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The relationship between school resources and grade 8 mathematics achievement: A comparison of Palestinian Authority, Israeli Hebrew and Israeli Arab schools in TIMSS 2007

Abstract

The relationship between school resources such as learning materials, computers, and student-teacher ratio and student performance has been shown to be important (e.g., Hanushek, 1986, 2003; Hanushek & Woessmann, 2007; Krueger, 2003). In this article, school resources and their relationship with student achievement are compared for Israeli and Palestinian Authority (PA) schools using data from the International Association for the Evaluation of Educational Achievement's (IEA) 2007 Trends in International Mathematics and Science Study (TIMSS) in the context of efforts aimed at reducing the differences in resources in schools in Israel.

Results of bivariate analyses show some differences regarding the availability of school resources between the three groups of schools under review, namely PA schools, Israeli Arab schools and Israeli Hebrew schools. Moreover, results of the multivariate hierarchical linear model analyses reveal that only shortages regarding computer hardware, software and support have a significant relationship with mathematics achievement of Grade 8 students once the socio-economic level of their schools and home backgrounds are taken into account. Finally, these effects are found for the Israeli Arab schools and the PA schools but not for the Israeli Hebrew schools.

Keywords

School resources; mathematics achievement; HLM

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Über den Zusammenhang zwischen Schulressourcen und Mathematikleistung in der 8. Klasse: Ein Vergleich von Schulen der palästinensischen Autonomiebehörde sowie israelisch-hebräischer und israelisch-arabischer Schulen in TIMSS 2007

Zusammenfassung

Der Zusammenhang zwischen Schulausstattung mit Lernmaterialien, Computern sowie die Klassengröße und den Leistungen von Schülerinnen und Schülern hat sich vielfach als wichtig herausgestellt (siehe Hanushek, 1986, 2003; Hanushek & Woessmann, 2007; Krueger, 2003). Vor dem Hintergrund von Bemühungen in Israel, die Unterschiede in der Ausstattung von hebräischen und arabischen Schulen und damit schlussendlich deren Leistungsunterschiede zu verringern, wird in diesem Beitrag der Zusammenhang zwischen Schulausstattung und Schülerleistung vergleichend für diese beiden Schultypen in Israel sowie auch arabische Schulen der Autonomiebehörde (PA) untersucht mittels Daten der International Association for the Evaluation of Educational Achievement's (IEA) Trends in International Mathematics and Science Study (TIMSS) von 2007.
Die bivariaten Analysen zeigen einige Unterschiede in der Ausstattung der drei untersuchten Schulgruppen, und zwar hebräischen Schulen und arabischen Schulen in Israel sowie den PA Schulen, auf. Darüber hinaus bestätigen multivariate Mehrebenenanalysen, die den sozioökonomischen Hintergrund von Schulen sowie Schülerinnen und Schülern einbeziehen, einen signifikanten Zusammenhang mit der Schülerleistung von Achtklässlern in Mathematik nur dort, wo Schulen von einer mangelhaften Ausstattung mit Computer Hardware, Software und Computerunterstützung berichten. Schließlich finden sich diese Zusammenhänge nur für arabische Schulen in Israel und PA Schulen, nicht jedoch für hebräische Schulen in Israel.

Schlagworte

Schulausstattung; Mathematikleistung; Mehrebenenmodelle

1. Introduction

Globally, researchers and policy-makers increasingly focus on improving the quality of education as the differences in quality between schools have been shown to be related to a nation-state's economic growth (Hanushek & Kimko, 2000; Hanushek, 2003). This focus is further underscored by a global initiative for quality education as a human right. A proliferation of international non-governmental organizations has created an era of global accountability (Meyer, Boli, Thomas, & Ramirez, 1997) in which countries are accountable for the provision of quality education. Student achievement on cognitive tests has now become an accepted measure of educational quality (Murnane, Willett, Braatz, & Duhaldeborde, 2001; Levin, 2001), to which national education systems may be held accountable.

It is assumed that increasing the amount of school resources will increase the quality of education, as measured by student achievement data as one indicator. Consequently, the relationship between school resources such as textbooks, computers, calculators, number of pupils per teacher as input and student achievement as output is of particular interest to policy-makers who are responsible for the allocation of school resources. Still, this relationship is one of the most debated issues in education (e.g., Hanushek, 1986, 2003; Hanushek & Woessmann, 2007; Krueger, 2003) because the current literature provides mixed results.

The argument that school resources are related to student achievement is supported by evidence from quantitative studies (e.g., Krueger, 2002; Dustmann, Rajah, & van Soest, 2003) and literature reviews (e.g., Lonsdale, 2003) and qualitative studies (Chan, 2008; Bonnano & Timbs, 2004; Koechlin & Zwaan, 2003; Oberg, 2001), even after controlling for school and community characteristics (Lance, Welborn, & Hamilton-Pennell, 1993; Lance, Rodney, & Hamilton-Pennell, 2000).

Other studies, however, conclude that school resources are not related to student achievement. In a meta-analysis, Hanushek (2003) shows that significant relationships between school resources and student achievement result from misapplication of sampling and methodological procedures. Hoxby (2000), using exogenous population variation in the size of class cohorts, concludes that class size does not significantly increase student achievement. Still, it has to be noted that research on resource allocation and student achievement has been largely conducted in western, English-speaking contexts although a growing international body of research explores this relationship.

Mullis et al. (2005) argue in the Assessment Frameworks for the 2007 Trends in International Mathematics and Science Study (TIMSS) that internationally, students from well-resourced schools generally have higher achievement than students from schools that report resource shortages. However, the Programme for International Student Assessment (PISA) 2009 concludes that between countries, school resources are not significantly related to student achievement (OECD, 2010). Results from PISA show that typically "socio-economically advantaged students attend schools with better resources" (OECD, 2010, p. 50) and that there may not be enough variation in the level of school resources in participating OECD countries to support a relationship between school resources and achievement. Hanushek and Kimko (2000) argue that international differences in student achievement are not related to differences in educational expenditures including resources. Likewise, Woessmann (2000) concludes that international differences in student achievement are not significantly related to differences in school resources, but rather to institutional differences.

Another viewpoint posits that school resources may be more important for academic achievement in economically developing countries than economically developed countries. Again, empirical studies provide mixed results for this viewpoint.

Heyneman and Loxley (1982, 1983) find that the effect of school resources on student academic achievement is larger for economically developing countries than it is for developed countries. However, Ilie and Lietz (2010) in a re-examination of the Heyneman-Loxley effect for 21 European countries conclude that school resources were not more likely to have an effect on student achievement in economically more developed countries than economically less developed countries.

While empirical results may not support a systematic direct relationship between school resources and student achievement, school resources could offset the strong relationship between student background characteristics and performance, particularly in economically developing countries. Results from a mixed-methods case study in Baja California, Mexico, suggest that student's use of mobile technology in the classroom had a greater effect on increased literacy achievement for students in a rural school than for students in an urban school (Kim et al., 2010). Tayyaba (2010), using national assessment data for mathematics achievement in Pakistan, finds an interaction of availability of classroom resources with other school level variables, such that low availability of classroom resources is associated with lower levels of mathematics achievement for small classes in rural schools. Likewise, using secondary school achievement data in Nepal, Subedi (2003) finds that the importance of classroom resources for academic achievement lessens with increasing class size. As a result of the growth in available data from cross-national and national assessments in developing countries, Lee, Zuze, and Ross (2005) urge that future research should undertake in-depth and local analyses to examine student-level variables as functions of school effects, such as availability of school resources.

Thus, the international policy focus on *physical* school resources may be more pronounced in economically developing countries (Fuller & Clarke, 1994), as this may be easily implemented by policy-makers to redress educational inequity for disadvantaged groups. Likewise, an era of global accountability advocates transparency in educational policy, especially for developing countries (United Nations Development Programme, 2003). The re-allocation of physical resources may be a relatively easy policy solution to comply with global norms. The Middle-East provides an illuminating context in which to further explore this relationship for some economically developing countries, and simultaneously for economically developed countries like Israel (Hanushek, 2003).

BenDavid-Hadar and Ziderman (2011) note that little research on educational resource allocation has been undertaken in Israel and that the empirical literature provides mixed results. Angrist and Lavy (1999) using an exogenous source of variation in primary education class sizes in Israel, report a negative effect of class size on student achievement, whereby students in smaller classes have higher achievement. Angrist and Lavy (2002) find that an increased use of computers in the classroom does not positively affect student achievement. In addition, Lavy (1998) examines the effect of differences of school resources on Israeli Arab and Jewish primary school students' achievement using national achievement data from 1991. Lavy concludes that increasing school inputs to Israeli Arab schools, specifically expenditures per student, instructional hours and teacher qualifications significantly increases student achievement.

In terms of evidence from Arab students in other countries, analyses undertaken as part of the Arab Region Training Seminar Series conducted by IEA between 2006 and 2007 highlight the importance researchers and policy makers place on physical school resources as a way of addressing educational quality in some economically developing Arab countries. In Jordan, physical school and classroom resources are positively related to student achievement after controlling for student and school-level characteristics (Abulibdeh & Abdelsamad, 2008). In Morocco, no relationship between class size and student achievement emerges while in Tunisia higher student achievement is associated with larger classes (Mokhtar, 2008).

Examining computer use as a physical resource, in Tunisia, student achievement is highest for students in schools with fewer rather than many computers (Alrasbi, Albalushi, Alkharusi, Alharhty, & Alzadjali, 2008). This relationship is reversed at the school level in Egypt as a greater number of computers for student use at school is associated with higher achievement (Alrasbi et al., 2008); a relationship which also holds for Lebanon and Saudi Arabia (Bouderga, 2008). Thus, support is mixed for the argument that resources may be more important for student achievement in economically developing countries in the Middle East, than economically developed countries such as Israel.

Results of the TIMSS studies in which Israel has participated since 1995 gave rise to discussions about how differences in educational experiences between students attending Arab or Jewish schools in Israel could be reduced (Human Rights Watch, 2001; Zuzovsky, 2006). In particular, it was argued (e.g., by the "Dovrat Committee"[1], 2005) that differences in performance could be reduced by improving the resources in Israeli Arab schools. In response, the Ministry of Education in Israel developed a 5-year plan aimed at improving education in the Israeli Arab schools. The resulting changes in the resourcing of Israeli Arab schools led Zuzovsky (2006, p. 47) to conclude that "although inequality in input between the two sectors still remains, gaps in learning outcomes have narrowed".

The Palestinian Authority (PA) participated for the first time in TIMSS in 2003 and again in 2007. As the Arab students in this educational system and the Arab students in Israel can be considered to have a similar cultural background, it is of interest to extend the two-way comparison between Israeli Arab and Israeli Hebrew schools to a three-way comparison by including Arab students taught in PA schools. In this way, differences can be examined in how school resources are linked to students' Grade 8 mathematics achievement between the three groups.

In this specific context as well as the more general focus on quality education as a human right and the claimed links between school resources and student achievement as one of the accepted indicators of quality education, this article seeks to address the following research questions:

1 The "Dovrat Committee" was officially called the "National Task Force for the Advancement of Education in Israel" and undertook a review of the Israeli education system in 2001-2006.

RQ1: To what extent do school resources differ between (a) PA schools, (b) Israeli Hebrew schools and (c) Israeli Arab schools?

RQ2: To what extent does the relationship between school resources and students' achievement in mathematics in TIMSS 2007 differ between the three groups specified in RQ1, once students' home background and schools' socio-economic status are taken into account?

RQ3: Do school resources amplify or reduce the relationships between student-level predictors and mathematics achievement?

2. Method

2.1 Data

The data used in this article were collected in Israel and by the PA as part of TIMSS 2007. In addition to collecting student achievement data based on mathematics and science tests, information was collected from students, their teachers and schools by way of background questionnaires. Only 8th grade level (14-year-old students) and mathematics achievement are considered in this article. A complete list of variables in the analyses is given in Appendix A.

2.2 Analyses

In order to address the above research questions, two types of analyses were conducted. First, cross-tabulations and simple regression analyses of all school resource variables specified in Appendix A were undertaken and compared for students in PA schools, Israeli Hebrew and Israeli Arab schools. It was investigated whether the three groups of schools differed considerably on any of these variables by way of cross-tabulations.

For these analyses, SAS 9.2 (2008) and WesVar (v5.1.17) were used and listwise deletion of missing data was employed. This method of handling missing data is considered to be robust to violations of assumptions that data are missing at random (MAR) or missing completely at random (MCAR), resulting in unbiased estimates of regression coefficients (Allison, 2009).

Second, hierarchical linear modeling analysis (HLM; Raudenbush & Bryk, 2002) was employed to overcome the limitations of traditional single level multiple regression analyses. Traditional models of multiple regression analyses can examine relationships between variables at only one level at a time. This means that either only student or only school variables may be related to each other and achievement. Alternatively, student variables need to be aggregated to the school level or school variables need to be disaggregated to the student level in order to be analyzed in one multiple regression model. In both cases, the analysis does not reflect the nested structure of formal education. Moreover, misleading conclusions are likely to be drawn as a result of applying principles of testing for statistical significance which tend to be based on simple random samples and do not take into account the clustered nature of a sample such as the one used in these analyses where schools are sampled first followed by some form of student sample within schools.

Therefore, analyses were undertaken using the HLM software (HLM-6; Raudenbush, Bryk, & Congdon, 2004) firstly to examine the relationship between school resources and mathematics performance once the socio-economic status of schools and students had been taken into account at the appropriate levels. This was done by specifying direct effects of the school resource variables as well as the direct effects of students' home background status variables on mathematics achievement. Secondly, the HLM analyses were aimed at identifying possible interaction effects whereby school resources changed (i.e., reduced or amplified) the relationship between students' home background status and mathematics achievement.

The dependent variable consisted of the five plausible values calculated for each student as a measure of mathematics achievement (Mislevy, Beaton, Kaplan, & Sheehan, 1992).

The original TIMSS variable of the first plausible values indicating mathematics achievement (BSMMAT01) was selected, alongside the other four plausible values as the outcome variable at level-1. Although centering of predictors around their group mean is recommended for analyses examining cross-level interaction effects (Luedtke, Robitzsch, Trautwein, & Kunter, 2009, p. 128), predictors were left uncentered to facilitate interpretation of the results. In addition, data at level-1 were weighted using the total students weight while data at level-2 were weighted using the school weight.

HLM 6 allows for missing data only at the first level. As some of the data were missing at the school level, the number of schools in the analyses was reduced by 5 to 143 PA schools, by 26 to 81 Israeli Hebrew schools and by 9 to 30 Israeli Arab schools. All students within those schools for which data were missing were also removed prior to the analysis. Thus, this way of handling missing data resulted in about 14 % of schools (294 initially, 254 in the HLM analyses) that were excluded from the analysis together with the corresponding students (7,514 initially, 6,744 in the HLM analysis = 11 % at the student level). While this will have reduced the statistical power of the analysis, any relationships that do emerge as non-trivial from the analyses are not likely to be due to chance. An examination of the schools that had to be removed from the analyses provided no indication that the removed schools systematically differed in terms of student achievement or the resources under examination from the ones remaining in the analysis.

The initial two-level model included student data at the first and school data at the second level. The same model was estimated separately for (a) PA schools, (b) Israeli Hebrew schools and (c) Israeli Arab schools. The equations for the initial two-level model are as follows:

Level 1, student level, model (no centering):

Student Mathematics Achievement = $\beta_0 + \beta_1$ (Parental Education) + β_2 (Student Gender) + β_3 (Student Home Background) + r

Level 2, school level, model (no centering):

$\beta_0 = \gamma_{00} + \gamma_{01}$ (Student comes from economically disadvantaged homes) + γ_{02} (Total School Enrollment) + γ_{03} (School Material Resources) + γ_{04} (Computer Resources) + γ_{05} (Equipment Resources) + u_0

Next, those variables for which the effects did not exceed twice the associated standard error were considered to be not significant and removed from the analysis (see "ns" in Table 8). The model was re-estimated with only the significant effects retained for each of PA schools, Israeli Hebrew schools and Israeli Arab schools (see "✓" in Table 8). Then, possible interaction effects of school level variables (Level 2) were examined in instances where a relationship between a student level variable (Level 1) and achievement emerged as being significant. This was done by inserting the possible interaction effect of one school variable at a time and examining whether or not its effect on the relationship between each of the level-1 predictors and achievement was significant. By way of example, the equation below illustrates how the interaction effect of the level-2 predictor School Material Resources on the relationship between the level-1 predictor Student Home Background and Student Mathematics Achievement was examined:

$\beta_3 = \gamma_{30} + \gamma_{31}$ (School Material Resources) + u_3

The final model included only effects that were significant.

3. Results

Results are presented first for the cross-tabulation analyses followed by the results of the regression analyses. In the final section, findings from the HLM analyses are discussed.

Cross-tabulation analyses. In preparation for the analyses, composite variables as indicators of school resources were created:

1. Extent to which teaching in TIMSS class is limited by a shortage in computer resources;
2. Extent to which teaching in TIMSS class is limited by a shortage in equipment;
3. Extent to which instruction is affected by a shortage or inadequacy of school resources for mathematics instruction.

All composites were recoded into dummy variables with a higher level of shortage coded as "0" and lower level of shortage coded as "1". Details regarding the way in which the composites were created are given in Appendix B.

In these analyses, the Paired Jackknife Replication method (JK2) was applied to accommodate the complex clustered sampling design of the TIMSS 2007 data in order to produce unbiased and corrected standard errors. As the TIMSS 2007 sampling design applied a stratified multistage cluster sampling technique, the JK2 method is considered to estimate the standard error and to avoid the assumption of simple random sampling. For samples as the one in this analysis, the JK2 method is considered more appropriate compared with the Jackknife-1 (JK1) method and the Balanced Repeated Replication (BRR) as the JK1 is designed for unstratified samples and BRR is designed for stratified samples assuming fixed numbers of units in strata. For the purpose of examining the dependency and strength of association between school resources and the three groups of schools, cross-tabulation, Chi-square test and Contingency coefficient 'Cramer's V' were calculated. Results are presented in Tables 1 to 3.

Table 1: Rao-Scott (Jackknife-2) contingency table of groups associated with shortage in computer resources limiting teaching

Groups of analysis	Percentage	Standard Error	t Value
Palestinian Authority Schools			
Shortage limits teaching	29	3.93	7.38***
Shortage does not limit teaching	71	3.99	17.78***
Israeli Hebrew Schools			
Shortage limits teaching	7	2.29	3.06***
Shortage does not limit teaching	93	2.44	38.11***
Israeli Arab Schools			
Shortage limits teaching	21	10.94	1.92*
Shortage does not limit teaching	79	10.76	7.34***

Note. Variance estimation method: Jackknife-2. See section 3. Results.
Chi-square (Degrees of freedom = 2; $p < .0001$). Cramer's V = 0.24.
*** $p < 0.01$. * $p < 0.1$.

Table 2: Rao-Scott (Jackknife-2) contingency table of groups associated with shortage in equipment resources limiting teaching

Groups of analysis	Percentage	Standard Error	t Value
Palestinian Authority Schools			
Shortage limits teaching	9	2.12	4.25***
Shortage does not limit teaching	91	2.03	44.86***
Israeli Hebrew Schools			
Shortage limits teaching	2	1.02	1.97**
Shortage does not limit teaching	98	1.23	79.99***
Israeli Arab Schools			
Shortage limits teaching	15	6.55	2.29**
Shortage does not limit teaching	85	6.47	13.13***

Note. Variance estimation method: Jackknife-2. See section 3. Results.
Chi-square (Degrees of freedom = 2; $p < .0001$). Cramer's V = 0.15.
*** $p < 0.01$. ** $p < 0.05$.

Table 3: Rao-Scott (Jackknife-2) contingency table of groups associated with availability of school resources for mathematics instruction

Groups of analysis	Percentage	Standard Error	t Value
Palestinian Authority Schools			
High shortage of resources	81	3.26	24.88***
Low shortage of resources	19	3.14	6.05***
Israeli Hebrew Schools			
High shortage of resources	56	5.76	9.73***
Low shortage of resources	44	5.66	7.78***
Israeli Arab Schools			
High shortage of resources	86	4.95	17.38***
Low shortage of resources	14	5.00	2.80***

Note. Variance estimation method: Jackknife-2. See section 3. Results.
Chi-square (Degrees of freedom = 2; $p < .0001$). Cramer's V = 0.28
*** $p < 0.01$.

Results of the cross-tabulations show some differences in school resources between the three groups. As can be seen in Table 1, the lowest percentage (7 %) of shortages in computer resources limiting teaching (incl. shortage of hardware, software, computer support) is recorded for the Israeli Hebrew schools. In contrast, such a shortage is recorded for more than 20 % of students in Israeli Arab Schools and PA schools. A similar difference in resources emerges for the other two school resource variables. In Table 2, only 2 % of Israeli Hebrew schools report a shortage in equipment (incl. shortage in textbooks, instructional materials, student-teacher ratio, equipment for demonstration and exercises) compared to 9 % in PA schools and 15 % in Israeli Arab schools. In Table 3, it can be seen that a low level of mathematics specific resources (incl. calculators, instructional space, library and audiovisual materials for mathematics instruction) is reported by just over half (56 %) of Israeli Hebrew schools compared with 81 % in PA schools and 86 % in Israeli Arab schools. In other words, while still more than half of students in Israeli Hebrew schools are taught in schools with shortages in terms of physical infrastructure and mathematics specific resources, this percentage rises to more than 80 % in PA schools (81 %) and Israeli Arab schools (86 %).

As part of Tables 1 to 3, the chi-square statistics is given to examine whether or not any difference between the three groups (i.e., PA schools, Israeli Hebrew schools and Israeli Arab schools) in terms of the school resources is significant. In addition, Cramer's V[2] was calculated to evaluate the strength of the relationships. These analyses were undertaken using WesVar (v5.1.17) as it produces the Rao-Scott (JK2) contingency and chi-square analyses which is a cluster design adjusted version of chi-square.

Results show that the differences between the three groups of schools can be considered medium for shortages regarding computer hardware, software and support (r = 0.24) and availability of physical infrastructure and mathematics specific resources (r = 0.28). In addition, the difference between the three groups in terms of shortage in equipment, while small (r = 0.15)[3], is still significant.

3.1 Regression analyses

Tables 4 to 6 summarize the results of the simple regression analyses aimed at examining whether the differences in mathematics achievement associated with different levels of school resources were significant for each of the three groups of schools.

2 Chi-square and Cramer's V statistics are used as they are considered appropriate tests for categorical data.

3 For an operational definition of small, medium, and large effect size indexes see Cohen, J. (1992). A power primer. *Psychological Bulletin, 112* (1), 155–159.

Table 4: Regression analysis for differences in mathematics achievement associated with shortage in computer resources limiting teaching

Groups of analysis	*N*	Multiple R Squared	Total Sum of Squares	Regression Sum of Squares	B00	B01
Palestinian Authority Schools	4,278	0.005	957,210,957	5,058,337	356 (8.2)	16 (9.8)
Israeli Hebrew Schools	1,882	0.000	399,525,835	77,843	484 (11.5)	5 (12.8)
Israeli Arab Schools	766	0.005	160,047,781	777,354	396 (10.7)	16 (16.1)

Note. B00: Intercept - Math achievement score. B01: Difference associated with shortage in computer resources limit teaching. Standard errors are in brackets. None of the results in this table were significant.

Table 5: Regression analysis for differences in mathematics achievement associated with shortage in equipment resources limiting teaching

Groups of analysis	*N*	Multiple R Squared	Total Sum of Squares	Regression Sum of Squares	B00	B01
Palestinian Authority Schools	4,314	0.003	964,457,065	2,437,935	351 (13.5)	18 (13.9)
Israeli Hebrew Schools	1,883	0.000	391,628,439	169,797	478 (30.6)	12 (31.1)
Israeli Arab Schools	765	0.008	164,111,699	1,383,633	387 (19.6)	25 (21.9)

Note. B00: Intercept - Math achievement score. B01: Difference associated with shortage in equipment resources limit teaching. Standard errors are in brackets. None of the results in this table were significant.

Table 6: Regression analysis for differences in mathematics achievement associated with availability of school resources for mathematics instruction

Groups of analysis	*N*	Multiple R Squared	Total Sum of Squares	Regression Sum of Squares	B00	B01
Palestinian Authority Schools	4,378	0.012	971,822,404	11,320,762	362 (4.2)	28 (7.6) ***
Israeli Hebrew Schools	2,219	0.000	488,022,300	123,933	487 (7.5)	-3 (11.2)
Israeli Arab Schools	917	0.021	207,120,531	4,302,161	404 (6.6)	40 (31.4)

Note. B00: Intercept - Math achievement score. B01: Difference associated with availability of school resources for mathematics instruction. Standard errors are in brackets.
*** $p < 0.01$.

In Table 4, results are presented regarding differences in mathematics achievement associated with shortage in schools' computer resources for each of the three groups. While performance differences are larger for PA and Israeli Arab schools than for Israeli Hebrew schools (16 points compared with 5 points), none of these differences are significant.

Results of the analyses which regress mathematics performance on shortage in equipment (e.g., shortage in textbooks, instructional materials, student-teacher ratio, equipment for demonstration and exercises) are presented in Table 5. Again, results show that students in schools that report not having such shortages in equipment limiting their teaching perform slightly higher than students in schools that do report such shortages. However, none of the differences are significant for any of the three groups of schools.

In Table 6, differences in mathematics achievement associated with the availability of school resources for mathematics instruction between the three groups emerge. Thus, for the PA, students taught in schools reporting that a shortage of school resources for mathematics instruction does not limit teaching perform, on average, 28 points higher than students in schools that report such a limitation.

To put the point difference into perspective, it should be noted that the international benchmarks in TIMSS at Grade 8 are as follows:

- Advanced International Benchmark: 625 points
- High International Benchmark: 550 points
- Intermediate International Benchmark: 475 points
- Low International Benchmark: 400 points

This indicates that 75 scale points lie between benchmarks. Thus, the above coefficient of 28 points is slightly more than one third of difference between TIMSS benchmarks.

Whilst the difference in mathematics achievement depending on levels of mathematics school resources shown in Table 6 for Israeli Arab schools is larger than for PA schools in absolute terms (40 compared to 28 points), the difference is not significant due to the larger standard error which is a consequence of the smaller number of Israeli Arab schools available in the analysis. The difference in mathematics achievement depending on mathematics school resources for Israeli Hebrew schools is not significant.

3.2 HLM analyses

Although the analyses reported in the previous section provide first insights into the differences in the availability of school resources and their relationship to mathematics achievement, they are limited in two ways. First, they consider only bivariate relationships between one variable and achievement at a time. Second, they do not allow for the multilevel nature of the data where achievement is measured at the student level and school resources are measured at the school level. Hence, results of a multilevel model analysis for each of the three groups of schools are presented and discussed in this section. Each model examines simultaneously the relationship of the three school resource constructs on mathematics achievement. Moreover, these relationships are examined while taking into account students' socio-economic status (SES) in terms of home possessions and parental education and the schools' SES through the proportion of students coming from disadvantaged homes. These indicators of SES were included at the student and school levels to control for the continuously strong effects these variables have been shown to have on performance (e.g., Comber & Keeves, 1973; Sirin, 2005).

One of the first results of interest that emerge from an HLM analysis is information regarding the variance associated with the levels in the analysis. In addition to the number of schools and students in the analysis, Table 7 presents results of the estimation of variance components (for an explanation of how these were calculated, see Raudenbush & Bryk, 2002) that are required to calculate the variance (a) associated with the between-student within school and the between-school levels respectively and (b) accounted for at each level, which are presented in Table 8. Since the aim of the analyses in this article was to examine possible differences in the associations of school resources on mathematics achievement for the three groups of schools, results were calculated for the initial model which included the same variables.

Table 7: Estimation of variance components

			Estimation of variance components for			
			Fully unconditional model		Initial model	
Groups of analysis	*N* Schools	*N* Students	School Tau(pi)	Student Sigma-squared	School Tau(pi)	Student Sigma-squared
Palestinian Authority Schools	143	4,097	2,107.00	8,245.54	1,682.49	7,470.31
Israeli Hebrew Schools	81	1,878	2,653.32	5,835.92	2,342.62	5,203.09
Israeli Arab Schools	30	769	2,208.25	6,773.51	1,530.13	6,545.63

Table 8: Between student and between school variance

	Variance associated with		Variance accounted for by initial model between	
Groups of analysis	Schools	Students	Schools	Students
Palestinian Authority Schools	0.20	0.80	0.20	0.09
Israeli Hebrew Schools	0.31	0.69	0.12	0.11
Israeli Arab Schools	0.25	0.75	0.31	0.03

It can be seen from Table 8 that the variance in mathematics achievement between schools is lowest in PA schools (20 %), higher for the Israeli Arab schools (25 %) and highest between the Israeli Hebrew schools (31 %). Correspondingly, differences in achievement between students within schools are greatest in PA schools (80 %), smaller for students in Israeli Arab schools (75 %) and smallest between students in Israeli Hebrew schools (69 %).

When examining how much of the variance in achievement the initial model accounts for in the three groups of schools, differences also emerge. Thus, the largest amount of variance between schools that is accounted for by the model is recorded for the Israeli Arab schools (31 %), followed by the PA schools (20 %) and the Israeli Hebrew schools (12 %). This relatively large amount of explained variance for the Israeli Arab schools is interesting given that they are not the schools with the largest variance associated with the school level. At the student level, the model has the largest explanatory power for students in Israeli Hebrew schools (11 %), followed by students in PA schools (9 %) and students in Israeli Arab schools (3 %). Again, this is of interest as one might have expected variance accounted for to be greatest where the largest differences can be observed (i.e., PA at Level 1).

Table 9 provides a summary of the effects that emerge from the HLM analyses. Shortage of computer hardware, software and support is significantly linked to achievement in PA and Israeli Arab schools. Thus, students in schools in which teachers report less of a shortage on the computer related matters perform at a higher level than students in schools where teachers report a greater shortage. This applies even after the effects of SES in the form of parental education (in PA schools) and home possessions (in PA and Israeli Arab schools) are taken into account.

Table 9: Summary of HLM analysis

	Groups of analysis		
	Palestinian Authority Schools	Israeli Arab Schools	Israeli Hebrew Schools
Level-1, Students			
Gender	ns	ns	ns
Parental education	✓	ns	✓
Home possessions	✓	✓	ns
Level-2, Schools			
% students from economically disadvantaged backgrounds	ns	ns	✓
Total enrollment	ns	✓(-)	ns
Shortage resources maths instruction	ns	ns	ns
Shortage computer resources	✓	✓	ns
Shortage equipment resources	ns	ns	ns
Interaction effects	ns	ns	ns

Note. ✓ Significant effect on mathematics achievement/Significant interaction effect of school resource on relationship between level-1 variable and achievement. Except for the effect of 'Total enrollment', which is negative, all other effects are positive (for coding of variables, see Appendix B).
ns = Effect not significant.

No significant effects on achievement emerge for either shortage of equipment or school resources for mathematics instruction in PA, Israeli Hebrew or Israeli Arab schools. This suggests that differences in terms of inadequate physical facilities or a high student-teacher ratio do not contribute to differences in achievement in any of the three kinds of schools. Likewise, limitations with respect to general and mathematics specific resources do not emerge as significant predictors of achievement in the three models, student and school SES have been taken into account.

Two further significant level-2 effects on achievement emerge in the Israeli Arab and Israeli Hebrew schools. In the Israeli Arab schools, total school enrollment has a negative effect on achievement indicating that students in larger schools perform at a lower level than students in smaller schools. In the Israeli Hebrew schools, the proportion of students from economically disadvantaged homes has an effect whereby schools with less than 50 % of students from such homes perform at a higher level than schools where more than half the students come from such homes. No such differential effect of socio-economic intake of the school is found for the Israeli Arab or PA schools.

No significant interaction effects are found in any of the three HLM models. This means that none of the three school resource variables either amplifies or reduces the relationship between home background in terms of possessions or parental education and mathematics achievement.

While the summary table above (Table 9) indicates whether or not the effects examined in the initial model are significant, Tables 10 to 12 present details regarding the size of the coefficients and the associated standard error of those variables that were found to be significant and included in the final model.

Table 10: Final model – Palestinian Authority (PA) Schools

Fixed Effect	Coefficient	Standard Error	T - ratio	Approx. degrees of freedom	P - value
INTRCPT1, B0					
INTRCPT2, G00	378.28	5.00	75.59	141	0.000
Computer resources	26.33	11.42	2.31	141	0.023
Parental education slope, B1					
INTRCPT2, G10	10.02	1.94	5.16	100	0.000
Home possession slope, B2					
INTRCPT2, G20	30.56	6.01	5.08	879	0.000

The value of the intercept indicates the mathematics score when the values of the predictors in the model are zero. Hence, the average performance of students with a low level of home possessions whose parents have not completed school and who attend schools in which teachers indicate a shortage of computer hardware, software and support in PA schools is a score of 378 with a standard error of five. This score increases by 26 for schools in which teachers do not report such shortages with regard to computer equipment and support and by 31 for students from homes with high levels of possessions. The third coefficient indicates an increase of about 10 points in average performance for each additional level of education that has been completed by parents (i.e., lower secondary, upper secondary, post-secondary non tertiary, first degree, beyond first degree).

As pointed out above, the difference between one international benchmark and the next is 75 points in TIMSS. Thus, taken together, the reported coefficients mean that the average performance of students in schools without computer resource shortages (26 points), a high level of home possessions (31 points) and two additional levels of completed parental education (2*10 = 20 points) is about one benchmark level higher (= 77 points) than the performance of other students in PA schools.

Table 11: Final model – Israeli Arab Schools

Fixed Effect	Coefficient	Standard Error	T - ratio	Approx. degrees of freedom	P - value
INTRCPT1, B0					
INTRCPT2, G00	419.22	11.76	35.64	27	0.000
Total enrollment, G01	-0.06	0.03	-2.37	27	0.026
Computer resources	48.15	19.09	2.52	27	0.018
Home possession slope, B1					
INTRCPT2, G10	25.98	12.15	2.14	66	0.036

In the final model, three effects emerge for the Israeli Arab schools (see Table 11). At the school level, total enrolment and computer shortage are significantly linked to achievement. The negative effect of total enrolment indicates that smaller schools perform at a higher level. More specifically, for each additional student in the school, the performance decreases by 0.06 score points. The positive coefficient reported for computer resources indicates that schools in which teachers do not report a shortage the average score of 419 increases by 48 points, or half a TIMSS international benchmark level difference. At the student level, the coefficient for home possessions indicates that students with a higher number of possessions at home (i.e., calculator, computer, study desk, dictionary, internet connection, TV, video camera, dishwasher, air conditioning) perform 31 points higher in mathematics than students from less affluent homes.

Table 12: Final model – Israeli Hebrew Schools

Fixed Effect	Coefficient	Standard Error	T - ratio	Approx. degrees of freedom	P - value
INTRCPT1, B0					
INTRCPT2, G00	498.66	5.51	90.38	79	0.000
% students from economically disadvantaged backgrounds, G01	33.19	16.12	2.06	79	0.042
Parental education slope, B1					
INTRCPT2, G10	14.54	2.69	5.39	40	0.000

Of the three models, the final model for Israeli Hebrew schools has the smallest number of significant effects. For two variables non-trivial coefficients are found and both are measures of SES. At the school level, students in schools with less than 50 % of students from economically disadvantaged homes perform 33 points higher than students in schools with more than 50 % of students from economically disadvantaged homes. At the student level, for each additional level of completed parental education, mathematics achievement increases by 15 points or 20 % of an international TIMSS benchmark level. In contrast, school resources, school size, student gender or home possessions are not significantly related to mathematics achievement. Still, the two significant predictors emphasize the importance of socio-economic background in Israeli Hebrew schools.

4. Summary and Conclusion

Assessment programs such as TIMSS and PISA have been used not only to monitor student performance at particular age or grade levels but also to collect contextual or background information from students, teachers, schools and education systems on variables thought to be related to performance. While acknowledging the greater limitations of such cross-sectional studies compared with experimental studies in terms of drawing conclusions regarding causality, results of the analyses of relationships between various context variables and performance have received widespread attention (e.g., Bos & Kuiper, 1999; OECD, 2010; Hanushek & Woessmann, 2007). These analyses frequently use prior research, replication, temporal order and logic as arguments for their implicit or explicit causal ordering of variables and their relationships with performance.

In line with this approach, the analyses reported in this article have focused on one specific aspect, namely the relationship between school resources and student performance in mathematics. This is not to say that other variables, such as how teachers use these resources or how school principals go about obtaining and managing these resources and their schools, do not potentially also have an impact on student outcomes. Also, while it would have been desirable to include indicators of school autonomy or school accountability to check the robustness of results, such information was not available in the data set. In addition, while information regarding whether schools were government or privately managed, the numbers of privately managed schools in the three groups under review would have been too small to warrant inclusion in the analyses.

However, by focusing on this relationship, further evidence was sought to contribute to the discussion whether (a) differences in schools resources between Israeli Hebrew and Israeli Arab schools in Israel had been reduced as intended by the Dovrat Committee and (b) differential school resources in each of the three groups of Israeli Arab, Israeli Hebrew and Palestinian Arab schools were related to performance.

In response to these issues and the research questions posed in this article, three main findings are noted from the analyses reported in this article. First, significant differences can be observed between the resources of Palestinian Authority, Israeli Hebrew and Israeli Arab schools. Thus, principals in Israeli Hebrew schools report lower levels of shortages concerning computers, equipment, buildings, classrooms, and resources specific to mathematics instruction than principals in Israeli Arab and PA schools. This finding indicates that, although the differences in resources between Israeli Hebrew schools and Israeli Arab schools might have been reduced, the shortages regarding computer, equipment and mathematics instructions resources reported by Israeli Arab schools still exceed the shortages reported by Israeli Hebrew schools. In this sense, the aim of the Dovrat Committee has only partly been reached. However, even though principals of Israeli Arab and PA schools report greater shortages, not all of these are related significantly to student achievement. While somewhat surprising, this is in line with previous findings (Hanushek, 2003; Hanushek & Woessmann, 2007; Hoxby, 2000).

Second, the relationship between school resources and students' achievement in mathematics in TIMSS 2007 differs for the three groups of schools. Thus, no links between school resources and achievement emerge for the Israeli Hebrew schools, most likely because the differences between the resource levels of the schools in that group are not as large as they are between schools in the other two groups. This evidence supports previous findings (Heyneman & Loxley, 1982, 1983) that in economically developing scenarios, resources may be related to student achievement as a consequence of greater differential resourcing than occurs in economically developed scenarios.

In Israeli Arab schools as well as in PA schools, the level of shortages regarding computer hardware, software and support is linked to achievement with schools reporting less shortages performing at a higher level in mathematics which confirms that some school resources can be significant predictors of student achievement (Abulibdeh & Abdelsamad, 2008; Bouderga, 2008). The other two school resource variables, namely shortages in terms of equipment for demonstrations and exercises, textbooks, and high student-teacher ratio as well as limitations as regards buildings, classrooms and mathematics-specific instructional equipment, were not related to differences in mathematics achievement.

Third, results indicate that none of the three school resource variables were able to offset the strong link between home background in terms of parental education and home possessions and achievement.

In conclusion, the results presented in this article contribute to the growing international body of evidence regarding the relationship between school resources and student achievement in different contexts. Results presented in this article support the observation that relationships between school resources and performance should not be dismissed and are highly dependent on the economic and development context in which schools operate. Still, as the international literature grows to clarify this relationship between school resources and performance across contexts, further empirical evidence of how school resources operate through other factors and may thus be indirectly linked to performance are of interest. This would give further insights into how national and global calls for national economic growth and the provision of quality education may be fulfilled.

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Appendix A

List of variables in the analyses
School questionnaire

Variable name	***Variable label***
BC4GTENR	Total school enrollment
BC4GSBED	Percentage of student from economically disadvantaged homes

Extent to which instruction is affected by a shortage or inadequacy of (BCDSRMI):

BC4GST01	Instructional materials (e.g., textbooks)
BC4GST02	Budget for supplies (e.g., paper, pencils)
BC4GST03	School buildings and grounds
BC4GST04	Heating, cooling, lighting systems
BC4GST05	Instructional space and classrooms
BC4MST07	Computers for mathematics instruction
BC4MST08	Computer software for mathematics instruction
BC4MST09	Calculators for mathematics instruction
BC4MST10	Library materials relevant to mathematics instruction
BC4MST11	Audio-visual resources for mathematics instruction

Teacher questionnaire

Extent to which teaching in TIMSS class is limited by:
(Shortage in equipment, BCDEQUPS)

BT4MLI09	Shortage of textbook for student use
BT4MLI10	Shortage of other instructional equipment for student use
BT4MLI11	Shortage of equipment for your use in demonstrations and other exercises
BT4MLI12	Inadequate physical facilities
BT4MLI13	High student-teacher ratio

(Shortage in computer resources, BCDCOMPS)

BT4MLI06	Shortage of computer hardware
BT4MLI07	Shortage of computer software
BT4MLI08	Shortage of support for using computers

"In our analyses, BCDCOMPS and BCDEQUPS were considered at level-2 (i.e., the school level) as the reference point of the questions was the TIMSS class at school".

Student questionnaire

ITSEX Sex of student

Index indicating home possessions (HMEPOSS) built from the following questions:

BS4GTH01	Calculator
BS4GTH02	Computer
BS4GTH03	Study desk
BS4GTH04	Dictionary
BS4GTH05	Internet connection
BS4GTH06	Country-specific
BS4GTH07	Country-specific
BS4GTH08	Country-specific
BS4GTH09	Country-specific

The country-specific home possessions for the two countries in the analyses were as follows:

For Israel:

BS4GTH06	Two TVs, plasma screen
BS4GTH07	Video camera
BS4GTH08	Air conditioning
BS4GTH09	Dishwasher

For PA, only two of the four possible country-specific options were spelt out:

BS4GTH06	TV without satellite
BS4GTH07	TV with satellite

Index indicating parental education (PAREDU) taking the highest value from the following questions:

BS4GMFED	Highest level of mother's education
BS4GFMED	Highest level of father's education

Appendix B

List of composites and derived variables

BCDCOMPS (Index of Shortage in Computer Resources Limiting Teaching)

Source Variables:
BT4MLI06, BT4MLI07, BT4MLI08

Procedure:
Based on responses to the following question in the teacher questionnaire:
In your view, to what extent do the following limit how you teach the TIMSS class?
- Shortage of computer hardware (TQM2_18f, BT4MLI06)
- Shortage of computer software (TQM2_18g, BT4MLI07)
- Shortage of support for using computers (TQM2_18h, BT4MLI08)

Response options: not applicable = 1; not at all = 2; a little = 3; some = 4; a lot = 5

The index is computed by averaging the responses to the 3 source questions.
1 = Shortage does not limit teaching = Average of BT4MLI06 to BT4MLI08 is less than or equal 4
2 = Shortage does limit teaching = Average of BT4MLI06 to BT4MLI08 is greater than 4
The index is coded as missing if there are 2 or more source questions of BT4MLI06 to BT4MLI08 with invalid data.

In our analyses, BCDCOMPS was considered at level-2 (i.e., the school level) as the reference point of the questions was the TIMSS class at school.
Dummy recoding for the Cross-tabulation & HLM analyses:
1 → *1 (Shortage does not limit teaching)*
2 → *0 (Shortage does limit teaching)*

BCDEQUPS (Index of Shortage in Equipment Resources Limiting Teaching)

Source Variables:
BT4MLI09, BT4MLI10, BT4MLI11, BT4MLI12, BT4MLI13

Procedure:
Based on responses to the following question in the teacher questionnaire:
In your view, to what extent do the following limit how you teach the TIMSS class?
- Shortage of textbooks for student use (TQM2_18i, BT4MLI09)

- Shortage of other instructional equipment for students' use (TQM2_18j, BT4MLI10)
- Shortage of equipment for your use in demonstrations and other exercises (TQM2_18k, BT4MLI11)
- Inadequate physical facilities (TQM2_18l, BT4MLI12)
- High student/teacher ratio (TQM2_18m, BT4MLI13)

Response options: not applicable = 1; not at all = 2; a little = 3; some = 4; a lot = 5
The index is computed by averaging the responses to the 5 source questions.
1 = Shortage does not limit teaching = Average of BT4MLI06 to BT4MLI08 is less than or equal 4
2 = Shortage does limit teaching = Average of BT4MLI06 to BT4MLI08 is greater than 4
The index is coded as missing if there are 2 or more source questions of BT4MLI09 to BT4MLI13 with invalid data.

In our analyses, BCDEQUPS was considered at level-2 (i.e., the school level) as the reference point of the questions was the TIMSS class at school.
Dummy recoding for the Cross-tabulation & HLM analyses:
1 → 1 (Shortage does not limit teaching)
2 → 0 (Shortage does limit teaching)

BCDSRMI (Availability of school resources for mathematics instruction)

Source Variables:
BC4GST01, BC4GST02, BC4GST03, BC4GST04, BC4GST05, BC4MST07, BC4MST08, BC4MST09, BC4MST10, BC4MST11

Procedure:
Based on responses to the following question in the school questionnaire:
Is your school's capacity to provide instruction affected by a shortage or inadequacy of any of the following?

- Instructional materials (e.g., textbook) (SCQ2_19a, BC4GST01)
- Budget for supplies (e.g., paper, pencils) (SCQ2_19b, BC4GST02)
- School buildings and grounds (SCQ2_19c, BC4GST03)
- Heating/cooling and lighting systems (SCQ2_19d, BC4GST04)
- Instructional space (e.g., classrooms) (SCQ2_19e, BC4GST05)
- Computers for Mathematics instruction (SCQ2_19g, BC4MST07)
- Computer software for Mathematics instruction (SCQ2_19h, BC4MST08)
- Calculators for Mathematics instruction (SCQ2_19i, BC4GST09)
- Library materials relevant to Mathematics instruction (SCQ2_19j, BC4GST10)
- Audio-visual resources for Mathematics instruction (SCQ2_19k, BC4GST11)

Response options: none = 1; a little = 2; some = 3; a lot = 4
The index is computed by averaging the responses to the 10 source questions.
1 = High = Average of BC4GST01 to BC4GST05 is less than 2 and the average of BC4MST07 to BC4GST11 is less than 2
2 = Medium = All other responses combinations
3 = Low = Average of BC4GST01 to BC4GST05 is greater than or equal to 3 and the average of BC4MST07 to BC4GST11 is greater than or equal to 3
The index is coded as missing if there are 2 or more source questions of BC4GST01 to BC4GST05 with invalid data OR 2 or more source questions of BC4MST07 to BC4GST11 with invalid data.

Dummy recoding for the Cross-tabulation & HLM analyses:
1 → 1 (Low shortage of resources for mathematics instruction)
2, 3 → 0 (High shortage of resources for mathematics instruction)

HMEPOSS (Index of Home Possessions)

Source Variables:
BS4GTH01, BS4GTH02, BS4GTH03, BS4GTH04, BS4GTH05, BS4GTH06, BS4GTH07, BS4GTH08, BS4GTH09

Procedure:
Based on responses to the following question in the student questionnaire:

Do you have any of these things at your home?
- Calculator (SQ2_5a, BS4GTH01)
- Computer (SQ2_5b, BS4GTH02)
- Study desk/table for your use (SQ2_5c, BS4GTH03)
- Dictionary (SQ2_5d, BS4GTH04)
- Internet connection (SQ2_5e, BS4GTH05)
- Country-specific (SQ2_5f, g, h, i; BS4GTH06, BS4GTH07, BS4GTH08, BS4GTH09)

PA used 2 country-specific options:
TV without satellite for BS4GTH06
TV with satellite for BS4GTH07

Israel used 4 country-specific options:
TVs, plasma screen for BS4GTH06
Video camera for BS4GTH07
Air conditioning for BS4GTH08
Dishwasher for BS4GTH09

Response options: Yes = 1; No = 2
The index is computed by averaging the responses to the 8, respectively 10 source questions.
1 = Yes = Rounded average is equal to 1
2 = No = Rounded average is equal to 2

The index is coded as missing if there are more than one third of the variables with invalid data.

Dummy recoding for HLM analysis:
1 → 1 (High)
2 → 0 (Low)

PAREDU (Index of Parental Education)

Source Variables:
BS4GMFED, BS4GFMED

Procedure:
Based on responses to the following questions in the student questionnaire:
- What is the highest level of education completed by your mother (or stepmother or female guardian)?
- What is the highest level of education completed by your father (or stepfather or male guardian)?

Response options:
1 = 'Some ISCED Level 1 or 2, or did not go to school'
2 = 'ISCED 2'
3 = 'ISCED 3'
4 = 'ISCED 4'
5 = 'ISCED 5B'
6 = 'ISCED 5A, first degree'
7 = 'Beyond ISCED 5A'
8 = 'I do not know'

The index is computed by taking the highest value "MAX" of both variables. If one of the answers was "I do not know", the other response had been taken.

The index is coded as missing if both variables are missing.

We decided to use all categories of this ordinal index, as we see the importance of keeping all of them for our analyses. Therefore, dummy recoding was not adopted here, and just recoding was used for statistics interpretation purposes.

Recoding for HLM analysis:
1 → 0
2 → 1
3 → 2
4 → 3
5 → (Not used by both countries)
6 → 4
7 → 5
8 → Missing

ITSEX (Student gender)

Source Variables:
ITSEX and BS4GSEX

Procedure:
Based on responses to the Students' information provided by the national centers and the following question in the student questionnaire:
- Are you a girl or a boy?

Response options:
1 = 'Girl'
2 = 'Boy'

Dummy recoding for HLM analysis:
1 → 0 (girl)
2 → 1 (boy)

BC4GSDIR (Percentage of student from economically disadvantaged homes)

Source Variable:
BC4GSBED

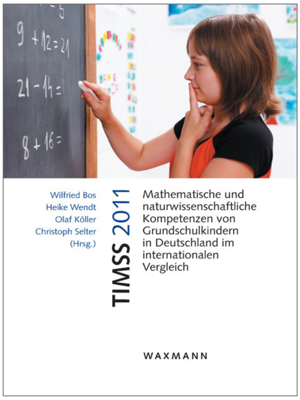
Procedure:
Based on responses to the following question in the school questionnaire:
- Approximately what percentage of students in your school has the following backgrounds?

a) Come from economically disadvantaged homes.

Response options:
1 = '0 to 10 %'
2 = '11 to 25 %'

3 = ‘26 to 50 %’
4 = ‘More than 50 %’

Dummy recoding for HLM analysis:
1, 2, 3 → 1
4 → 0



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TIMSS 2011

Mathematische und naturwissenschaftliche Kompetenzen von Grundschulkindern in Deutschland im internationalen Vergleich

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Im Jahr 2011 beteiligte sich Deutschland zum zweiten Mal an der Grundschuluntersuchung *Trends in International Mathematics and Science Study* (TIMSS). Mit TIMSS werden alle vier Jahre die Fachleistungen von Schülerinnen und Schülern der vierten Jahrgangsstufe in den Bereichen Mathematik und Naturwissenschaften im internationalen Vergleich untersucht. Dieser Band präsentiert die Ergebnisse der Untersuchung.

[...] Das Buch gehört [...] in mindestens einem Exemplar in die Bibliothek jeder Ausbildungsstätte für Soziale Arbeit und mindestens ein weiteres Mal, wenn an der entsprechenden Hochschuleinheit zumindest ein speziell Bildungsfragen gewidmeter Studiengang vorhanden ist.

H.-P. Heekerens, http://www.socialnet.de/rezensionen/14539.php

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