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Availability of School Resources and TIMSS Grade 8 Students' Science Achievement: A Comparative Study between Malaysia and Singapore

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ABSTRACT

Studies have shown that resources are crucial for improving schooling, perhaps even more so in developing countries than in economically developed countries, where adequate school structures and material resources may be taken for granted. Recent research reviews suggest that computer use continues to grow in mathematics and science instruction, and that it can positively affect students' mathematics and science achievement. Hence, the most successful schools tend to have students that are relatively economically affluent and speak the language of the instruction. Successful schools also are likely to have better working conditions and facilities as well as more instructional materials. The ultimate goal of this study is to investigate the contribution of school resources towards the achievement in science among Malaysian and Singaporean eighth-graders. Data were obtained from 5,733 Malaysian students and 5,927 Singaporean students who participated in the TIMSS 2011.

KEYWORDS
School resources, science achievement, TIMSS

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Introduction

The Singaporean education system has consistently been outperforming its counterparts in mathematics and science on each cycle of the Trends in International Mathematics and Science Study (TIMSS) ever since its inception in 1995. The findings of the recent cycles of TIMSS reveal that at the eighth grade,

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Singapore had the highest average science achievement while Malaysia was ranked 31.

The purpose of the present study, however, is to examine the predictive effects of school resources (school location, school composition by student background, teacher working conditions, availability of science teachers, computers and science laboratories for science instruction) on science achievement among eighth grade students in Malaysia and Singapore who participated in the TIMSS 2011 assessment. The findings of this study may help educators and policy makers to identify and nurture the major learning prerequisites of early adolescents in these education systems.

Background

TIMSS is an international comparative study that has been implemented by the International Association for the Evaluation of Educational Achievement (IEA) since 1995. It was designed to assess the quality of the teaching and learning of science and mathematics among the Grades 4 and 8 students across participating countries. Singapore joined TIMSS since 1995 at both the fourth and eighth grade levels. However, Malaysia joined the programme in 1999 only at the eighth grade level. This study examined the availability of school resources and the relationship with the science achievement of grade 8 students from Malaysia and Singapore in the TIMSS 2011. A summary of the science performance (Grade 8) of the two countries in TIMSS 1995 to TIMSS 2011 is provided in Table 1.

Table 1. TIMSS (Grade 8) Science Scores from 1995 to 2011 for Malaysia and Singapore

TIMSS Grade 8 Science	No. of participating countries	Malaysia	Singapore
TIMSS 1995	45	-	580
TIMSS 1999	38	492	568
TIMSS 2003	46	510	578
TIMSS 2007	59	471	567
TIMSS 2011	63	426	590

Review of Literature

The learning environment of a school can be a positive influence, encouraging a positive attitude toward academic excellence and facilitating classroom instruction. Considerable research has shown that higher levels of school resources are associated with higher achievement (e.g., Betts, Reuben, & Danenberg, 2000; Caldas & Bankston, 1997; Greenwald, Hedges, & Laine, 1996; Lee & Burkam, 2002; Rivkin, Hanushek, & Kain, 2005; Wenglinsky, 1997). The most successful schools are likely to have more socioeconomically advantaged students and better resources. The home backgrounds of students attending a school can be closely related to the learning environment, with the two reinforcing each other and being strongly linked to academic achievement. Students from home backgrounds supportive of learning are likely to have more positive attitudes toward learning and, perhaps, even better discipline. Beyond that, parents who have high educational expectations for their children are more likely to take an active interest in the quality of teachers and school facilities. However, factors that might have contributed to the outstanding science performance in TIMSS are multi-faceted, and such factors have been widely researched recently, including cognitive, affective (i.e., interest, attitude, and motivation), as well as psycho/sociological aspects (see Ong & Gonzalez, 2012; Ong, Gonzalez, & Shanmugam, 2013).

Depending on each country's characteristics, a school's location can have a substantial impact on whether the students attending that school typically are from economically and educationally advantaged home backgrounds. Ever since the Coleman report (Coleman, et al., 1966), researchers have recognized that the compositional characteristics of a school's student body can affect student achievement, and specifically that students from disadvantaged backgrounds typically have higher achievement if they attend schools in which the majority of the students are from advantaged backgrounds. To provide information on this topic, TIMSS routinely asks school principals to report on two demographic characteristics of their schools: economic and language home background. Previous assessments have found that both economic home background and language home background to be strongly related to average science achievement. In TIMSS 2007, the science achievement of students attending schools with a higher proportion of economically advantaged students was higher than for those attending schools with large proportions of disadvantaged students. Science achievement was highest for students in schools where most students spoke the language of the TIMSS assessment as their first language, and was progressively lower as percentages of students not having the TIMSS language as their first language increases.

Rationale

There are 11 SEAMEO countries in the Southeast-Asian (SEA) region. Four out of the 11 SEAMEO member countries participated in TIMSS 2011, namely Indonesia, Malaysia, Singapore and Thailand. However, only Singapore as the top-performing country in SEAMEO was selected for discussion in comparison with Malaysia based on two main concerns. First, the purpose of this study was to identify areas in which the Malaysian educational system could be improved after analyzing the availability of school sources in these two countries. Second, the Malaysian and Singaporean educational systems share some common similarities in terms of socio-cultural background and differences in geographical structures.

Research Question

The research question that underpinned this study was: How well do school resources predict TIMSS Grade 8 students' science achievement in Malaysia and Singapore?

Method

Data

Data for the study were drawn from the TIMSS 2011 database (http://timssandpirls.bc.edu/timss2011/international-database.html). The TIMSS 2011 science achievement scale was based on 302 items spanning across content (i.e., Biology, Chemistry, Physics, Earth Science) and cognitive (i.e., Knowing, Applying, Reasoning) domains in science. TIMSS uses an imputation methodology, usually referred to as plausible values, to report student performance. The plausible values, an approach developed by Mislevy and Sheehan (1987, 1989) and based on the imputation theory of Rubin (1987), are random elements from the set of scores (i.e., random draws from the marginal posterior of the latent distribution) that could be attributed to each student. For each student, the mean plausible value was used as a measure of science achievement. The IEA's International Database (IDB) Analyzer for TIMSS, a plug-in for SPSS, was used to combine the five plausible values as well as to produce their average values and the correct standard errors.

Sample

A total of 11,660 eighth-graders from Malaysia (N = 5,733) and Singapore (N = 5,927) took part in the TIMSS 2011 science assessment.

Results

School Location

The location of the school can provide access to important resources. To provide some information about each school's location, TIMSS 2011 asked principals to describe the population size of the city, town, or area in which their schools were located. Table 2 the shows principals' reports about the school location in the TIMSS 2011 eighth grade assessment, with percentages of students and their average achievement.

School Composition by Student Background

Students' background that was investigated included the economic background of their families as well as the language of the test compared to their native language. Table 3 summarises the principal economic categorization of their schools according to three categories, for participants in the TIMSS 2011 eighth grade assessment. The more affluent schools had more than one-fourth of their students from affluent home backgrounds and not more than one-fourth from disadvantaged home backgrounds, and the more disadvantaged schools had the reverse situation. The other schools were "in between".

Table 4 summarises the principals' reports of the percentage of eight grade students in their schools who had the language of the TIMSS 2011 test as their native language.

Schools with Sufficient Facilities, Books, Technology, and Other Resources

TIMSS collects information on the extent to which school resources are available to support science instruction by asking school principals about the degree of shortages or inadequacies in general school resources (e.g., instructional materials, supplies, heating/cooling/lighting systems, school buildings and grounds, instructional space, technologically competent staff) as well as about resources specifically targeted to support science instruction (e.g., teachers with a specialization in science, computers, computer software, library materials, audio-visual resources, calculators for science instruction, and science equipment and materials). All items were rated on a 4-point Likert type scale, ranging from '1' (A Lot) to '4' (Not At All). The Cronbach's alpha reliability coefficients for the scale were 0.96 and 0.98 in Malaysia and Singapore, respectively.

Tables 5 summarizes the state of several resources possessed by the schools in the two countries.

Table 2. School Location

Country	Population size of the city, town or area where the school in located					
	More than 100,000		15,001 to 100,000		15,000 or fewer	
	Percentage of students	Average achievement	Percentage of students	Average achievement	Percentage of students	Average achievement
Malaysia	18 (3.1)	446 (14.8)	49 (4.4)	431 (8.8)	33 (3.4)	407 (11.2)
Singapore	100 (0.0)	590 (4.3)	0 (0.0)	~	0 (0.0)	~
International	37 (0.5)	492 (1.1)	28 (0.5)	473 (1.2)	35 (0.4)	463 (1.3)

Standard errors appear in parentheses; because of rounding of, some results may appear inconsistent; (~) indicates insufficient data to report achievement.

Table 3. School Composition by Student Economic Background

Country	More affluent		Neither more affluent nor more disadvantaged		More disadvantaged	
	% of students	Average achievement	% of students	Average achievement	% of students	Average achievement
Malaysia	26 (3.2)	458 (12.0)	23 (3.3)	440 (13.1)	52 (4.1)	408 (10.4)
Singapore	27 (0.0)	631 (6.9)	61 (0.0)	581 (5.7)	11 (0.0)	538 (13.6)
International	32 (0.5)	501 (1.3)	33 (0.6)	481 (1.2)	36 (0.5)	458 (1.3)

Standard errors appear in parentheses; because of rounding of, some results may appear inconsistent.

Table 4. Schools with Students Having the Language of the Test as Their Native Language

Country	More than 90% of Students		51-90% of Students		50% of Students or Less	
	% of Students	Average Achievement	% of Students	Average Achievement	% of Students	Average Achievement
Malaysia	40 (3.3)	429 (9.7)	24 (3.2)	412 (13.2)	36 (3.6)	433 (11.5)
Singapore	7 (0.0)	663 (8.5)	15 (0.0)	611 (11.0)	77 (0.0)	579 (5.1)
International	69 (0.4)	483 (1.0)	13 (0.4)	478 (1.9)	17 (0.3)	466 (2.8)

Standard errors appear in parentheses; because of rounding of, some results may appear inconsistent.

Table 5. Descriptive Statistics (Weighted) for the General School Resources and Resources for Science Instruction

Variables	Malaysia		Singapore	
	M	*SD*	*M*	*SD*
General School Resources				
Instructional materials (e.g., textbooks)	2.56	1.281	3.40	1.100
Supplies (e.g., papers, pencils)	2.74	1.188	3.47	1.071
School buildings and grounds	2.51	1.092	3.29	1.056
Heating/cooling and lighting systems	2.55	1.007	3.38	.997
Instructional space (e.g., classrooms)	2.44	1.100	3.18	1.048
Technologically competent staff	2.55	.864	3.07	.950
Resources for Science Instruction				
Teachers with a specialization in science	2.51	1.198	3.24	1.124
Computers for science instruction	2.43	1.044	3.34	.964
Computer software for science instruction	2.45	1.023	3.20	.939
Library materials relevant to science instruction	2.54	.915	3.36	.898
Audio-visual resources for science instruction	2.52	.910	3.25	.958
Calculators for science instruction	2.81	1.044	3.40	1.092
Science equipment and materials	2.45	1.089	3.27	1.131

Note: 1 = A Lot, 4 = Not At All

Table 6 summarises the results for the Science Resources Shortages scale for participants in the TIMSS 2011 eighth grade assessment. Students were scored according to their principals' responses concerning thirteen school and classroom resources on the Science Resource Shortages Scale. Students in schools where instruction was not affected by resource shortages had a score on the scale of at least 11.2, which corresponds to their principals reporting that shortages affected instruction "not at all" for seven of the thirteen resources and "a little" for the other six, on average. Students in schools where instruction was affected a lot had a score no higher than 7.3, which corresponds to their principals reporting that shortages affected instruction "a lot" for seven of the thirteen resources and "some" for the other six, on average. All other students attended schools where instruction was somewhat affected by resource shortages.

Teachers' Working Conditions

Descriptive statistics for teacher working condition are presented in Tables 7 and 8. Students were scored according to their teachers' responses concerning five potential problem areas on the Teacher Working Conditions Scale. Students whose teachers had hardly any problems with their working conditions had a score on the scale of at least 11.7, which corresponds to their teachers reporting "not a problem" for three of the five areas and "minor problem" for the other two, on average. Students whose teachers had moderate problems had a score no higher than 8.9 which corresponds to their teachers reporting "moderate problems" for three of five conditions and "minor problems" for the other two, on average. All other students had teachers that reported minor problems with their working conditions.

Difficulties Filling Vacancies for Science Teachers

Table 9 summarizes the school principals' reports from the TIMSS 2011 eighth grade assessment about difficulties in filling vacancies for science teachers.

Schools with Computers Available for Instruction

Table 10 shows the principals' reports about the availability of computers for eighth grade instruction for participants in the TIMSS 2011.

Schools with Science Laboratories

Undertaking "hands-on" science investigations is an important component of science curricula in many countries. TIMSS 2011 collected information on the availability of science laboratories at the eighth grade and the availability of instructional assistance when students are conducting experiments. Table 11 presents results from the principals' reports of the availability of science laboratories and of assistance for teachers when students are conducting science experiments in the eighth grade assessment.

To address the purpose of the study, correlation and separate simultaneous multiple regression analyses were conducted for each education system to determine whether or not school resources were predictive of science achievement.

Table 6. Instruction Affected by Science Resource Shortage

Country	Not Affected		Somewhat Affected		Affected A Lot		Average Scale Score
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	
Malaysia	18	454	69	420	14	422	9.4
	(2.6)	(14.0)	(3.5)	(6.8)	(2.5)	(16.5)	(0.15)
Singapore	64	593	28	578	8	604	11.7
	(0.0)	(5.2)	(0.0)	(7.6)	(0.0)	(14.5)	(0.0)
International	22	494	71	474	7	464	
	(0.4)	(1.9)	(0.5)	(0.7)	(0.3)	(3.3)	

Standard errors appear in parentheses; because of rounding of, some results may appear inconsistent.

Table 7: *Descriptive Statistics for Teachers' Working Conditions*

Variables	Malaysia		Singapore	
	M	*SD*	*M*	*SD*
Teacher Working Condition				
The school building needs significant repair.	2.82	.778	3.31	.785
Classrooms are overcrowded.	2.42	.957	3.09	.868
Teachers have too many teaching hours.	2.75	.927	2.71	.826
Teachers do not have adequate workspace (e.g., for preparation, collaboration, or meeting with students).	2.73	.839	3.03	.933
Teachers do not have adequate instructional materials and supplies.	2.86	.777	3.31	.727

Note: 1 = Serious Problem, 4 = Not A Problem

Table 8: Comparison of *Teachers' Working Conditions*

Country	Hardly Any Problems		Minor Problems		Moderate Problems	
	% of Students	Average Achievement	% of Students	Average Achievement	% of Students	Average Achievement
Malaysia	10 (2.1)	433 (20.8)	56 (3.5)	419 (9.0)	34 (3.5)	435 (9.5)
Singapore	28 (2.5)	595 (8.9)	56 (2.6)	591 (6.2)	16 (1.8)	579 (10.0)
International	20 (0.4)	489 (1.5)	48 (0.5)	477 (0.8)	32 (0.5)	473 (1.1)

Standard errors appear in parentheses; because of rounding of, some results may appear inconsistent.

Table 9: Schools with Difficulties Filling Vacancies for Science Teachers

Country	No vacancies		Vacancies are easy to fill		Vacancies are somewhat difficult to fill		Vacancies are very difficult to fill	
	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement	Percent of Students	Average Achievement
Malaysia	38 (3.2)	428 (9.2)	52 (3.3)	431 (9.0)	8 (1.8)	413 (30.1)	2 (1.2)	~
Singapore	57 (0.0)	581 (6.0)	39 (0.0)	603 (6.3)	4 (0.0)	579 (17.0)	0 (0.0)	~
International	56 (0.5)	477 (0.9)	25 (0.5)	479 (1.5)	15 (0.4)	468 (1.9)	4 (0.2)	459 (3.6)

Reported by principals; Standard errors appear in parentheses. Because of rounding of, some results may appear inconsistent; ~ indicates insufficient data to report achievement.

Table 10. Schools with Computers Available for Instruction

Country	1 Computer for 1-2 Students		1 computer for 3-5 Students		1 Computer for 6 or More Students		No Computers Available	
	% of Students	Average Achievement	% of Students	Average Achievement	% of Students	Average Achievement	% of Students	Average Achievement
Malaysia	2	-	13	425	78	421	6	445
	(1.1)		(2.7)	(17.4)	(3.1)	(6.6)	(1.9)	(16.2)
Singapore	68	593	28	585	4	600	0	-
	(0.0)	(5.2)	(0.0)	(8.4)	(0.0)	(29.0)	(0.0)	
International	40	481	28	480	28	474	4	408
	(0.5)	(1.2)	(0.5)	(1.4)	(0.4)	(1.7)	(0.2)	(5.6)

Standard errors appear in parentheses; because of rounding, some results may appear inconsistent.
- indicates insufficient data to report achievement.

Table 11. School Resources for Conducting Science Experiments

Country	Schools Have a Science Laboratory				Teachers Have Assistance Available When Students are Conducting Experiments			
	Yes		No		Yes		No	
	% of Students	Average Achievement	% of Students	Average Achievement	% of Students	Average Achievement	% of Students	Average Achievement
Malaysia	99	426	1	-	93	424	7	457
	(0.8)	(6.4)	(0.8)		(2.0)	(6.5)	(2.0)	(21.5)
Singapore	100	590	0	-	89	590	11	591
	(0.0)	(4.4)	(0.0)		(0.0)	(4.7)	(0.0)	(13.8)
International	80	485	20	451	57	480	43	472
	(0.4)	(0.7)	(0.4)	(1.9)	(0.5)	(1.1)	(0.5)	(1.3)

Standard errors appear in parentheses; because of rounding, some results may appear inconsistent.
- indicates insufficient data to report achievement.

Table 12: Correlations between Teachers' Working Conditions with Students' Science Achievement in TIMSS 2011

	Malaysia		Singapore	
	r	SE	r	SE
Teacher Working Condition	-.02	.06	.02	.05

Table 13: Teacher Working Condition in Predicting Students' Science Achievement in TIMSS 2011

	Malaysia		Singapore	
	B	SE	B	SE
Gender	29.57	18.77	19.58*	10.00
Teacher Working Condition	-1.39	4.27	1.29	2.60
Adjusted R^2		.02		.01

Table 14: Correlations between Instruction Affected by School Resource Shortage with Students' Science Achievement in TIMSS 2011

	Malaysia		Singapore	
	r	SE	r	SE
Instruction Affected by School Resource Shortage	.13*	.06	.05	.04

Table 15: Instruction Affected by School Resource Shortage in Predicting Students' Science Achievement in TIMSS 2011

	Malaysia		Singapore	
	B	SE	B	SE
Instruction Affected by School Resource Shortage	6.61*	3.06	1.64	1.34
Adjusted R^2		.02		.00

Discussion and Conclusions

In Malaysia, 18% of students attended schools in cities with more than 100,000 people, 49% attended schools in cities or towns of 15,001 to 100,000, and 33% in small towns, villages, or rural areas (see Table 2). On average, science achievement differences among students attending the three types of schools were somewhat more pronounced, with average science achievement highest in the big city schools (446), next highest in schools in medium sized cities (431), and lowest in schools in rural areas or small towns (407). In contrast, 100% of students in Singapore were attending schools in cities with more than 100,000 people. For the eighth grade assessment, 37% of students were attending schools in cities with more than 100,000 people, 28% attended schools in cities or towns of 15,001 to 100,000, and 35% in small towns, villages, or rural areas. On average, science achievement differences among students attending the three types of schools were somewhat more pronounced, with average science achievement highest in the big-city schools (492), next highest in schools in medium sized cities (473), and lowest in schools in rural areas or small towns (463).

In Malaysia, 52% of the eighth grade students attended schools with relatively more disadvantaged than affluent students, and 26% attended schools with relatively more affluent than disadvantaged students (see Table 3). The average science achievement was highest among the eighth grade students attending schools with relatively more affluent students than disadvantaged students (458), and lowest among students attending schools with relatively more disadvantaged students (408). In Singapore, 27% of the eighth grade students attended schools with relatively more affluent than disadvantaged students and only 11% attended schools with relatively more disadvantaged than affluent students. The average science achievement was highest among the eighth grade students attending schools with relatively more affluent students than disadvantaged students (631), and lowest among students attending schools with relatively more disadvantaged students (538).

Internationally students were distributed relatively equally across the three categories of schools, with 32% of the eighth grade students attending schools with relatively more affluent than disadvantaged students and 36% attending schools with relatively more disadvantaged than affluent students. The average science achievement was highest among the eighth grade students attending schools with relatively more affluent students than disadvantaged students (501), and lowest among students attending schools with relatively more disadvantaged students (458).

In Malaysia, the majority of eighth grade students (40%) were in schools where almost all students (more than 90%) spoke the language of the TIMSS test as their native language, 24% were in schools where the majority of students (51-90%) were native speakers of the TIMSS test language, and 36% were in schools where half the students (or less) spoke the language of the test as their native language. For the eighth grade students in Malaysia, science achievement was highest among students in schools where 50% or fewer of the students had the language of the TIMSS test as their native language (433), next highest in schools where almost all students (more than 90%) spoke the language of the TIMSS test as their native language (429), and lowest in schools where the majority of students (51-90%) were native speakers of the TIMSS test language (412). In Singapore, the majority of eighth grade students (77%) were in schools where half the students (or less) spoke the language of the test as their native language, 15% were in schools where the majority of students (51-90%) were native speakers of the TIMSS test language, and only 7% were in schools where almost all students (more than 90%) spoke the language of the TIMSS test as their native language. For the eighth grade students in Singapore, science achievement was highest among students in schools where almost all students had the language of the TIMSS test as their native language (663), next highest in schools where 51-90% of students had the language of the TIMSS test as their native language (611), and lowest in schools where 50 or fewer of the students had the language of the TIMSS test as their native language (579).

Internationally, across countries, the majority of eighth grade students (69%) were in schools where almost all students (more than 90%) spoke the language of the TIMSS test as their native language, 13% were in schools where the majority of students (51-90%) were native speakers of the TIMSS test language, and 17% were in schools where 50% of the students (or less) spoke the language of the test as their native language.

Internationally, on average across countries internationally, the relationship between language composition of the school and average science achievement was similar to the fourth grade. Science achievement was highest among students in schools where almost all students had the language of the TIMSS test as their native language (483), next highest in schools where 51-90% of students had the language of the TIMSS test as their native language (478), and lowest in schools where 50% or fewer of the students had the language of the TIMSS test as their native language (466).

Studies have shown that resources are crucial for improving schooling, perhaps even more so in developing countries than in economically developed countries, where adequate school structures and material resources can be taken for granted (Lee & Zuze, 2011). The extent and quality of school resources can have an important impact on the quality off classroom instruction. Although "adequacy" can be relative, in each previous TIMSS assessment, there has been a strong positive relationship between principals' perceptions of the shortages of school resource and average science achievement.

Regarding resources for science teaching, in Malaysia, on average, 69% of the eighth grade students attended schools where instruction was Somewhat Affected by resource shortages, 18% attended schools where instruction was Not Affected, and 14% attended schools where instruction was affected a lot by resource shortages. Students in schools that were affected a lot by science resource shortages had lower science achievement (422) than students in schools that were Not Affected (454). In Singapore, 64% of the eighth grade students attended schools where instruction was not affected by resource shortages, 28% attended schools where instruction was Somewhat Affected, and only 8% attended schools where instruction was affected a lot by resource shortages. students in schools that were somewhat affected by science resource shortages had lower science achievement (578) than students in schools that were not affected (593).

Internationally, on average across countries, 71% of the eighth grade students attended schools where instruction was Somewhat Affected by resource shortages, 22% attended schools where instruction was Not Affected, and 7% attended schools where instruction was affected a lot by resource shortages. students in schools that were affected a lot by science resource shortages had lower science achievement (464) than students in schools that were not affected (494) or somewhat affected (474).

There is evidence that, in some countries, teacher shortages may exist partly as a result of poor working conditions. A review of research from the United States suggests that teachers who leave the profession after just a few years are more likely to leave because of poor working conditions than because of low pay (Johnson, 2006).

More than half (56%) of the Malaysian eighth grade students in Malaysia, on average, were in schools where teachers had minor problems and about one-third (34%) of the eighth grade students were in schools with moderate problems. Students whose teachers reported hardly any problems had somewhat higher science achievement, on average, than those whose teachers reported minor problems (433 vs. 419). In Singapore, more than half (56%) of the eighth grade students were in schools whose teachers reported minor problems and 28% in schools with hardly any problems. Students whose teachers reported hardly any problems had somewhat higher science achievement, on average, than those whose teachers reported minor problems, and those students in turn had higher achievement than students whose teachers reported moderate problems (595, 591, and 579, respectively).

Internationally, eighth grade science teachers expressed about the same level of satisfaction with working conditions as fourth grade teachers, with 20% of students in schools whose teachers reported Hardly Any Problems and 32% in schools with Moderate Problems. On average across countries, the science achievement difference between these two groups of students was 16 points (489 vs. 473).

Recent research suggests that teachers are in relatively short supply in some countries, and that the impending retirement of aging teachers will further contribute to this shortage (Ingersoll & Perda, 2010). TIMSS Advanced 2008 noted that, in several countries, not only were teachers of physics nearing retirement age, but relatively few students were considering physics as a career option, suggesting that there also may be a shortage of students entering science education careers (Mullis, Martin, Robitaille, & Foy, 2009).

On average, 52% of the eighth grade students in Malaysia were in schools where principals reported that vacancies were easy to fill or that there were no vacancies (38%). The average science achievement was almost similar for these two groups of students (428 and 431, respectively). However, the average science achievement was somewhat lower among the 8% of students in schools where vacancies were somewhat difficult to fill (413). In Singapore, on average, eighth grade students were in schools where principals reported that there were no vacancies (57%) or that vacancies were easy to fill (39%). The average science achievement was somewhat lower among the 4% of students in schools where vacancies were somewhat difficult to fill (579).

Internationally, in most countries, on average, 56% of the eighth grade students were in schools where principals reported that there were no vacancies (56%) or that vacancies were easy to fill (25%). The average science achievement was similar for these two groups of students (477 and 479, respectively). However, the average science achievement was somewhat lower among the 15% of students in schools where vacancies were somewhat difficult to fill (468) and among the 4% in schools where vacancies were very difficult to fill (459).

Recent research reviews suggest that the use of computers continues to grow in mathematics and science instruction, and that it can positively affect students' achievement in these two subjects. A review of evaluation studies of computer use in US primary and secondary schools since 1990 found that computer tutorials in natural and social science classes have a strong record of effectiveness, and that simulation programs sometimes improve the effectiveness of science teaching although the evidence is less definitive (Kulik, 2003).

The relationship between computer availability and the average science achievement is difficult to interpret because it is highly interrelated with socio-economic levels and instructional practices. There was little relationship between computer-to-student ratio and science achievement, although average science achievement was lower for the 4% of students in schools with no computers available for instruction. The eighth grade students with access to computers for instruction had higher average science achievement than those students with no access to computers for instruction. In Malaysia, only 2% of the eighth grade students, on average, in schools that had 1 computer for every 1-2 eighth grade students, 13% in schools with 1 computer for every 3-5 eighth grade students, and 78% in schools with 1 computer for 6 or more students. 6% of the eighth grade students were in schools with no provision for computers for science instruction. Conversely, 68% of the eighth grade students in Singapore, on average, were in schools that had 1 computer for every 1-2 eighth grade students, 28% in schools with 1 computer for every 3-5 eighth grade students, and only 4% in schools with 1 computer for 6 or more students. None of the eighth grade students were in schools with no computers for science instruction.

Internationally, 40% of the eighth grade students, on average, were in schools that had 1 computer for every 1-2 eighth grade students, 28% in schools with 1 computer for every 3-5 eighth grade students, and 28% in schools with 1 computer for 6 or more students. Only 4% of the eighth grade students were in schools with no provision of computers for instruction.

In Malaysia, almost all eighth grade students attended schools with science laboratories (99%) as compared to 100% in Singapore. Internationally, across the eighth grade countries, a much lower percentage of students attended schools with science laboratories (80%). On average across countries, student science achievement in schools with laboratories was higher (485) than that of students from schools with no laboratories (451). A total of 93% of Malaysian eighth grade students attended schools in which teachers had assistance when students were conducting science experiments. However, on average, the eighth grade students attending schools in which teachers had assistance had lower achievement (424) than students attending schools in which teachers did not have assistance (457). In Singapore, 89% of students attended schools in which teachers had assistance when students were conducting science experiments. On average, the eighth grade students attending schools in which teachers had assistance had almost similar achievement (590) than students attending schools in which teachers did not have assistance (591).

Internationally, across the eighth grade, 57% of students attended schools in which teachers had assistance when students were conducting science experiments. On average across countries, the eighth grade students attending schools in which teachers had assistance had higher achievement (480) than students attending schools in which teachers did not have assistance (472).

The results in Table 12 and Table 13 indicated that teacher working conditions were not statistically associated with students' science achievement in Malaysia and Singapore. However, the results in Table 14 and Table 15 indicated that school resource shortage was positively and significantly associated with students' science achievement in Malaysia only.

Disclosure statement

No potential conflict of interest was reported by the authors.

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