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Home and school environmental determinants of science achievement of South African students

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Determinants of educational achievement extend beyond the school environment to include the home environment. Both environments provide tangible and intangible resources to students that can influence science achievement. South Africa provides a context where inequalities in socio-economic status are vast, thus the environments from whence students draw resources vary. This paper investigates school and home environments to determine what resources influenced science achievement. Multiple regression analyses were conducted on data from 11,969 South African Grade Nine students, who participated in the Trends in International Mathematics and Science Study in 2011. The findings reveal that both the school and home environments play important roles in students' science achievement, with the strongest associations exhibited with: speaking the language of the test at home, home assets, and the condition of school buildings. Implications for policy are discussed.

Keywords: home resources; learning environment; predictors of performance; science performance; South Africa; TIMSS 2011

Introduction

In a global environment characterised by the growing role of science and technology in our economic, social and political lives, the role of science education has become increasingly important. In developing countries, such as South Africa, science, technology and innovation have become forces that drive economic growth and competitiveness and have the potential for improving the quality of life. As a result, the adoption of knowledge-based economic strategies is becoming increasingly popular in many countries. South Africa aspires to be a knowledge-based economy for its development. A knowledge-based economy, in its simplest form, relies on the generation of relevant knowledge and the productive use of that knowledge to advance growth (World Bank, 1999). This type of economy is built, in part, on people who are skilled and educated in science subjects. The number of scientifically skilled people (such as scientists, engineers and other technically skilled personnel) in a country is thus associated with the economic growth of the country and the ability of a country to compete in the global economy. The development of these skilled people begins at the school level. It is therefore concerning that the 2011 Trends in International Mathematics and Science Study (TIMSS) found the average science achievement of Grade Nine South African students to be well below the international centre point of 500 points (for all students who participated in the TIMSS study) (Mullis, Martin, Foy & Arora, 2012).

South African students achieved an average score of 332 out of a possible 1,000 points and the country placed in the bottom five of the 63 participating countries. This is even more concerning given that South Africa participated at the Grade Nine level, whereas all but three of the other countries participated at the Grade Eight level. In attempting to improve science performance, policy makers need to understand what resources currently influence student achievement and how strong these relationships are.

Identifying the determinants of science achievement is especially important in South Africa, which has experienced numerous educational policy reforms over the past 20 years, in order to redress historical imbalances in the allocation of educational resources, as well as to promote the economic development of the country. The goal of this paper is to investigate home and school environmental factors and the strength of their relationship with science performance. Through this investigation, the paper will answer the following key questions:

1) Which home resources have a significant association with student science achievement in South Africa?
2) Which school resources have a significant association with student science achievement in South Africa?
3) When examined in unison, what environmental resources are significantly associated with science performance?

This study is framed within an ecological systems model put forward by Bronfenbrenner (1979). The model recognises that human development does not take place in isolation; rather it is influenced by interactions between multiple systems or environments. In particular, the home and school environments provide resources from whence students can draw. The bodies of knowledge within households, which can be rich resources, may influence achievement, if utilised (Moll, Amanti, Neff & Gonzalez, 1992). We argue that, in order to understand the developmental outcomes of South African students, the unique environmental experiences should be examined.

Home Environment Resources

Home resources refer to the tangible assets in a home, as well as the intangible assets, including parental education levels, parental involvement in homework, and home language. All of these are resources that can be drawn upon by a student and constitutes each student's social capital (Visser, Juan & Feza, 2015). A meta-analysis of 58 studies found that socio-economic status (measured by parental education, parental income and parental occupation) is a moderate to strong predictor of academic achievement, with low socio-economic status predicting low achievement (Sirin, 2005). More specifically, students who have access to educational resources at home, tend to perform better in science than those who do not (Mohammadpour, 2013; Tsai & Yang, 2015; Visser et al., 2015). Other researchers, however, argue that it is actually what goes on in the home, in combination with socio-economic status, that is associated with a student's achievement. Variables such as parental support and encouragement for a child's schooling play an important role in academic achievement (Eamon, 2005).

Although the results from existing research are mixed, parent characteristics (level of educational attainment, intelligence) and family structure, are associated with academic achievement (Eamon, 2005; Visser et al., 2015). Students with more educated mothers tend to exhibit higher academic achievement scores. Attitudes are important factors, as students from environments where their parents value science highly are more likely to demonstrate higher achievement in Science (Eamon, 2005). TIMSS 2011 asked Grade Eight and Nine students about their parents' education, books in the home, and study supports. From their responses, a scaled index for home educational resources were developed which was categorised into many, some and few resources. Internationally, the 12% of students with "many resources" had the highest average achievement (540 points). A 116 point difference in the average science achievement score (540 and 424 respectively) was found between the students with "many resources" and those with "few resources" (Mullis et al., 2012).

A factor that makes the South African context unique, and that has a noteworthy role in Science achievement among South African students, is the language of teaching and learning when it differs from the language spoken in the home (Howie, 2003). More than anywhere else in the world, the previous South African government used language policy as a tool to effect socio-economic and educational division within the country. Thus, language as a home resource cannot be over-looked in South Africa, where only 26% of students who participated in TIMSS 2011 spoke the language of the test at home (which was also the language of instruction). The international results of TIMSS 2011 show that, with few exceptions, students from homes where the language of the test and of instruction is often spoken had higher average science achievement than students who did not speak the language of the test often (Mullis et al., 2012). As learning is dependent on having mastered the language of instruction, the language or languages spoken at home and how they are used were found to be important factors in subsequent school achievement (Mullis et al., 2012). With South Africa being a multilingual country of 11 official languages, this variable must be acknowledged in practice.

School Environment Resources

The international results from TIMSS 2011 showed that, on average, successful schools were more likely to have better working conditions, more facilities, and more instructional materials, such as books and computers (Mullis et al., 2012). It is recognised in South African studies that the availability of key school resources influences educational outcomes, with higher levels of resources associated with better educational outcomes (Fiske & Ladd, 2004; Oosthuizen & Bhorat, 2006; Taylor & Yu, 2009; Van der Berg, 2008). Socio-economic variances at the school level affect the educational outcomes of South African students, as students in the most affluent quintile of schools out-perform schools in the other four quintiles significantly (Van der Berg, 2008).

Some studies have pointed to the school environment as being able to compensate for deficiencies in the home environment (Spaull, 2011, 2013). Students with a higher socio-economic status tend to perform poorly in resource-poor schools, whilst economically disadvantaged students attending affluent schools tend to improve in reading and mathematics achievement. Due to the historical imbalances in the provision of educational resources from the State in the past, two distinct types of schools have emerged: affluent, functional schools; and poor, dysfunctional schools (Van der Berg, 2008). The more affluent schools can use income generated from school fees to obtain materials and technology for instruction. The poorer 60% of schools in South Africa are reliant on state funding and cannot, legally, charge fees of any kind.

A number of experimental and quasi-experimental studies have been conducted on the effect of class size on learner achievement. Overall, the results of these studies suggest that smaller class sizes are positively related to higher levels of achievement. These effects become larger as the class sizes are reduced (Nye, Hedges and Konstantopoulos, 2000). There is, however, a body of international studies on the effect of class size that does not support this finding, instead finding that class size has almost no effect on achievement (Hattie, 2009; Hoxby, 2000). In South Africa, Visser et al. (2015) found that for every learner added to a class, the average TIMSS mathematics score decreased by 1 point. This echoed Howie's (2003) finding that there is a strong negative association between class size and academic achievement.

The current body of literature tends to examine the school and the home environments separately, thus being able to isolate points for policy intervention. We suggest that this is a convenient and adequate focus for research. It is a more attractive option, as school level interventions (as opposed to wider social policy interventions) prove easier to implement, and are thus more amenable to policy making. Attributing problems to environmental factors requires solutions that are more difficult to implement. However, in the South African context, where students are faced with multiple forms of deprivation, both environments must be considered simultaneously.

Methods

Data Source and Sample

The data of South African students used for this paper was taken from the 2011 TIMSS study conducted by the International Association for the Evaluation of Educational Achievement (IEA). From the population of 10,085 South African schools that offered Grade Nine classes in 2011, a stratified random sample of 298 schools was selected to participate in TIMSS 2011. The sample was stratified by language of instruction, province and type of school (independent or public). A random selection process of intact classes (as opposed to the selection of individual learners) was applied for each sampled school. A total of 11,969 Grade Nine students from South Africa participated in the 2011 TIMSS study.

Measurement of Science Achievement

Science achievement scores were calculated out of a possible 1,000 scale points, with a mean of 500 and a standard deviation of 100. The achievement tests represented the curricula of the 63 participating countries. The process to ensure non-biased testing included adapting items according to data from curriculum analysis and the piloting of instruments. The achievement tests were administered in each school's language of instruction.

Data Analysis

The data were subjected to exploratory and inferential data analysis. Cluster robust multiple regression analysis was used to examine the effects that exposure to selected home and school resources had on the achievement of Grade Nine students in science. The aim was to identify and investigate the quantitative effect of independent variables upon science achievement as the dependent variable. The selected independent variables, their origin and the methods by which they were derived are provided in Appendix A. Statistics such as frequencies, mean scores, minimum and maximum values of each item, where applicable, are provided as a source of reference. Three multiple regression analyses were conducted to answer the three research questions of the paper.

Results

The results of the regression analyses are ordered by home resources (Model 1), school resources (Model 2) and, lastly, both home and school resources (Model 3).

Table 1 presents the results of a regression analysis that included home resource measures as predictors. The selected home resource variables accounted for 33% of the variance in the science scores (Adjusted R^2 = .33, p < .01). The results of the regression analysis on school resource variables as predictors are presented in Table 2. The selected school resource variables accounted for 20% of the variance in science achievement (Adjusted R^2 = .20, p < .01). Table 3 presents the results of the final regression analysis, which included both home and school resource variables. Thirty-seven percent of the variance in science achievement was explained by these variables (Adjusted R^2 = .37, p < .01).

It is evident that all independent home resource variables contributed significantly to the dependent variable. It is clear that having more assets at home (β = .29, p < .01) and frequently speaking the language of the test at home (β = .27, p < .01) had the strongest association with science performance. Students with parents with a tertiary education achieved higher test scores (β = .1, p < .01); this was a stronger association with Science achievement than the variable that included parents with Grade 12 (β = .07, p < .01). The number of books in the home was also positively associated with science achievement (β = .07, p < .01), while parental involvement in students' homework negatively impacted on science achievement (β = -.11, p < .01).

There was a 68 point difference (β = 67.75, p < .01), on average, between the results of students who spoke the language of the test frequently or exclusively at home, and the group of students who spoke the test language less frequently. It was also found that students performed 13 points better, on average, for each additional asset at home (β = 12.83, p < .01). Students with parents who had a qualification higher than Grade 12 (post-matric qualification) performed 23 points higher, on average, than students whose parents' highest qualification was at least Grade 12 (β = 23.15, p < .01).

Table 2 presents the results of the regression analysis on the effects of school resources on science achievement.

The results also revealed that the following had a significant effect on students' science performance (in order of the strongest to the weakest association): the condition of the school building (β = .25, $p < .01$); the use of workbooks or worksheets as the basis of instruction (β = .24, $p < .05$); class size (β = -.20, $p < .01$); the capacity of the school to provide instruction (affected by inadequacy of resources) (β = .12, $p < .05$).

Table 1 Results of a multiple regression analysis on the effects of home resource variables on Science achievement

Regression Variable	β	β (s.e.)	β (*t*-value)	Standardised Coefficient	Standardised Coefficient (s.e.)	Standardised Coefficient (*t*-value)	Statistical Significance (*p*-value)
(Constant)	243.59	6.23	39.13	-	-	-	
Parent tertiary qualification	23.15	3.63	6.38	0.1	0.01	6.69	$p < 0.01$
Parent qualification Grade 12 or higher	18.49	5.42	3.41	0.07	0.02	3.39	$p < 0.01$
Parental involvement	-12.4	1.68	-7.39	-0.11	0.01	-7.52	$p < 0.01$
Home assets	12.83	0.97	13.2	0.29	0.02	13.61	$p < 0.01$
No. of books	17.47	3.65	4.79	0.07	0.01	4.85	$p < 0.01$
Frequency of speaking language of test	67.75	4.76	14.22	0.27	0.02	14.49	$p < 0.01$

Note. Source: Authors' own calculations based on the TIMSS 2011 datasets.

Table 2 Results of a multiple regression analysis on the effects of school resource variables on science achievement

Regression Variable	β	β (s.e.)	β (*t*-value)	Standardised Coefficient	Standardised Coefficient (s.e.)	Standardised Coefficient (*t*-value)	Statistical Significance (*p*-value)
(CONSTANT)	233.59	41.62	5.61	-	-	-	
Computers for instruction	0.28	0.14	2.02	0.09	0.04	2.5	$p < 0.05$
School capacity	9.09	3.29	2.77	0.12	0.05	2.71	$p < 0.05$
Condition of building	56.63	11.56	4.9	0.25	0.05	5.14	$p < 0.01$
Class size	-1.31	0.24	-5.51	-0.20	0.04	-5.42	$p < 0.01$
Textbook BI	-2.74	25.79	-0.11	-0.01	0.11	-0.10	*ns*
Textbook SI	2.84	25.57	0.11	0.01	0.1	0.11	*ns*
Worksheet BI	56.7	21.71	2.61	0.24	0.09	2.64	$p < 0.05$
Worksheet SI	28.13	18.22	1.54	0.12	0.08	1.54	*ns*
Science equipment BI	-30.77	21.66	-1.42	-0.11	0.08	-1.40	*ns*
Science equipment SI	-10.69	13.57	-0.79	-0.04	0.06	-0.78	*ns*
Computer software BI	9.77	91.6	0.11	0.01	0.11	0.13	*ns*
Computer software SI	19.04	17.38	1.1	0.06	0.05	1.14	*ns*
Reference material BI	-11.14	24.69	-0.45	-0.03	0.06	-0.46	*ns*
Reference material SI	25.65	14.22	1.8	0.10	0.06	1.76	*ns*

Note. BI: basis of instruction; SI: Supplement for instruction; *ns*: not statistically significant. Source: Authors' own calculations based on the TIMSS 2011 datasets.

The condition of the school building contributed significantly and positively to student science achievement (β = .25, $p < .01$). The analysis revealed that students who attended schools where the buildings needed minor or no repairs, performed 57 points better, on average, than students who attended schools with moderate to serious building problems (β = 56.63, $p < .01$).

Students taught by teachers who used workbooks and worksheets as the basis of instruction performed 57 points better, on average, than students who received instruction without workbooks and worksheets being used as the basis of instruction (β = 56.7, $p < .05$).

The class size played a significantly negative role in student science achievement. It was found that, for each student added to a class, the average score of the class dropped by one-and-a-third points (β = -1.31 $p < .01$).

The association between the school's capacity to provide instruction (inadequacy of general school and science resources) and student science achievement was significant and positive (β = 9.09, $p < .05$). The results showed that for each unit increase on the index scale, students performed nine points better, on average.

Final Model

The final model tested the association of both home and school resources simultaneously in a regression analysis, as presented in Table 3. Variables that did not have a significant association with science achievement were omitted in the final model. The analysis shows that the language most often spoken at a student's home was the most important predictor of a student's achievement in science (β = .24, $p < .01$). The data analysis suggests that students who used the language most frequently spoken at home in the test, scored 62 points higher, on average, than students who seldom spoke the language of the test (β = 62.42, $p < .01$).

The number of home assets present in a student's home had the second strongest positive association with science achievement (β = .23, $p < .01$). It was found that for each additional asset in a student's home, the student scored 11 points higher in science, on average (β = 10.59, $p < .01$).

The third most important predictor of science achievement was the condition of the school building (β = .11, $p < .05$). Students who attended schools with minor problems with the building performed 24 points higher, on average, than students who attended schools that reported moderate to serious problems with the buildings (β = 24.15, $p < .05$).

Table 3 Results of a multiple regression analysis on the effects of home and school resource variables on science performance

Regression Variable	β	β (s.e.)	β (*t*-value)	Standardised Coefficient	Standardised Coefficient (s.e.)	Standardised Coefficient (*t*-value)	Statistical Significant (*p*-value)
(CONSTANT)	203.02	20.4	9.95	-	-	-	
Parent tertiary qualification	19.5	3.94	4.95	0.08	0.02	5.03	$p < 0.01$
Parent qualification Grade 12 and higher	20.97	6.31	3.32	0.08	0.03	3.27	$p < 0.01$
Computers	0.26	0.07	3.45	0.08	0.02	4.53	$p < 0.01$
School capacity	5.27	2.14	2.46	0.07	0.03	2.33	$p < 0.05$
Frequency of speaking language of test	62.42	4.89	12.77	0.24	0.02	12.89	$p < 0.01$
No. of books	12.26	3.99	3.07	0.05	0.01	3.06	$p < 0.01$
Condition of building	24.15	8.79	2.75	0.11	0.04	2.79	$p < 0.05$
Class size	-0.39	0.19	-2.03	-0.06	0.03	-1.99	$p < 0.05$
Worksheet BI	10.47	6.79	1.54	0.04	0.03	1.55	*ns*
Home assets	10.59	1.3	8.13	0.23	0.03	8.07	$p < 0.01$
Parental involvement	-9.79	1.86	-5.26	-0.08	0.02	-5.28	$p < 0.01$

Note. BI: basis of instruction; *ns*: not statistically significant. Source: Authors' own calculations based on the TIMSS 2011 datasets.

Parental involvement in students' homework at home was surprisingly negative (β = -9.79, $p < .01$). This finding could be related to the highest level of qualification of either parent or to parents being more likely to be involved in the homework of weaker students. Further investigation in this regard is needed. Additionally, larger class sizes had a negative effect on science achievement (β = -.39, $p < .05$). By comparing the regression analyses, which included home environment resources only, with the analysis on both resources, it was found that the effect (on science achievement) of either parent having a qualification higher than Grade 12 was reduced in the combined model: (β = 23.15, $p < .01$) and (β = 19.5, $p < .01$), respectively. In the combined model, students who had a parent with a qualification higher than Grade 12 performed 20 points higher, on average, than students with parents with a lower qualification.

Discussion

The results of Models 1 and 2 are consistent with the literature on the influences of home resources and school resources, respectively, showing that these resources contribute significantly to science achievement. Model 3, however, has allowed us to compare the strengths of these associations when the home environment is viewed as an extension of the school learning environment. Even after school resources are added to the final model, the home resources of speaking the language of the test at home and possessing home assets exhibited the strongest associations with science achievement. This suggests that policy interventions that aim to increase science achievement cannot be aimed solely at school level, but must take cognisance of the broader environmental factors at play.

The strongest relationship was found between language and science achievement, supporting findings by Eamon (2005) and Howie (2003). Language development is recognised as crucial in order for all other learning to take place. This is especially the case for science, which is a language-dependent learning area. The findings suggest that the language of instruction (and of testing) has not been mastered by the time students are in Grade Nine. This is unsurprising, as a majority of the students tested are, in essence, learning science through a foreign language. Thus, students are likely to be at a disadvantage, because their knowledge of the language of instruction is below the expected level for their age and grade. The implication is that policies must both seek to improve the manner in which the language of instruction is taught to students who do not speak that language at home, and concurrently, the policies that promote instruction in the home language – the Language in Education Policy (Department of Education, 1997) – should be strengthened. Here the home language can be used as an enriching tool, rather than a subject taught at school.

The finding regarding the importance of home and educational assets (used to measure socio-economic status) confirms the findings of Mohammadpour (2013), Tsai and Yang (2015) and Visser et al. (2015). This finding should be viewed in unison with the significant association that was found between the condition of the school buildings (a proxy for school socio-economic status) and science achievement. These determinants can be linked, as schools will likely reflect the communities in which they are situated. This finding points to a need to consider the home environments from which the students originate. This may not necessarily call for policy interventions that take a "deficit" perspective and seek to compensate for a lack of home resources. As put forward by Moll et al. (1992), teachers must endeavour to understand the cultural capital students possess. This capital is derived from their households, which it is incumbent upon teachers to acknowledge, contain rich cultural and cognitive resources. Teachers should be made aware that these resources can be utilised in the classroom in order to provide culturally appropriate and meaningful lessons that tap students' prior knowledge.

In addition to the implications for education policy, understanding the determinants of Science achievement of South African students has far-reaching implications for the broader growth and development of the country. This is because successful interventions at the school level may contribute to increasing the pool of matriculants who are eligible to study science-related subjects at a tertiary level, and who will later join the skilled workforce. Disregard of these environmental factors may hinder the success of policies designed to improve achievement and further economic growth.

Notes

i. 13.0% of the 26.7% is accounted for by learners who selected the option 'I don't know' for the qualification level of both parents. The rest (13.7%) represents missing values, which could also indicate a lack of knowledge of parents' qualification levels.

ii.

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Appendix A

The sets of variables selected for inclusion in the regression analyses for this study are provided below.

Measurement of Home Resources

The selected home resource variables were all taken from the learner questionnaire and included the following (cf. Tables A1 & A2): how often the language of the test has been spoken at the learner's home; the number of books at home; the number of home assets such as a fridge, television, own room, computer, internet connection, etc.); if the highest qualification of either parent was equal to Grade 12 (Matric) or higher; and whether the highest qualification of either parent was higher than Grade 12 (Matric); and a measure of parental involvement in school homework at home.

The *Home Assets* variable was generated from learners' responses to eighteen listed assets in the learner questionnaire. Learners were asked to indicate whether each of the listed assets was present at their homes (dichotomous variables - yes/no response). Frequency analysis was done on the responses to each listed asset. Missing values ranged from 2.3% to 7.1% across all assets. The variable was generated by adding the responses of all assets where the number of positive responses was less than 75 percent. Put differently, if a specific asset was present in 75% or more of the learners' homes it was excluded from the variable. Ten of the eighteen assets were included in the Home Assets variable. Thus, the values ranged from zero to ten.

The variable for *Parental Involvement* contains the factor scores from a Principal Component Analysis (PCA) of learner responses to four questions in the learner questionnaire (cf. Table A3). Missing values on these four questions ranged from 5.9% to 6.9 percent. The questions are listed below. The learners were required to respond by selecting options (every day or almost every day = 3, once or twice a week = 2, once or twice a month = 1, never or almost never = 0):

- My parents ask me what I am learning in school.
- I talk about my schoolwork with my parents.
- My parents make sure that I set aside time for my homework.
- My parents check if I do my homework.

The PCA extracted a unidimensional (one-dimensional) component named as PARENTINVOLV, with reliable internal consistency (4 items; Cronbach's Alpha: α=0.76), and which explains 58% of the variance in the sample (cf. Table A3).

Measurement of School Resources

A set of variables from the science teacher questionnaire and the school questionnaire was used for school resource variables (cf. Tables A4 and A5). The variables included: the number of learners per class, the number of computers available for science instruction, school building needs significant repair, use of textbooks, use of workbooks or worksheets, use of science equipment and materials, computer software for science instruction, and reference materials (e.g. encyclopaedia, dictionary). The five latter variables were further disaggregated into resources used as basis of instruction (with a postfix of _BI) and resources used as a supplement (with a postfix of _SI).

Another variable included in the regression model was an index called Index on instruction affected by resource shortage, which was developed by the IEA from principals' responses to thirteen questions in the school questionnaire. The questions investigated how the capacity of the school to provide instruction was affected by shortages of six general school resources and seven science-specific resources. High values of at least 11.2 on the index indicate that the instruction at the school has not been affected for seven of the thirteen resources, and affected only a little for the other six resources on average, while values not higher than 7.3 on the index indicate that instruction at the school has been severely affected by resource shortages for seven of the resources and somewhat affected for the other six resources on average.

Tables A4 and A5 provide lists and descriptive statistics of all independent variables on school resources selected and used in a regression model with science performance as the dependent variable.

Table A1 Statistics on the selected continuous variables related to HOME resources

School resource variables	*N* valid	*N* missing	Mean (Standard error)	Standard deviation (*SD*)	Variance	Minimum	Maximum
Parental involvement in learner's school work at home (Factor score)	10,866	1,103	46.85 (.0095)	1	1	-3.24	0.94

Note. Source: Authors' own calculations based on the TIMSS 2011 datasets.

Table A2 Statistics on the selected nominal variables related to HOME resources

Home resource variables and attributes	Frequency	Percent	Valid Percent
How often the language of testing is spoken at home			
Sometimes or never (=0)	7,836	65.5	66.3
Always or almost always (=1)	3,986	33.3	33.7
N missing	147	1.2	
Number of books at home			
0–25 books (=0)	8,706	72.7	74.4
More than 25 books (=1)	3,000	25.1	25.6
N missing	263	2.2	
Home assets			
None of the selected assets	343	2.9	2.9
1 of the selected assets	691	5.8	5.8
2 of the selected assets	1,045	8.7	8.8
3 of the selected assets	1,472	12.3	12.4
4 of the selected assets	1,805	15.1	15.2
5 of the selected assets	1,627	13.6	13.7
6 of the selected assets	1,438	12.0	12.1
7 of the selected assets	1,133	9.5	9.6
8 of the selected assets	874	7.3	7.4
9 of the selected assets	724	6.0	6.1
All 10 of the selected assets	706	5.9	6.0
N missing	111	0.9	
Either parent with Grade 12 or higher qualification			
Below matric (=0)	2,261	18.9	25.8
Grade 12 (Matric) or above (=1)	6,516	54.4	74.2
N missing	3,192	26.7[i]	
Either parent with qualification higher than Grade 12			
Grade 12 (Matric) or below (=0)	5,193	43.4	59.2
Above matric (=1)	3,584	29.9	40.8
N missing	3,192	26.71	

Note. Source: Authors' own calculations based on the TIMSS 2011 datasets.

Table A3 Results of PCA - Total Variance Explained for PARENT INVOLVEMENT

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.337	58.414	58.414	2.337	58.414	58.414
2	.639	15.974	74.388			
3	.575	14.381	88.768			
4	.449	11.232	100.000			

Extraction Method: Principal Component Analysis.

Component Matrix[a]	Component
	1
My parents check if I do my homework.	.807
My parents make sure that I set aside time for my homework.	.776
My parents ask me what I am learning in school.	.744
I talk about my schoolwork with my parents.	.728

Extraction Method: Principal Component Analysis.
a. 1 component extracted.

Note. Source: Authors' own calculations based on the TIMSS 2011 datasets.

Table A4 Statistics on the selected continuous variables related to SCHOOL resources

School resource variables	*N* valid	*N* missing	Mean (Standard error)	Standard deviation (*SD*)	Variance	Minimum	Maximum
Number of learners per class	11,969	0	46.85 (0.164)	17.97	323.05	10	118
Number of computers available for instructional purposes	10,783	1,186	24.54 (0.353)	36.63	1341.35	0	288
Index on instruction affected by resource shortages	11,496	473	9.38 (0.015)	1.63	2.66	5.010	15.147

Note. Source: Authors' own calculations based on the TIMSS 2011 datasets.

Table A5 Statistics on the selected nominal variables related to SCHOOL resources

School resource variables	Frequency	Percent	Valid Percent
School building needs significant repair			
Moderate to serious problem (=0)	5,579	46.6	51.3
Minor to no problem (=1)	5,293	44.2	48.7
N missing	1,097	9.2	
Textbooks used as basis for instruction			
No (=0)	3,823	31.9	34.1
Yes (=1)	7,374	61.6	65.9
N missing	772	6.4	
Textbooks used as supplement			
No (=0)	7,877	65.8	70.3
Yes (=1)	3,320	27.7	29.7
N missing	772	6.4	
Workbooks or worksheets used as basis for instruction			
No (=0)	6,632	55.4	60.0
Yes (=1)	4,413	36.9	40.0
N missing	924	7.7	
Workbooks or worksheets used as supplement			
No (=0)	5,360	44.8	48.5
Yes (=1)	5,685	47.5	51.5
N missing	924	7.7	
Science equipment and materials used as basis for instruction			
No (=0)	9,197	76.8	82.2
Yes (=1)	1,997	16.7	17.8
N missing	775	6.5	
Science equipment and materials used as supplement			
No (=0)	3,454	28.9	30.9
Yes (=1)	7,740	64.7	69.1
N missing	775	6.5	
Computer software for science used as basis for instruction			
No (=0)	10,805	90.3	97.4
Yes (=1)	287	2.4	2.6
N missing	877	7.3	
Computer software for science used as supplement			
No (=0)	8,906	74.4	80.3
Yes (=1)	2,186	18.3	19.7
N missing	877	7.3	
Reference materials used as basis for instruction			
No (=0)	10,168	85.0	91.1
Yes (=1)	993	8.3	8.9
N missing	808	6.8	
Reference materials used as supplement			
No (=0)	2,790	23.3	25.0
Yes (=1)	8,371	69.9	75.0
N missing	808	6.8	

Note. Source: Authors’ own calculations based on the TIMSS 2011 datasets.