇	◇	◇	◇	◇
Slovenia	0.71	0.08	0.08	0.01	0.01	0.89	0.09	0.09	0.01	0.01
Sweden	0.76	0.15	0.16	0.02	0.03	0.86	0.11	0.11	0.01	0.01
Syrian Arab Republic	◇	◇	◇	◇	◇	0.79	0.15	0.14	0.02	0.02
Thailand	◇	◇	◇	◇	◇	0.78	0.17	0.15	0.03	0.02
Tunisia	0.79	0.24	0.24	0.06	0.06	0.75	0.08	0.07	0.01	0.01
Turkey	◇	◇	◇	◇	◇	0.81	0.17	0.17	0.03	0.03
Ukraine	0.76	0.17	0.15	0.03	0.02	0.86	0.18	0.18	0.03	0.03
United States	0.76	0.21	0.24	0.05	0.06	0.85	0.23	0.25	0.05	0.06
Yemen	0.76	0.15	0.15	0.02	0.02	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.76</b>	<b>0.15</b>	<b>0.15</b>	<b>0.02</b>	<b>0.02</b>	<b>0.81</b>	<b>0.17</b>	<b>0.17</b>	<b>0.03</b>	<b>0.03</b>
<b>Benchmarking Participants</b>										
Alberta, Canada	0.79	0.18	0.17	0.03	0.03	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	0.76	0.23	0.21	0.05	0.05
British Columbia, Canada	0.75	0.20	0.18	0.04	0.03	0.87	0.22	0.20	0.05	0.04
Dubai, UAE	0.81	0.19	0.13	0.04	0.02	0.76	0.27	0.23	0.07	0.05
Massachusetts, US	0.64	0.14	0.15	0.02	0.02	0.78	0.33	0.29	0.11	0.09
Minnesota, US	0.65	0.21	0.23	0.05	0.05	0.81	0.23	0.20	0.05	0.04
Ontario, Canada	0.79	0.22	0.20	0.05	0.04	0.82	0.12	0.11	0.01	0.01
Quebec, Canada	0.76	0.16	0.15	0.03	0.02	0.88	0.36	0.32	0.13	0.10

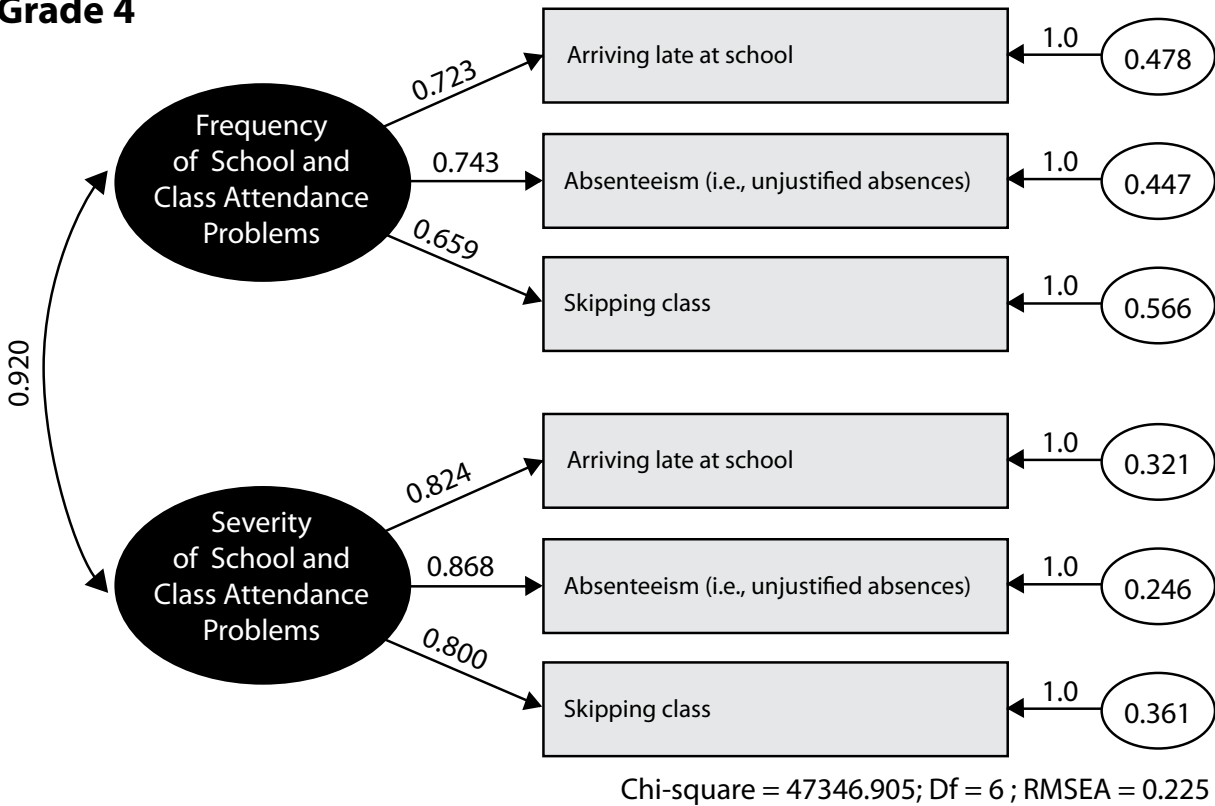
SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◇) indicates the country did not participate in the assessment.

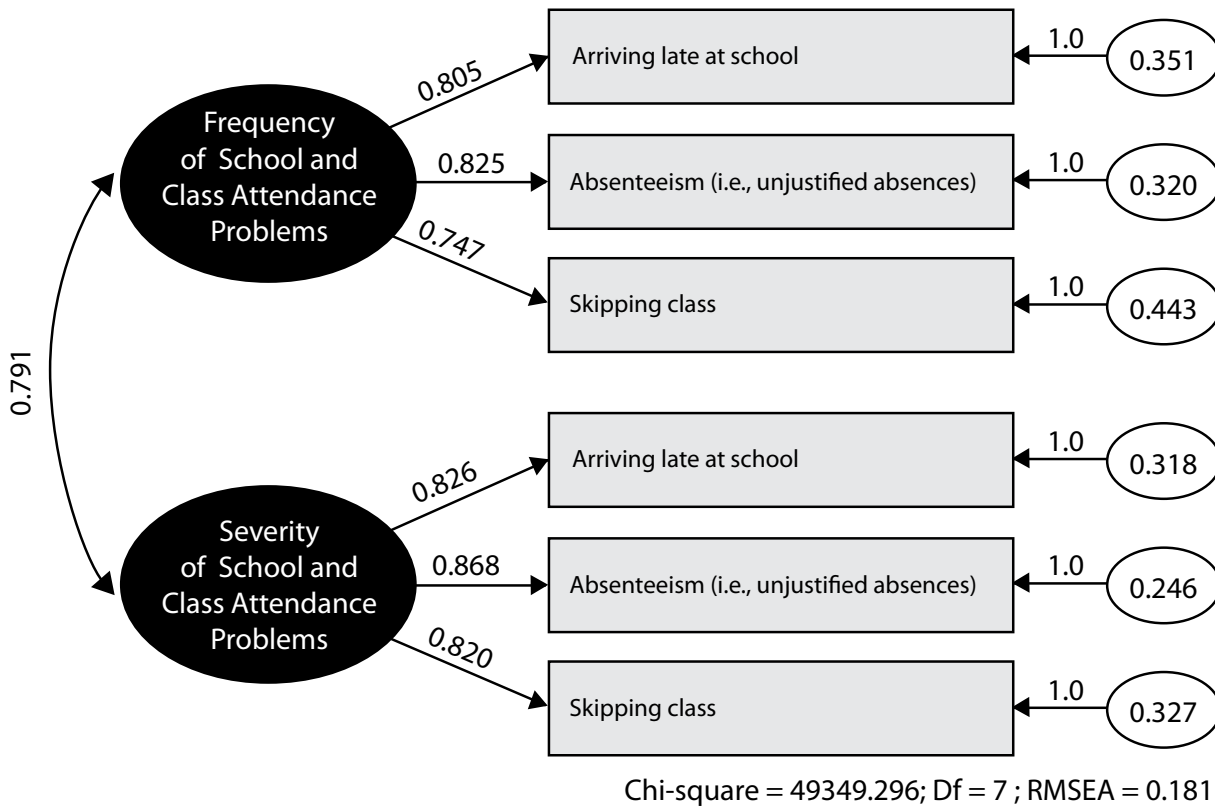


Exhibit 12.18 Latent Variable Model of Good Attendance at School

**Grade 4**



**Grade 8**



class attendance problems, with the somewhat higher loadings associated with the severity factor.

The Index of Availability of School Resources for Mathematics Instruction (ASRMI) and the Index of Availability of School Resources for Science Instruction (ASRSI) categorize students according to their principals' reports of the extent to which their schools' capacity to provide instruction is impacted by a lack of important resources. The index is based on principals' responses to a series of questions about shortages affecting schools' general capacity to provide instruction, and to provide mathematics and science instruction in particular.

Five areas where shortages or inadequacies could affect the school's general capacity to provide instruction were included in the index computation for both subjects: 1) Instructional materials (e.g., textbook); 2) Budget for supplies (e.g., paper, pencils); 3) School buildings and grounds; 4) Heating/cooling and lighting systems; and 5) Instructional space (e.g., classrooms). To make the index for mathematics, these were combined with five areas where shortages or inadequacies could affect the school's capacity to provide instruction in mathematics specifically: 1) Computers for mathematics instruction; 2) Computer software for mathematics instruction; 3) Calculators for mathematics instruction; 4) Library materials relevant to mathematics instruction; and 5) Audio-visual resources for mathematics instruction. Similarly, to make the indices for science, the five general areas were combined with six areas where shortages or inadequacies could affect the school's capacity to provide instruction in science: 1) Science laboratory equipment and materials; 2) Computers for science instruction; 3) Computer software for science instruction; 4) Calculators for science instruction; 5) Library materials relevant to science instruction; and 6) Audio-visual resources for science instruction. School principals rated each area on a 4-point scale: *none* = 1, *a little* = 2, *some* = 3, and *a lot* = 4. Students were assigned to the high level of the indices if their school principals reported that their school's capacity to provide instruction was not affected or affected only a little, on average, by shortages in both general and subject-specific areas (i.e., an average rating of less than 2 on both sets). Students at the low level had principals with average ratings greater than or equal to 3. The medium level included all other combinations of ratings.

The percentage of students at each level of the index together with achievement is presented in Exhibit 8.7 of the TIMSS 2007 international

reports. Exhibit 8.8 reports the percentage of students at the high level of the index with trends from 2003, 1999 (for eighth grade) and 1995.

As shown in Exhibit 12.19, the components form reliable scales, with median reliability coefficients of 0.85 and 0.86 for mathematics and science at the fourth grade, and 0.84 and 0.85, respectively, at the eighth grade. The median multiple correlation between the statements and student achievement ranged from 0.16 to 0.18 across the subjects and grades, corresponding to an R-square value of about 0.03.

The factor loadings presented in Exhibit 12.20 all are strongly positive (0.6 or greater). Loadings for the mathematics- and science-specific areas were somewhat higher than for the general areas. For example, for fourth grade mathematics, loadings for the mathematics-specific areas ranged from 0.790 to 0.906, compared to a range of from 0.618 to 0.726 for the general areas. With a RMSEA value above 0.2 indicating not good fit for the single factor model, it may be useful to explore a two-factor model in the future, incorporating a general resource factor and a subject specific resource factor.

The Index of Principals' Perception of School Climate (PPSC) summarizes school principals' perceptions of their school's climate. This index is based on the same eight statements rated by teachers and reported in Exhibits 12.13 and 12.14. These were: 1) Teachers' job satisfaction; 2) Teachers' understanding of the school's curricular goals; 3) Teachers' degree of success in implementing the school's curriculum; 4) Teachers' expectations for student achievement; 5) Parental support for student achievement; 6) Parental involvement in school activities; and 7) Students' regard for school property; and 8) Students' desire to do well in school. Principals rated each attribute of their school on a 5-point scale: *very high* = 1, *high* = 2, *medium* = 3; *low* = 4; and *very low* = 5. Students were assigned to the high level of the index if their school principal rated each attribute as at least high, on average (i.e., an average rating of less than or equal to 2). The medium level of the index corresponds to an average rating greater than 2 but less than or equal to 3. The low level corresponds to an average rating of greater than 3 (i.e., ratings of low or very low, on average). The index, developed in 2003, is presented in Exhibit 8.11 of the *TIMSS 2007 International Mathematics Report* and Exhibit 8.12 of the *TIMSS 2007 International Science Report*, including trends from 2003.

**Exhibit 12.19 Index of Availability of School Resources for Mathematics (ASRMI) / Science (ASRSI) Instruction—Reliability and Validity Indicators**

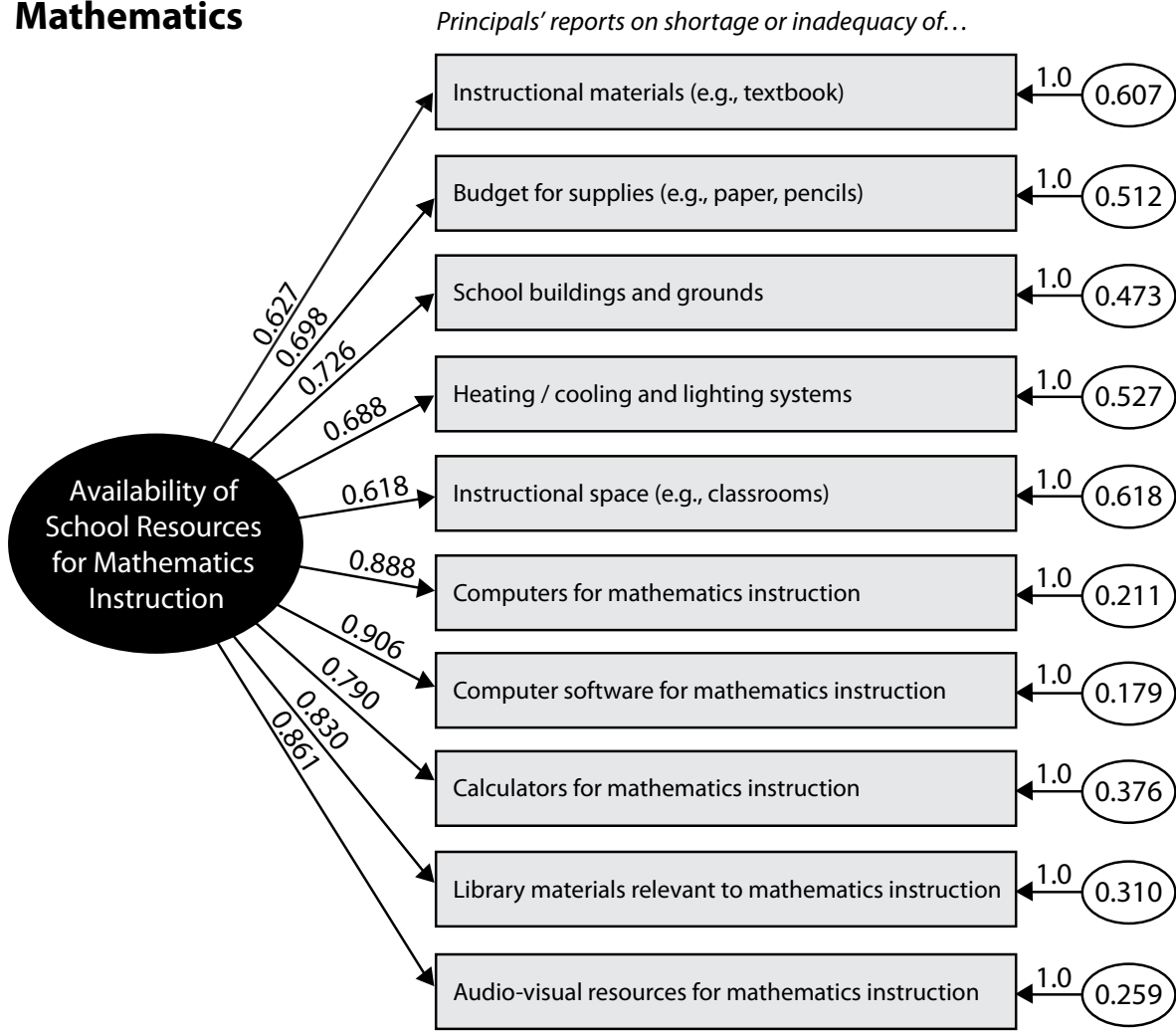
Country	Grade 4						Grade 8					
	Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables		Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science	Mathematics	Science
Algeria	0.80	0.84	0.22	0.18	0.05	0.03	0.74	0.79	0.07	0.11	0.01	0.01
Armenia	0.79	0.79	0.12	0.20	0.02	0.04	0.77	0.78	0.12	0.14	0.02	0.02
Australia	0.84	0.86	0.17	0.17	0.03	0.03	0.87	0.90	0.34	0.34	0.12	0.12
Austria	0.84	0.84	0.13	0.15	0.02	0.02	◇	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	◇	0.82	0.83	0.16	0.26	0.02	0.07
Bosnia and Herzegovina	◇	◇	◇	◇	◇	◇	0.83	0.85	0.13	0.17	0.02	0.03
Botswana	◇	◇	◇	◇	◇	◇	0.81	0.85	0.18	0.16	0.03	0.03
Bulgaria	◇	◇	◇	◇	◇	◇	0.83	0.85	0.34	0.23	0.12	0.05
Chinese Taipei	0.89	0.91	0.10	0.11	0.01	0.01	0.90	0.91	0.09	0.09	0.01	0.01
Colombia	0.88	0.91	0.38	0.35	0.14	0.12	0.92	0.92	0.27	0.24	0.07	0.06
Cyprus	◇	◇	◇	◇	◇	◇	0.80	0.87	0.07	0.09	0.01	0.01
Czech Republic	0.70	0.77	0.13	0.11	0.02	0.01	0.79	0.84	0.18	0.16	0.03	0.03
Denmark	0.85	0.86	0.14	0.16	0.02	0.03	◇	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	◇	0.84	0.85	0.19	0.15	0.04	0.02
El Salvador	0.88	0.90	0.23	0.27	0.06	0.07	0.88	0.89	0.27	0.30	0.08	0.09
England	0.85	0.88	0.12	0.16	0.01	0.02	0.87	0.90	0.14	0.19	0.02	0.04
Georgia	0.82	0.83	0.20	0.20	0.04	0.04	0.81	0.80	0.16	0.17	0.03	0.03
Germany	0.86	0.87	0.14	0.15	0.02	0.02	◇	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	◇	0.79	0.84	0.18	0.24	0.03	0.06
Hong Kong SAR	0.87	0.89	0.16	0.17	0.02	0.03	0.85	0.87	0.27	0.22	0.07	0.05
Hungary	0.86	0.88	0.18	0.24	0.03	0.06	0.85	0.88	0.20	0.13	0.04	0.02
Indonesia	◇	◇	◇	◇	◇	◇	0.88	0.89	0.27	0.31	0.07	0.09
Iran, Islamic Rep. of	0.80	0.81	0.25	0.24	0.06	0.06	0.77	0.81	0.28	0.23	0.08	0.05
Israel	◇	◇	◇	◇	◇	◇	0.87	0.88	0.31	0.30	0.10	0.09
Italy	0.85	0.85	0.16	0.15	0.02	0.02	0.81	0.84	0.17	0.17	0.03	0.03
Japan	0.90	0.91	0.07	0.09	0.01	0.01	0.87	0.89	0.17	0.15	0.03	0.02
Jordan	◇	◇	◇	◇	◇	◇	0.84	0.84	0.16	0.24	0.03	0.06
Kazakhstan	0.88	0.89	0.23	0.26	0.05	0.07	◇	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	◇	0.87	0.89	0.10	0.10	0.01	0.01
Kuwait	0.78	0.79	0.18	0.19	0.03	0.04	0.82	0.80	0.12	0.13	0.02	0.02
Latvia	0.77	0.80	0.12	0.15	0.01	0.02	◇	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	◇	0.78	0.86	0.36	0.39	0.13	0.15
Lithuania	0.85	0.85	0.16	0.12	0.02	0.01	0.80	0.83	0.11	0.14	0.01	0.02
Malaysia	◇	◇	◇	◇	◇	◇	0.93	0.94	0.18	0.16	0.03	0.02
Malta	◇	◇	◇	◇	◇	◇	0.84	0.85	0.31	0.34	0.10	0.11
Morocco	0.89	0.91	0.28	0.33	0.08	0.11	0.79	0.82	0.20	0.21	0.04	0.04
Netherlands	0.82	0.80	0.14	0.12	0.02	0.01	◇	◇	◇	◇	◇	◇
New Zealand	0.88	0.88	0.16	0.17	0.03	0.03	◇	◇	◇	◇	◇	◇
Norway	0.83	0.86	0.13	0.14	0.02	0.02	0.82	0.85	0.12	0.12	0.01	0.01
Oman	◇	◇	◇	◇	◇	◇	0.87	0.88	0.19	0.22	0.03	0.05
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	◇	0.84	0.86	0.23	0.17	0.05	0.03
Qatar	0.78	0.78	0.20	0.32	0.04	0.10	0.88	0.90	0.27	0.44	0.08	0.19
Romania	◇	◇	◇	◇	◇	◇	0.82	0.86	0.15	0.17	0.02	0.03
Russian Federation	0.88	0.89	0.20	0.22	0.04	0.05	0.84	0.85	0.15	0.16	0.02	0.03
Saudi Arabia	◇	◇	◇	◇	◇	◇	0.83	0.84	0.14	0.14	0.02	0.02
Scotland	0.84	0.84	0.17	0.18	0.03	0.03	0.82	0.85	0.20	0.22	0.04	0.05
Serbia	◇	◇	◇	◇	◇	◇	0.85	0.88	0.19	0.17	0.04	0.03
Singapore	0.90	0.90	0.12	0.13	0.01	0.02	0.69	0.73	0.19	0.11	0.03	0.01
Slovak Republic	0.85	0.84	0.23	0.22	0.05	0.05	◇	◇	◇	◇	◇	◇
Slovenia	0.84	0.86	0.09	0.10	0.01	0.01	0.86	0.88	0.14	0.14	0.02	0.02
Sweden	0.84	0.87	0.16	0.15	0.03	0.02	0.85	0.85	0.07	0.10	0.01	0.01
Syrian Arab Republic	◇	◇	◇	◇	◇	◇	0.74	0.76	0.18	0.21	0.03	0.04
Thailand	◇	◇	◇	◇	◇	◇	0.90	0.92	0.24	0.29	0.06	0.08
Tunisia	0.81	0.84	0.25	0.26	0.06	0.07	0.84	0.84	0.20	0.18	0.04	0.03
Turkey	◇	◇	◇	◇	◇	◇	0.82	0.86	0.27	0.25	0.08	0.06
Ukraine	0.85	0.84	0.17	0.18	0.03	0.03	0.84	0.84	0.20	0.20	0.04	0.04
United States	0.87	0.88	0.17	0.21	0.03	0.04	0.89	0.90	0.22	0.19	0.05	0.04
Yemen	0.91	0.92	0.17	0.25	0.03	0.06	◇	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.85</b>	<b>0.86</b>	<b>0.16</b>	<b>0.17</b>	<b>0.03</b>	<b>0.03</b>	<b>0.84</b>	<b>0.85</b>	<b>0.18</b>	<b>0.17</b>	<b>0.03</b>	<b>0.03</b>
<b>Benchmarking Participants</b>												
Alberta, Canada	0.89	0.91	0.15	0.14	0.02	0.02	◇	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	◇	0.89	0.91	0.15	0.13	0.02	0.02
British Columbia, Canada	0.81	0.83	0.14	0.17	0.02	0.03	0.89	0.89	0.11	0.12	0.01	0.02
Dubai, UAE	0.86	0.87	0.28	0.33	0.08	0.11	0.89	0.92	0.44	0.39	0.20	0.15
Massachusetts, US	0.90	0.92	0.18	0.24	0.03	0.06	0.87	0.89	0.39	0.34	0.15	0.12
Minnesota, US	0.83	0.85	0.18	0.17	0.03	0.03	0.88	0.89	0.25	0.22	0.06	0.05
Ontario, Canada	0.86	0.87	0.20	0.22	0.04	0.05	0.84	0.86	0.23	0.22	0.05	0.05
Quebec, Canada	0.78	0.82	0.09	0.06	0.01	0.00	0.82	0.87	0.29	0.27	0.08	0.07

SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◇) indicates the country did not participate in the assessment.

**Exhibit 12.20 Latent Variable Model of Availability of School Resources for Instruction, Grade 4**

### Mathematics



Chi-square = 105955.037; Df = 15 ; RMSEA = 0.212

### Science

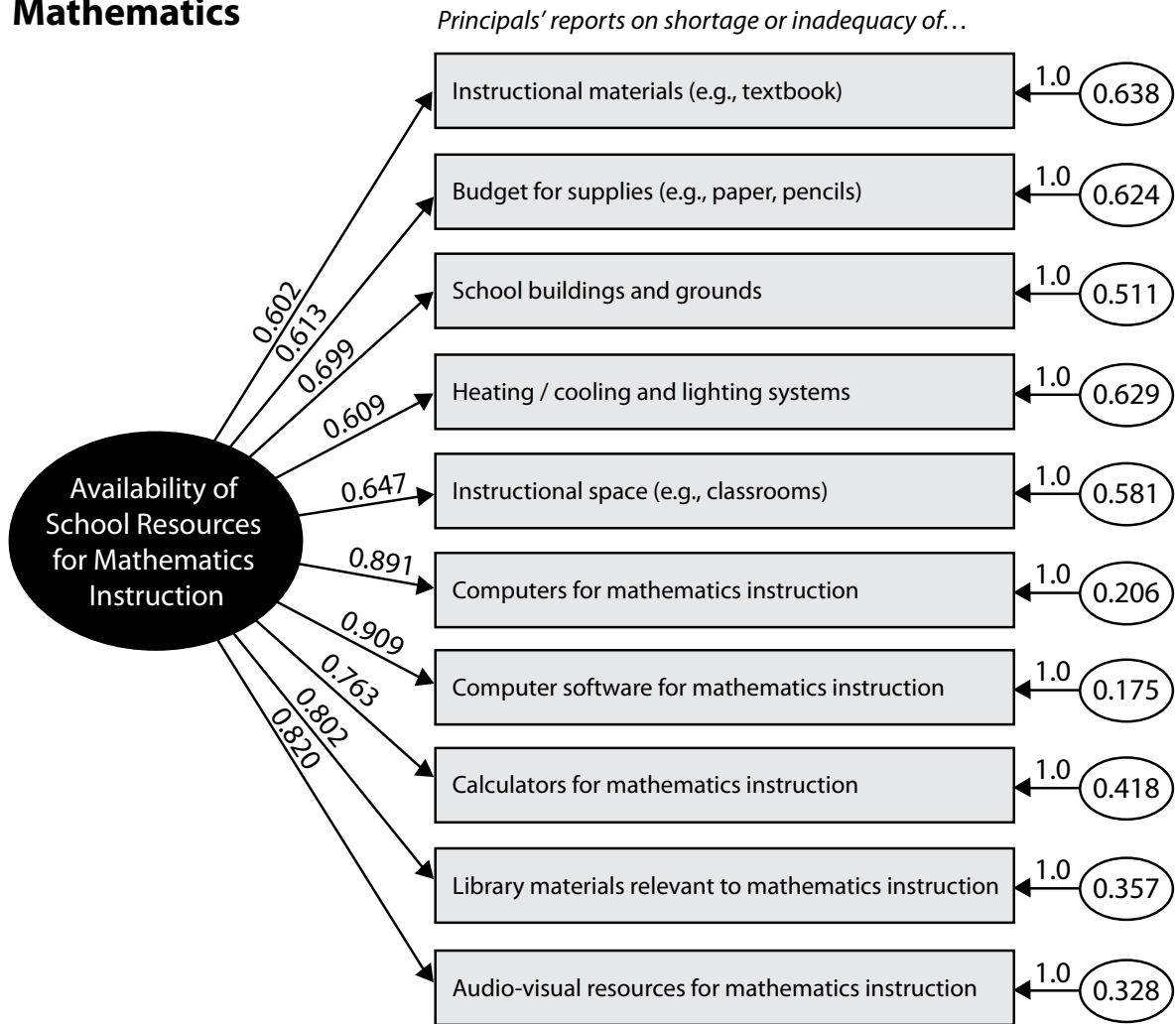
**Factor: Availability of School Resources for Science Instruction**

	Observed Variable	Availability of School Resources for Science Instruction Factor Loadings
<i>Principals' reports on shortage or inadequacy of...</i>	Instructional materials (e.g., textbook)	0.625
	Budget for supplies (e.g., paper, pencils)	0.683
	School buildings and grounds	0.711
	Heating / cooling and lighting systems	0.668
	Instructional space (e.g., classrooms)	0.603
	Science laboratory equipment and materials	0.734
	Computers for science instruction	0.902
	Computer software for science instruction	0.907
	Calculators for science instruction	0.764
	Library materials relevant to science instruction	0.845
	Audio-visual resources for science instruction	0.878

Chi-square= 114192.107; Df= 18; RMSEA= 0.201

**Exhibit 12.20 Latent Variable Model of Availability of School Resources for Instruction, Grade 8 (Continued)**

### Mathematics



Chi-square = 189839.382; Df = 15 ; RMSEA = 0.242

### Science

**Factor: Availability of School Resources for Science Instruction**

	Observed Variable	Availability of School Resources for Science Instruction Factor Loadings
Principals' reports on shortage or inadequacy of...	Instructional materials (e.g., textbook)	0.632
	Budget for supplies (e.g., paper, pencils)	0.635
	School buildings and grounds	0.688
	Heating / cooling and lighting systems	0.604
	Instructional space (e.g., classrooms)	0.638
	Science laboratory equipment and materials	0.696
	Computers for science instruction	0.911
	Computer software for science instruction	0.917
	Calculators for science instruction	0.740
	Library materials relevant to science instruction	0.816
Audio-visual resources for science instruction	0.829	

Chi-square= 199749.218; Df= 19; RMSEA= 0.221

As shown in Exhibit 12.21, the eight components form a reliable scale, with median reliability coefficients across countries of 0.79 for fourth grade and 0.81 for eighth grade. The median multiple correlation between the attributes and student achievement was 0.20 and 0.21 for mathematics and science, respectively, at the fourth grade, and 0.23 and 0.22, respectively, at the eighth grade, corresponding to R-square values of between 0.04 and 0.05.

As shown in Exhibit 12.22 all component variables loaded relatively highly on the school climate factors. Similar to the teacher perception factors (Exhibit 12.14) the highest loadings were associated with “parental support for student achievement”. “Teachers’ degree of success in implementing the school’s curriculum” and “students’ desire to do well in school” also loaded relatively highly on the underlying factors.

**Exhibit 12.21 Index of Principals' Perception of School Climate (PPSC)—Reliability and Validity Indicators**

Country	Grade 4					Grade 8				
	Cronbach's Alpha Between the Component Variables	Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables		Cronbach's Alpha Between the Component Variables	Multiple R Between Student Achievement and Component Variables		Percent of Variance in Student Achievement Accounted for by the Component Variables	
		Mathematics	Science	Mathematics	Science		Mathematics	Science	Mathematics	Science
Algeria	0.79	0.15	0.16	0.02	0.03	0.82	0.08	0.08	0.01	0.01
Armenia	0.71	0.17	0.19	0.03	0.04	0.70	0.10	0.13	0.01	0.02
Australia	0.83	0.30	0.27	0.09	0.07	0.88	0.45	0.42	0.20	0.18
Austria	0.73	0.15	0.18	0.02	0.03	◇	◇	◇	◇	◇
Bahrain	◇	◇	◇	◇	◇	0.76	0.23	0.27	0.05	0.08
Bosnia and Herzegovina	◇	◇	◇	◇	◇	0.76	0.13	0.12	0.02	0.01
Botswana	◇	◇	◇	◇	◇	0.75	0.21	0.21	0.04	0.04
Bulgaria	◇	◇	◇	◇	◇	0.83	0.37	0.24	0.13	0.06
Chinese Taipei	0.84	0.13	0.12	0.02	0.01	0.85	0.19	0.18	0.04	0.03
Colombia	0.85	0.23	0.21	0.05	0.04	0.86	0.25	0.24	0.06	0.06
Cyprus	◇	◇	◇	◇	◇	0.77	0.06	0.09	0.00	0.01
Czech Republic	0.59	0.19	0.16	0.04	0.03	0.72	0.26	0.22	0.07	0.05
Denmark	0.82	0.17	0.16	0.03	0.03	◇	◇	◇	◇	◇
Egypt	◇	◇	◇	◇	◇	0.83	0.21	0.19	0.04	0.04
El Salvador	0.83	0.19	0.22	0.04	0.05	0.84	0.19	0.20	0.04	0.04
England	0.87	0.22	0.24	0.05	0.06	0.86	0.29	0.29	0.09	0.08
Georgia	0.77	0.17	0.16	0.03	0.03	0.78	0.20	0.16	0.04	0.03
Germany	0.75	0.24	0.24	0.06	0.06	◇	◇	◇	◇	◇
Ghana	◇	◇	◇	◇	◇	0.79	0.29	0.30	0.09	0.09
Hong Kong SAR	0.81	0.17	0.13	0.03	0.02	0.84	0.42	0.36	0.18	0.13
Hungary	0.82	0.33	0.30	0.11	0.09	0.80	0.32	0.30	0.10	0.09
Indonesia	◇	◇	◇	◇	◇	0.86	0.21	0.20	0.04	0.04
Iran, Islamic Rep. of	0.78	0.27	0.28	0.07	0.08	0.81	0.39	0.40	0.16	0.16
Israel	◇	◇	◇	◇	◇	0.79	0.30	0.28	0.09	0.08
Italy	0.76	0.13	0.11	0.02	0.01	0.73	0.17	0.17	0.03	0.03
Japan	0.77	0.12	0.09	0.01	0.01	0.81	0.27	0.25	0.07	0.06
Jordan	◇	◇	◇	◇	◇	0.81	0.25	0.26	0.06	0.07
Kazakhstan	0.86	0.24	0.22	0.06	0.05	◇	◇	◇	◇	◇
Korea, Rep. of	◇	◇	◇	◇	◇	0.82	0.11	0.10	0.01	0.01
Kuwait	0.80	0.19	0.20	0.04	0.04	0.83	0.17	0.19	0.03	0.03
Latvia	0.68	0.11	0.11	0.01	0.01	◇	◇	◇	◇	◇
Lebanon	◇	◇	◇	◇	◇	0.85	0.43	0.48	0.19	0.23
Lithuania	0.75	0.20	0.17	0.04	0.03	0.68	0.19	0.17	0.03	0.03
Malaysia	◇	◇	◇	◇	◇	0.83	0.35	0.33	0.13	0.11
Malta	◇	◇	◇	◇	◇	0.85	0.60	0.57	0.36	0.33
Morocco	0.87	0.26	0.27	0.07	0.07	0.80	0.17	0.16	0.03	0.03
Netherlands	0.68	0.27	0.27	0.07	0.07	◇	◇	◇	◇	◇
New Zealand	0.85	0.29	0.30	0.09	0.09	◇	◇	◇	◇	◇
Norway	0.73	0.14	0.14	0.02	0.02	0.65	0.12	0.13	0.01	0.02
Oman	◇	◇	◇	◇	◇	0.81	0.21	0.21	0.05	0.05
Palestinian Nat'l Auth.	◇	◇	◇	◇	◇	0.77	0.20	0.17	0.04	0.03
Qatar	0.78	0.22	0.25	0.05	0.06	0.79	0.16	0.33	0.02	0.11
Romania	◇	◇	◇	◇	◇	0.85	0.32	0.28	0.11	0.08
Russian Federation	0.79	0.21	0.20	0.04	0.04	0.78	0.26	0.24	0.07	0.06
Saudi Arabia	◇	◇	◇	◇	◇	0.83	0.13	0.14	0.02	0.02
Scotland	0.81	0.22	0.22	0.05	0.05	0.88	0.27	0.24	0.07	0.06
Serbia	◇	◇	◇	◇	◇	0.70	0.16	0.15	0.03	0.02
Singapore	0.83	0.23	0.23	0.05	0.05	0.88	0.44	0.45	0.19	0.21
Slovak Republic	0.75	0.23	0.24	0.05	0.06	◇	◇	◇	◇	◇
Slovenia	0.74	0.09	0.10	0.01	0.01	0.72	0.13	0.12	0.02	0.02
Sweden	0.81	0.20	0.21	0.04	0.04	0.75	0.15	0.15	0.02	0.02
Syrian Arab Republic	◇	◇	◇	◇	◇	0.79	0.19	0.14	0.04	0.02
Thailand	◇	◇	◇	◇	◇	0.83	0.31	0.30	0.10	0.09
Tunisia	0.77	0.29	0.29	0.08	0.09	0.73	0.27	0.22	0.07	0.05
Turkey	◇	◇	◇	◇	◇	0.84	0.42	0.39	0.18	0.15
Ukraine	0.70	0.18	0.15	0.03	0.02	0.77	0.27	0.23	0.07	0.05
United States	0.88	0.31	0.30	0.09	0.09	0.88	0.33	0.32	0.11	0.10
Yemen	0.72	0.12	0.13	0.01	0.02	◇	◇	◇	◇	◇
<b>International Median</b>	<b>0.79</b>	<b>0.20</b>	<b>0.21</b>	<b>0.04</b>	<b>0.04</b>	<b>0.81</b>	<b>0.23</b>	<b>0.22</b>	<b>0.05</b>	<b>0.05</b>
<b>Benchmarking Participants</b>										
Alberta, Canada	0.83	0.25	0.26	0.06	0.07	◇	◇	◇	◇	◇
Basque Country, Spain	◇	◇	◇	◇	◇	0.87	0.27	0.21	0.07	0.05
British Columbia, Canada	0.86	0.22	0.20	0.05	0.04	0.82	0.23	0.21	0.05	0.04
Dubai, UAE	0.79	0.22	0.27	0.05	0.08	0.77	0.42	0.35	0.18	0.12
Massachusetts, US	0.82	0.26	0.30	0.07	0.09	0.89	0.40	0.40	0.16	0.16
Minnesota, US	0.89	0.36	0.36	0.13	0.13	0.87	0.31	0.29	0.09	0.08
Ontario, Canada	0.84	0.29	0.27	0.08	0.07	0.84	0.26	0.22	0.07	0.05
Quebec, Canada	0.67	0.22	0.21	0.05	0.04	0.81	0.39	0.37	0.15	0.13

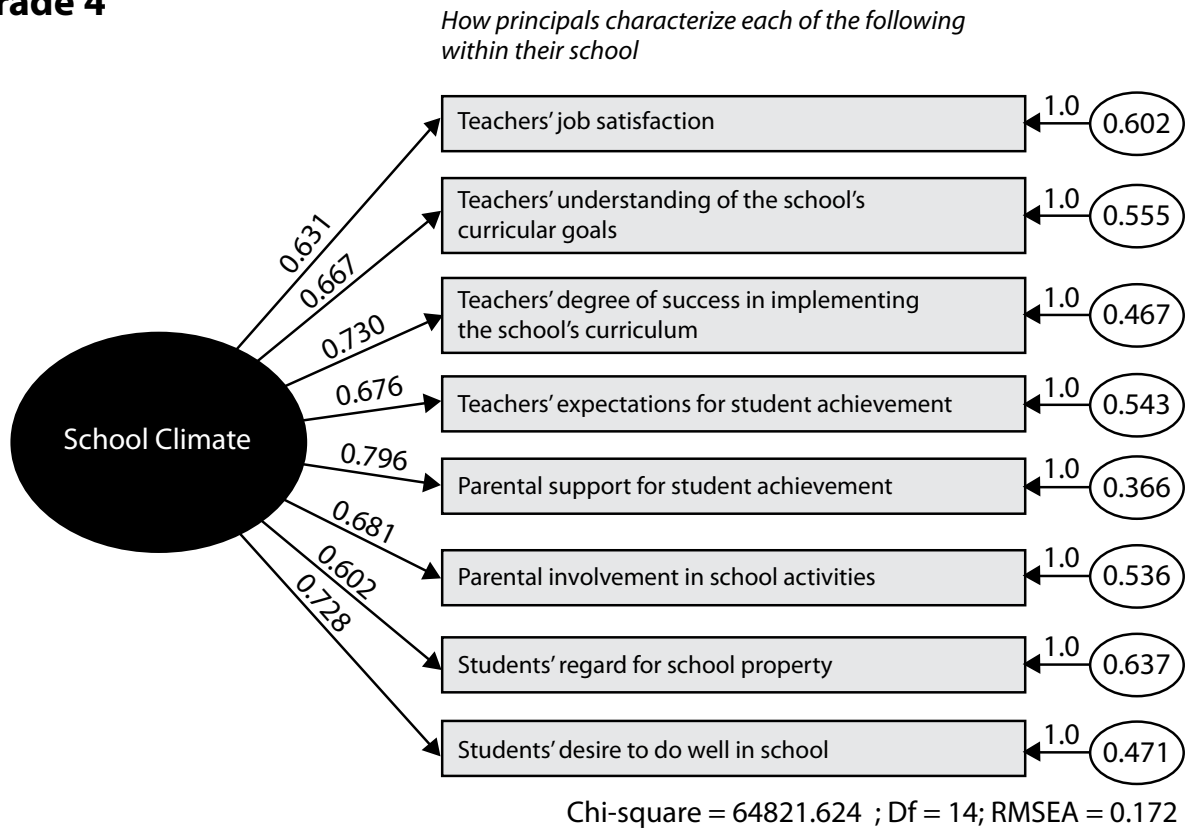
SOURCE: IEA's Trends in International Mathematics and Science Study (TIMSS) 2007

A diamond (◇) indicates the country did not participate in the assessment.

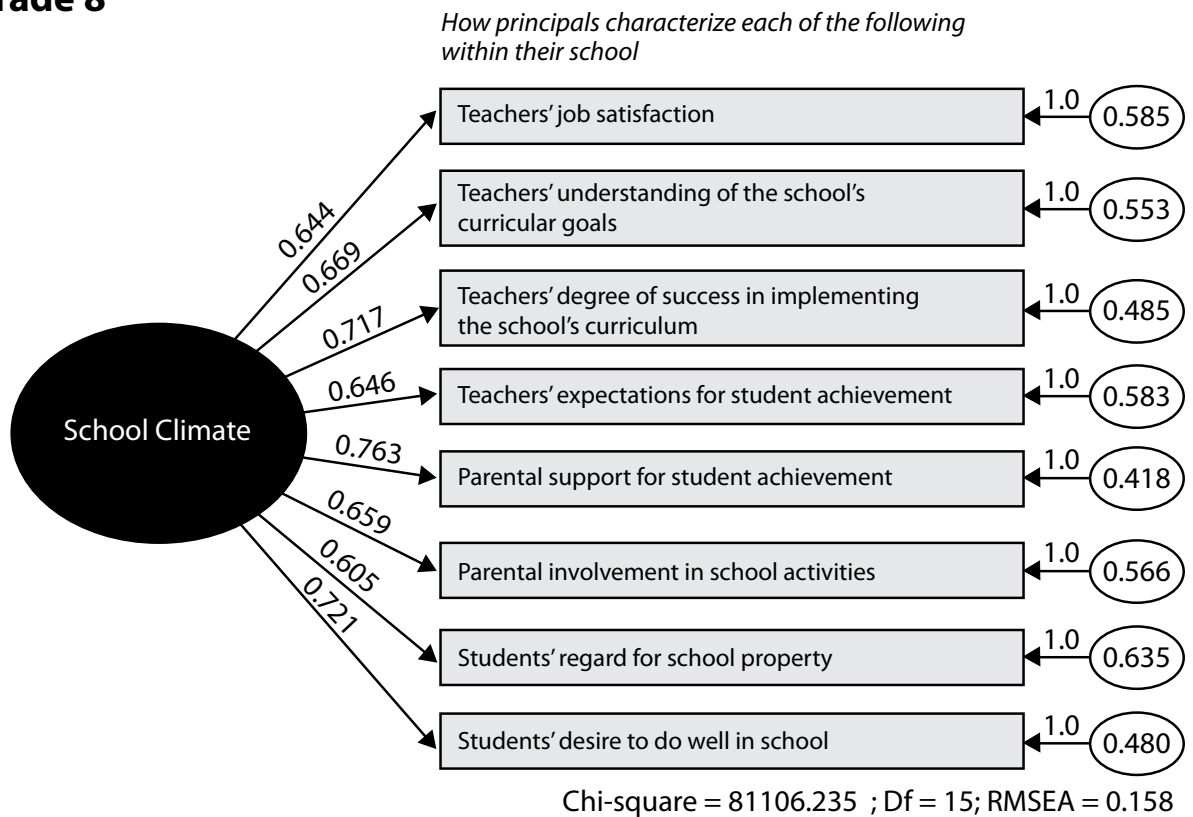


**Exhibit 12.22 Latent Variable Model of Principals' Perception of School Climate**

**Grade 4**



**Grade 8**



## References

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