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The Role of Students' Home Educational Resources and Parents' Level of Education in Science Achievement: Using TIMSS Data for Egypt, Morocco, and South Africa

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Abstract

This study examines the relationship between eighth-grade students' science achievement scores and their home backgrounds (educational resources and parental level of education) in three participating African countries: Egypt, Morocco, and South Africa using the Trends in International Mathematics and Science Study (TIMSS) data of 2019. Descriptive statistics and multiple regression models are used to show the effect of home educational resources and parents' level of education on science achievement in the three African countries. Results showed that the number of books at home correlated positively and best-predicted science achievement scores. Access to technology (computer/tablet, internet, and mobile phone) showed a negative relationship with science achievement. The significance of the predictors varied between countries, emphasizing the need for context-specific research to understand how different factors influence academic achievement. Findings have practical implications for educational policymakers and practitioners, pointing out the impact parental level of education and educational resources can have on students' science achievement.

Introduction

Education, the process of advancing learning through the acquisition of knowledge, values, and integrity, is widely accepted to significantly contribute to the development of competent citizens (David et al., 2022; Pedroso et al., 2022), well-equipped to improve the socio-economic progress of a country. African countries are very aware of this and have been trying to provide their citizens with high-quality and world-class education to spur much-needed socio-economic growth (Evans & Mendez Acosta, 2021; Amuda, 2021; Nafukho & Muyia, 2010). These efforts notwithstanding, the development of human resources on the African continent is lethargically slow at best and stagnant at worst. Several African countries rank low on the Human Development Index (HDI), with most having a low percentage of their population; 25 years and older have at least some secondary education (Kpolovie et al., 2017; Roser, 2014; UNDP, 2022).

Human Development Index (HDI) and Education in Africa

The HDI is a "composite index measuring average achievement in three basic dimensions of human development:

a long and healthy life, knowledge, and a decent standard of living" (UNDP, 2022. p. 303). The three African countries at the focus of this study, Egypt, Morocco, and South Africa, have varying ranks on the HDI. Egypt and South Africa are ranked high on HDI for their populations aged 25 and older having attained at least some secondary education: 81.6% of males and 76.6% of females in Egypt, and 68.9% of males and 87.7% of females in South Africa. In contrast, Morocco has a medium HDI ranking, with percentages of 30.9% of males and 37% of females. (UNDP, 2022). The adult population's academic qualifications indicate the general educational level of the parents of Grade 8 (14-16-year-olds) students who participated in the TIMSS 2019 study. In most African countries, the more educated the parents are, the likelihood of them being in a higher socioeconomic bracket, and the children of such individuals are more likely to have access to learning resources (books, computers, and the internet) that will positively impact their education. (Bofah, 2014; Ormrod, 2011).

The three African countries that are the focus of this study enrolled their Grade 8 students in the TIMSS 2019 study. The developers of TIMSS try to have the study be in line with or mirror, to a large extent as possible, the mathematics and science national curriculum in the participating countries (Foy, 2017). The aim is to have the data collected after each cycle of its administering provide empirical evidence on the mathematics and science concepts students have learned and the appropriate grade skills acquired in school (Lin, 2018). The data collected during the administration of TIMSS includes students' background information, teachers' data, and school context information that can be used for intra and inter-country analysis of educational contexts connected to student achievement (Mohtar et al., 2019; Lin, 2018). TIMSS results should not just be seen or interpreted as test scores but as assessments that measure mathematics and science achievement by providing considerable background information to help explain students' performance in context with the socioeconomic, cultural, political, and educational conditions prevailing in a participating country.

Ultimately, the TIMSS study seeks to support participating countries with the requisite information so that they make knowledgeable evaluations on the measures, approaches, and policies needed to advance teaching and learning in mathematics and science (Thomson et al., 2020). This research study looked at the effect and predictive power of students' home educational resources and parental level of education on the science achievement scores of Grade 8 students. The three African countries have different educational systems, largely primarily by national histories (Chisholm, 2020; Langa, 2014). The TIMSS data allows for studying the factors that affect students' achievement in the teaching and learning context within individual countries (Mohtar et al., 2019).

Country-Specific Educational Systems and Challenges

The education system in Egypt can be considered highly centralized in terms of education policies, curricula, student evaluation systems, teacher recruitment, training, and promotion. As a result, government appointees make education decisions at the national level, whose sole aim is to carry out policies of the appointing authority with minimal regard to best practices (Egyptian Ministry of Education, 2011). The centralization can be attributed to the influences of the various governance systems that have existed in the country since it became a republic, but the most notable of these influences is the culturally infused religious heritage of Islamic (traditional), secular Egyptian (Westernized), and British (neocolonial). Egypt initiated education sector reforms in September 2018 to

improve students' learning experience and reorient the secondary education system (Stopikowska & El-Deabes, 2012). These reforms have seen the introduction of a new curriculum, training of teachers, and an introduction of a new assessment system; the secondary education system has seen the introduction of digital learning resources to prepare them for new tests that address thinking and analytical skills (Stopikowska & El-Deabes, 2012). However, throughout her participation in the TIMSS study, Egypt's Grade 8 students have not performed as well as the country's educational stakeholders would have wanted (El Masri, 2013).

The Ministry of National Education and Vocational Training in Morocco is officially tasked with superintending the education of students enrolled at all levels of the education system (IEA, 2019). The ministry's 2015–2030 national strategic vision set measures to improve numeracy and reading in the first four grades. The strategic vision also has among its objectives to expand access to schooling in underprivileged areas, support students with learning difficulties, renew standards for pre-service teacher training to increase the quality of teaching, and build the capacity of in-service teachers, school staff, and administration (IEA, 2019). Morocco is one of the few African countries participating in TIMSS exams consistently. The Ministry of National Education has consistently relied on data from TIMSS to enhance its reform agenda. It has introduced the "Evaluation of Prerequisites program" to help identify the skills and competencies students need to acquire by improving assessments in mathematics and science (IEA, 2019). The ultimate goal is to lift Morocco from the bottom half of the quadrennial TIMSS results table.

In South Africa, the legacies of apartheid have left behind a profoundly unequal nation, with most of the population experiencing dire socioeconomic conditions (Olivier & Kruger, 2022). The quest to address the deep wealth gap has created two public school systems: fee-paying and non-fee-paying schools. The Department of Basic Education is tasked to maintain and support the South African school education system for the 21st century, and it has under its jurisdiction all schools from Grade R to Grade 12 (DBE, 2019a). Students from primary and upper-class backgrounds generally enroll in fee-paying schools, whereas their colleagues from economically disadvantaged backgrounds attend non-fee-paying and poorly resourced schools (IEA, 2019). South Africa's primary education is unique because it officially has 12 languages of instruction, including sign language in public schools due to the government's desire to promote the use of indigenous South African languages and multilingualism. However, many teachers use code-switching with indigenous African languages during instruction (IEA, 2019). Despite not performing well in the TIMSS exams, South Africa is a regular participant. However, South African students partook in Grade 9, whereas students from most countries write the TIMSS in Grade 8 (IEA, 2019).

Research Purpose

The purpose of this research study is to investigate the effect of students' family background on the science achievement scores in the TIMSS 2019 study for the three African countries (Egypt, Morocco, and South Africa) that participated in the study. Data on the number of books at home, having a computer, access to the internet, having own mobile phone, and parents' level of education were used as variables in the conduction of multiple regression analysis and descriptive statistical analysis. The following research questions guided this research:

1. How different or similar is students' background across the independent variables in Egypt, Morocco, and South Africa?
2. What is the relationship between the educational resources (books, computers, internet, and mobile phone), parental level of education, and science achievement scores?
3. What variable(s) best predict students' science achievement in the three countries?

Literature Review

The literature on factors affecting students' science achievement lists factors such as gender, students' background, parental education, and teacher characteristics as impacting prominently on students' test scores. Students' social and economic backgrounds are commonly considered among the main variables in student performance (Gobena, 2018; Takashiro, 2016). Students with more family resources, both financial and educational, are found to have much higher educational achievement and or test scores than those having fewer family resources (Caponera & Losito, 2016; Harju-Luukkainen et al., 2020; Kudari, 2016; Tomul & Savasci, 2012). Data from the TIMSS study provides information on students' background information, including home educational resources and parents' level of education. In this study, the authors focused on participating students' home educational resources as well as their parents' level of education to help answer the research questions stated earlier.

Students' Background Information

In the TIMSS 2019 study, information is provided on the home possessions of students and the educational level of their mothers and fathers. The items under home possessions are the number of books at home, ownership of a computer/tablet, room, study desk, internet access, and mobile phone ownership. The information on the parent/guardian's level of education provides separate data for the mother or female guardian's educational level and the father or male guardian's educational level. In this study, a selected number of home possessions items were used as students' educational resources; a selection based on a review of the literature on student-level factors that impact academic performance. The focus on students' background information is influenced by studies investigating the workings of the family structure and its effect on children's academic achievement from the human capital theory and social capital theory perspectives (Li & Qiu, 2018; Tan, 2019). The human capital theory outlines that educational investment decisions that parents make regarding their children are based on the availability of disposable financial resources, with the consequences being that children in low-income families face insufficient investment in their education, thereby negatively impacting their cognitive skills and academic achievement (Li & Qiu, 2018). The sections below provide a more in-depth synthesis of the literature related to students' home educational resources and parents' level of education.

Home Educational Resources

Using students' home educational resources as variables in investigating the factors that affect students' achievement in TIMSS is a recent development (Takashiro, 2017). However, educational researchers are widely using it. Recent studies show that home educational resources such as books, computers, and the Internet impact

students' achievement scores (Geesa et al., 2019; Marks & O'Connell, 2021; Thomson, 2018; Yoshino, 2012). Home educational resources as part of the factors to consider when studying students' academic performance are in line with recent research that highlights the importance of considering the broader context of students' lives in understanding the relationship between students' background and academic achievement (Broer et al., 2019; Juan & Visser, 2017). Caponera and Losito (2016) found that students with access to more home possessions or educational resources were likely to perform better in mathematics and science achievement scores. Studies using TIMSS data from numerous nations have found that home possessions such as a calculator, computer, dictionary, and study desk, as well as several books, have a stronger correlation with student achievement than school-level variables (Ersan & Rodriguez, 2020; Wiberg, 2019; Wiberg & Rolfsman, 2019). A study by Geesa et al. (2019) explored the roles of students' home resources in science achievement and found that the number of books owned at home seemed to be a good predictor of students' scores in science. These studies using TIMSS data demonstrate that educational resources such as books, computers, and internet access matter in predicting students' achievement in science and mathematics tests. Access to a computer and internet at home has been found to have a positive impact on students' science achievement and a predictor of higher scores in science (Towolawi & Onuka, 2018; Kareem & Olafare, 2017; Liu & Whitford, 2011; Wang et al., 2012). Daoud et al. (2020) did a synthesis of literature focusing on the use of the Internet at home and the educational value it brings; they surmised that access to the internet at home had general educational benefits, but the way it is utilized plays a significant role in determining how beneficial it will be. Some studies have found no correlation between having a computer and internet access and academic achievement (Erdogdu & Erdogdu, 2015; Kevogo et al., 2013), suggesting that the impact of computer and internet access on educational outcomes is multifaceted.

Parents' Level of Education

Studies show connections between parental educational levels and students' achievement in science and mathematics (Tomul & Savasci, 2012; Wang & Shi, 2014; Zhao & Hong, 2012). Parents with some degree of education tend to be mainly employed and can provide their children with home resources for individual learning (Thomson, 2018; Wiberg & Rolfsman, 2019). The educational levels of parents also play a role in extra learning opportunities such as private tutoring and more educational resources such as books and computers; the home culture, such as time management skills, role modeling, and establishing healthy social networks, are some of the benefits of high levels of parental education that work to improve the chances of students' achievement (OECD, 2013). The study done by Hacieminoglu (2015) on elementary school students' attitudes toward science in Turkey found that the parents' education level significantly affects attitudes toward science. Similar studies done in Pakistan and Nigeria also found that parents' level of education affected students' science achievement, with low parental education correlating strongly with poor academic performance of students (Abdullahi et al., 2015; Shah et al., 2020). A study on Programme for International Student Assessment (PISA) data that measures 15-year-olds' ability in reading, mathematics, and science knowledge and skills, revealed that the father's education has a stronger correlation with achievement in mathematics compared to the mother's education; the authors also reported that it was much more noticeable among sons, meaning there is a gender-specific effect between parental education and academic performance (Jerrim & Micklewright; 2011).

Methodology

Data

The data used for this research is from the IEA's Trends in Mathematics and Science Study (TIMSS) 2019 study. The International Association for the Evaluation of Educational Achievement (IEA) data on the three participating countries, Egypt, Morocco, and South Africa, in the 2019 TIMSS study is a valuable resource for educational researchers and policymakers. IEA's goal in supporting education is to promote student learning by analyzing global datasets to advance educational research and influence educational policies (Broer et al., 2019; Lin, 2018). The quadrennial TIMSS study generates a vast dataset that includes students' achievement scores, background information on students and families, teacher information, and school information serving contextual information, helping to strengthen the explanatory power of the analysis (Broer et al., 2019). The authors downloaded the relevant datasets for the respective countries from the IEA website (see www.iea.nl/timss). The TIMSS data provides population estimates of the mathematics and science performance of students in Grades 8 in participating countries.

Sample

The final analysis sample for each country was based on cleaned data files; students with missing cases on the student-level variables (i.e., home possession and parental education) were removed from the analysis sample. See Table 1 below for details of the sample used for the data analysis.

Table 1. Statistics of the Sample Size Used for Analysis.

Country	Number of Students (Raw data)	Number of Students (Analyzed data)
Egypt	7210	6442
Morocco	8458	7693
South Africa	20829	19140

Variables

To answer the research questions, the authors analyzed students' background information, including home possessions items and parents' level of education. The student background questionnaire on home possessions elicited information from students regarding the number of books at home, access to a computer, access to the Internet, and owning a personal mobile phone. The parent's level of education elicited information on the mother and father or the female or male guardian's educational level. A total of seven variables were used: the mean science achievement score, number of books at home, computer at home, internet access at home, own mobile phone, mother's level of education, and father's level of education. The mean science achievement score is the dependent variable created from the mean of the five plausible science achievement test scores. From the home possessions questionnaire, responses to items such as the number of books at home, access to a computer, access

to the internet, having own mobile phone, and level of education for mother and father were used as independent variables.

Data Analysis

The cleaned data were analyzed using the IBM SPSS Statistics (Version 28) software to run descriptive statistical and multiple linear regression analyses. The descriptive statistics generated bar graphs to show how the various independent variables were compared across the three African countries participating in the 2019 TIMSS study. The hierarchical method of the multiple regression analysis was used because it helps us know which independent variables can best predict students' science achievement scores. The predictors were selected based on a literature review and entered according to known predictors (Field, 2014). To ensure the reliability and validity of the analysis, independent observations were checked, and all the assumptions were met by using SPSS software to 'identify duplicate cases' to ensure that the sample for each country's observations was independent. The Durbin–Watson statistic was used to check for independent errors, and this assumption was also met. Histogram and P-P plots were used to check for normality. To check for multicollinearity, the variance inflation factor (VIF) values were used, and finally, the scatterplot of residuals versus predicted values was used to check for homoscedasticity and linearity (Field, 2014). The regression models generated can be generalized because all the necessary linear regression model assumptions were met.

Results

The findings of this research study are displayed using bar graphs that graphically show the descriptive statistics of the independent variables (number of books at home, computer at home, internet access at home, own mobile phone, parental education-mother, and parental education-father). The tables represent the output from the multiple regression analysis. The bar graphs below show how the three African countries compare on the independent variables. Figure 1 shows that generally, across the three countries, the number of books at home is less than 30, with nearly 50% of Moroccan students reporting that they have fewer or very few books at home.

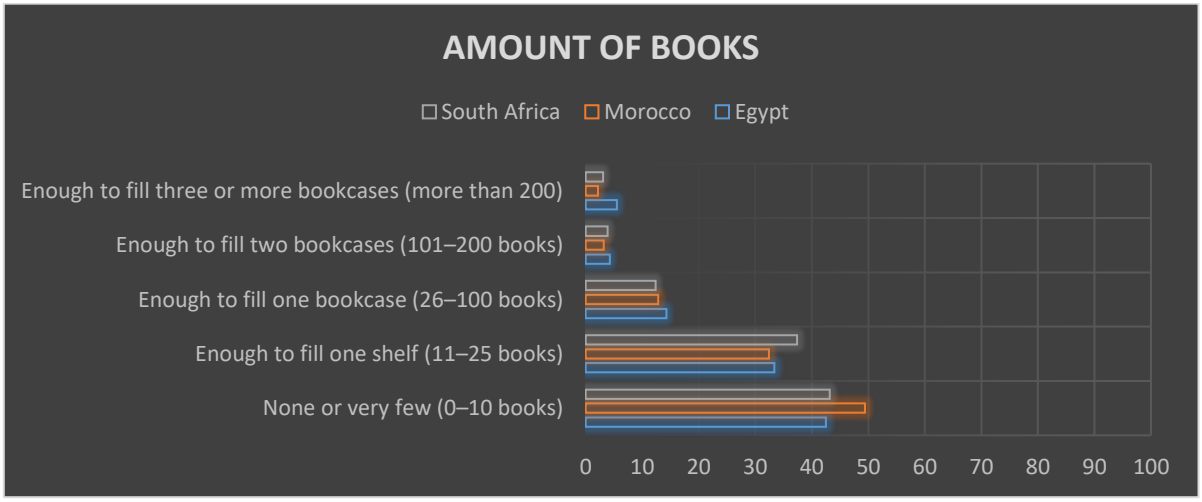
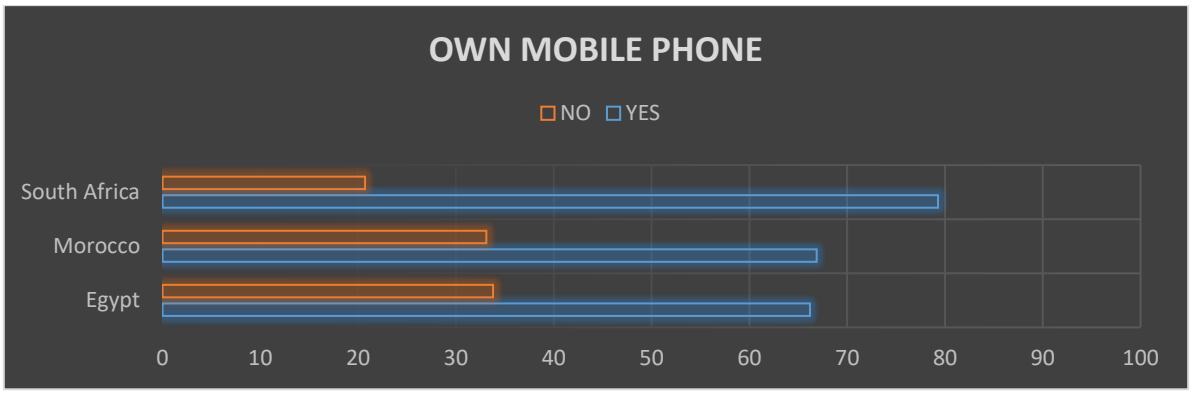


Figure 1. Graphical Representation of Books at Home

Figure 2 shows that about 75% of student respondents in Egypt claimed to have a computer or tablet at home. Many Moroccan and South African students reported having access to a computer or tablet at home.



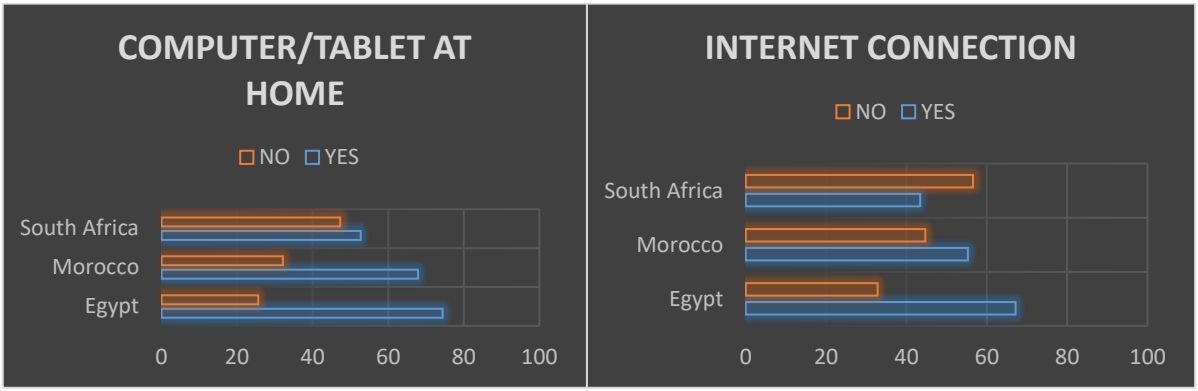
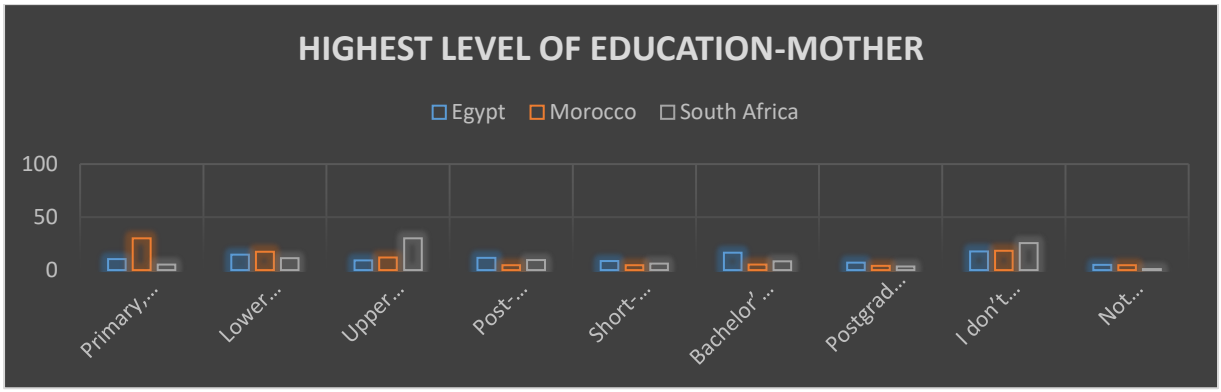


Figure 2. Bar Graphs Showing Mobile Phone Ownership, Computer, and Internet connection by Country



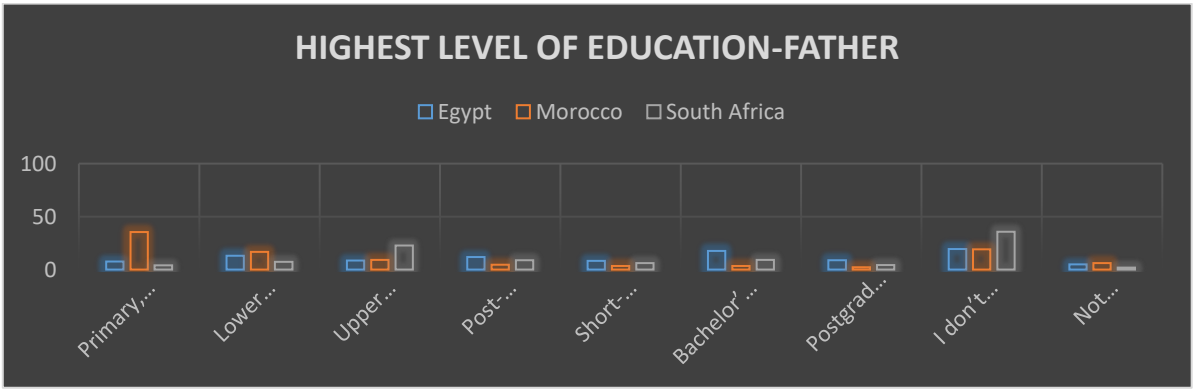


Figure 3. Graphical Representation of Parental Level of Education by Country

Students in Egypt (67.2%) reported in high percentages that they have access to an internet connection. In Morocco, 55.3% of students reported that they have access to an internet connection. However, South African students 56.6% of students reported that they do not have access to an internet connection. Regarding owning a phone, about 80% of South African students answered "yes," and 65% of students in Egypt and Morocco reported having their phones.

The parental level of education is represented graphically in Figure 3 above regarding the mother and father. Generally, parents' reported level of education was low across all three countries. Moroccan students reported in more significant percentages that their parents had primary, lower, or no education. Students in South Africa reported relatively higher percentages that their mothers and fathers have an upper secondary education compared to the other two countries.

Table 2. Pearson Correlations Between the Dependent and Independent Variables in TIMSS 2019

Egypt	1: Mean Science Score	2: Number of Books at Home	3: Computer/Tablet at Home	4: Internet Access at Home	5: Own Mobile Phone	6: Parental Education-Mother	7: Parental Education-Father
1	1	0.013	-0.238	-0.154	-0.087	0.112	0.101
2		1	-0.112	-0.097	-0.098	0.094	0.080
3			1	0.393	0.291	-0.156	-0.148
4				1	0.362	-0.150	-0.155
5					1	-0.130	-0.124
6						1	0.590
7							1
Morocco							
1	1	0.148	-0.019	-0.074	0.030	-0.019	-0.064
2		1	-0.231	-0.206	-0.067	0.152	0.101
3			1	0.392	0.244	-0.088	-0.033
4				1	0.256	-0.095	-0.064
5					1	-0.029	-0.024
6						1	0.530
7							1
South Africa							
1	1	0.248	-0.290	-0.330	-0.096	0.177	0.166
2		1	-0.223	-0.193	-0.081	0.089	0.042
3			1	0.307	0.220	-0.113	-0.052
4				1	0.207	-0.107	-0.054
5					1	-0.054	-0.029
6						1	0.421
7							1

The correlation matrix generated when a regression analysis is run provides information on the relationships

between the independent variables and the dependent variable. The results from the correlation matrix provided answers to research question two. Table 2 above details the Pearson correlation for all the variables used in the analysis. Pearson's correlation coefficient for Egypt shows a positive correlation between mean science achievement score and number of books at home (r = .013, p<.001), the mother's level of education (r = .112, p<.001), and the father's level of education (r= .101, p<.001). Having a computer at home (r = -.238, p<.001), internet (r = -.154, p<.001), and mobile phone (r = -.087, p<.001) all correlated negatively with science achievement scores for students in Egypt. In Morocco, the correlation statistics revealed something surprising, parents' level of education correlated negatively with science achievement scores for both mother (r = -.019, p<.001) and father (r = -.064, p<.001). The science achievement scores of students in South Africa with the number of books at home (r = .248, p<.001), mother's level of education (r = .177, p<.001), and father's level of education (r = -.166, p<.001). I was having a computer/tablet at home (r = -.290, p<.001), access to an internet connection (r = -.333, p<.001), and having own mobile phone (r = -.096, p<.001) all correlated negatively with South African students' science achievement scores in the TIMSS 2019 study.

Table 3. Regression Model Summary for Egypt, Morocco, and South Africa

Model	R	R^2	R^2_{adj}	*F*	*df1*	*df2*	*p*	Durbin-Watson
Egypt	0.259	0.067	0.066	77.099	6	6435	<.001	1.308
Morocco	0.201	0.041	0.040	74.286	6	7686	<.001	1.272
South Africa	0.442	0.196	0.196	776.414	6	19133	0.000	1.249

Table 3 above shows the overall summary model output for all the countries of interest in this research. The multiple regression analysis reveals that for Egypt (R=.259), the model predicts 25.9% of students' science achievement. The R^2 value of 0.067 indicates that 6.7% of the variation in science achievement scores can be explained by the model using the independent variables number of books at home, own computer/tablet, internet access, own mobile phone, mother's educational level, and father's educational level. The models for Morocco (R=.201) and South Africa (R=.442) explained 20.1% and 44.2% of the variation in science achievement scores, respectively. The R^2 values for Morocco and South Africa show that the regression model explained 4.1% and 19.6% of the variation in students' science achievement scores, respectively.

Table 4. Multiple Regression Coefficients for Predicting Science Achievement Scores

		Constant	Books at Home	Computer at Home	Internet Access	Mobile Phone	Education-Mother	Education-Father
Egypt	*B*	461.523	-2.035	-45.474	-13.643	0.875	2.134	1.262
	S.E	6.424	1.073	2.999	2.855	2.721	0.586	0.604
	β	-	-0.023	-0.203	-0.066	0.004	0.055	0.031
	t	71.843	-1.896	-15.163	-4.778	0.322	3.640	2.088
	p	＜0.001	0.058	＜0.001	＜0.001	0.748	＜0.001	0.037
Morocco	*B*	395.750	10.641	-15.558	-4.994	11.019	-0.202	-1.966

		Constant	Books at Home	Computer at Home	Internet Access	Mobile Phone	Education-Mother	Education-Father
	S.E	4.379	0.938	2.029	1.901	1.887	0.354	0.337
	β	-	0.133	-0.096	-0.033	0.068	-0.008	-0.077
	t	90.377	11.348	-7.669	-2.628	5.840	-0.570	-5.838
	p	0.000	0.000	0.000	0.009	0.000	0.569	0.000
South Africa	*B*	445.156	15.067	-33.309	-46.266	2.345	3.005	4.256
	S.E	3.804	0.660	1.366	1.363	1.609	0.292	0.285
	β	-	0.154	-0.171	-0.236	0.010	0.074	0.107
	t	117.030	22.831	-24.392	-33.945	1.458	10.306	14.951
	p	0.000	0.000	0.000	0.000	0.145	0.000	0.000

A multiple regression model is an equation with several unknown parameters (the b-values). Table 4 above estimates the b-values and other information, such as the beta and t-statistic values. The b-values tell us the individual contribution of every predictor to the model, and by replacing the b-values in the general equation, we get an equation of the model specific to the countries of interest in this study.

The general equation for the regression model defined by this study is:

$$\text{science-score}_i = b_0 + b_1\text{amount\_of\_books}_i + b_2\text{access\_to\_computer/tablet}_i + b_3\text{internet\_access}_i + b_4\text{own\_mobile\_phone}_i + b_5\text{mother\_education}_i + b_6\text{father\_education}_i$$

The country-specific equations for the three African countries are:

- $\text{EGY\_science-score}_i = 461.52 + (-2.04\ \text{amount\_of\_books}_i) + (-45.47\ \text{computer/tablet}_i) + (-13.64\ \text{internet\_access}_i) + (.875\ \text{mobile\_phone}_i) + (2.13\ \text{mother\_education}_i) + (1.26\ \text{father\_education}_i)$
- $\text{MOR\_science-score}_i = 395.75 + (10.64\ \text{amount\_of\_books}_i) + (-15.56\ \text{computer/tablet}_i) + (-4.99\ \text{internet\_access}_i) + (11.02\ \text{mobile\_phone}_i) + (-0.20\ \text{mother\_education}_i) + (-1.97\ \text{father\_education}_i)$
- $\text{ZAF\_science-score}_i = 445.16 + (15.07\ \text{amount\_of\_books}_i) + (-33.31\ \text{computer/tablet}_i) + (-46.27\ \text{internet\_access}_i) + (2.35\ \text{mobile\_phone}_i) + (3.01\ \text{mother\_education}_i) + (4.26\ \text{father\_education}_i)$

The coefficients or b-values not only tell us about the relationship between the predictors and the outcome variable but also the degree to which each predictor in the model affects the outcome variable if the effects of all the other predictors are constant (Field, 2014). The three countries are represented by three-letter codes i.e. EGY for Egypt, MOR for Morocco, and ZAF for South Africa. The country-specific model equations showed that in Egypt (b = 2.13; b = 1.26) and South Africa (b = 3.01; b = 4.26), mothers' and fathers' educational levels positively correlate with a student's science score. The model equation for Morocco showed that the mother ((b = -0.20) and father's (b = -1.97) level of education negatively impacted students' science scores. The b-value also indicates that if the mother's educational level increased by a unit (i.e., from primary to secondary or from secondary to bachelor's degree), the student's science score will increase by 2.13 points for Egypt and by 3.01 points for South Africa if all the other predictors are held constant. Access to the internet and having a computer or tablet negatively correlated with the outcome variable across all three countries.

The *t*-statistic values help us know the degree of a predictor's contribution to the model (Field, 2014). A look at the model for Morocco showed that the number of books, $t(7686) = 11.348$, $p<0.001$, the computer/tablet, $t(7686) = -7.669$, $p<0.001$, internet access, $t(7686) = -2.628$, $p<0.001$, mobile phone, $t(7686) = 5.840$, $p<0.001$, and father education level, $t(7686) = -5.838$, $p<0.001$, are all significant predictors of science achievement scores except mother education level, $t(7686) = -0.570$, which was not significant $p= 0.569$ at predicting science achievement scores. The model for Egypt showed that the number of books, $t(6435) = -1.896$, $p = 0.058$, and owning a personal mobile phone, $t(6435) = 0.322$, $p = 0.748$, was not a significant predictor of science achievement scores but the computer/tablet, $t(6435) = -15.163$, $p<0.001$, internet access, $t(6435) = -4.778$, $p<0.001$, mother education level, $t(6435) = 3.640$, $p<0.001$, and father education level, $t(6435) = 2.088$, $p = 0.037$, were all significant at predicting the science scores of students.

The regression model for South Africa showed that the number of books, $t(19133) = 22.831$, $p<0.001$, the computer/tablet, $t(19133) = -24.392$, $p<0.001$, internet access, $t(19133) = -33.945$, $p<0.001$, mother education level, $t(19133) = 10.306$, $p<0.001$, and father education level, $t(19133) = 14.951$, $p<0.001$, were all found to be significant at predicting science scores of students but owning a mobile phone, $t(19133) = 1.458$, $p = 0.145$ is not significant because the *p*-value is more than 0.05.

Discussion

This research study examined the effect that students' home educational resources and parents' level of education have on their science achievement in the TIMSS 2019 study. The findings generally showed that students' home educational resources and parents' level of education aligns with the existing literature as factors that influence academic performance in different contexts. Overall, there were positive correlations between the number of books at home and science achievement scores across the countries of interest; this agrees with studies that show that a print-rich home environment fosters a positive attitude towards reading and learning, which, in turn, can positively impact academic achievement (Mullis et al., 2012).

Access to technological resources such as a computer, internet, or mobile phone correlated negatively with science achievement in Egypt, Morocco, and South Africa; collaborating findings that technology access could lead to distraction and reduced study time, negatively affecting academic performance (Lepp et al., 2015). The negative correlations between parental education and science achievement scores in Morocco contradict typical findings in the literature, where parental education is considered a positive predictor of academic achievement (Abdullahi et al., 2015; Hacieminoglu, 2015; Jerrim & Micklewright, 2011; Shah et al., 2020). This finding is surprising and diverges from the typical positive correlation in the literature. This could be attributed to the socio-cultural context of Morocco, which might interact differently with parental education levels compared to other countries such that when the parents are well educated, their lack of involvement in their children's learning at home, an environment is created that negatively impact their achievement in school subjects (Şad & Gürbüztürk, 2013).

This discrepancy highlights the importance of context-specific research and the need to consider unique socio-cultural factors that may influence the relationship between parental education and academic performance in

different regions. Based on the given statistics from the multiple regression analysis, there is indeed a correlation between students' achievement and the education levels of their parents. This suggests that as the level of education of either the mother or the father increases, students' science achievement scores tend to improve. The correlation between students' achievement and the education levels of their mothers and fathers in Egypt, Morocco, and South Africa supports the existing literature on the significance of parental education in students' academic performance. In countries with limited educational resources and support, parental education can be an important proxy for the home environment's intellectual stimulation and resources (OECD, 2013). Parents with higher education levels tend to have higher expectations for their children's education, provide more learning resources, and engage in educational activities that positively influence their academic outcomes (Pektas, 2010; Sabah & Hammouri, 2010; Wiberg & Rolfman, 2019). However, it is crucial to remember that correlation does not imply causation; hence, as much as parental education is an essential factor, other variables such as teacher's experience, school-level educational resources, and student motivation also play significant roles in students' science achievement. Across all three countries, the regression coefficients showed that access to a computer/tablet, internet, and mobile phone negatively affected science achievement.

This finding supports previous research that reported that non-educational use of technology, particularly for entertainment purposes, can lead to reduced study time, ultimately affecting academic performance (Junco & Cotten, 2012). The number of books, computers/tablets, internet access, mobile phone, and the father's education level were all found to be significant predictors of science achievement scores. In contrast, the mother's education level was not significant. This indicates that these predictors play a more substantial role in explaining variation in science achievement in Morocco compared to the mother's educational level. In Egypt, owning a personal mobile phone and the number of books at home were not significant predictors. At the same time, the computer/tablet, internet access, and parental education levels were significant. In South Africa, all predictors except owning a mobile phone were found to be significant.

These findings have practical implications for educational policymakers and practitioners in the three countries. They highlight the importance of equal access to educational resources to support students' academic achievement. Additionally, efforts should be made to promote parental involvement in education, particularly in providing a conducive learning environment at home and encouraging parents to actively engage in their children's education. It is essential to recognize that the regression model explains a portion of the variance in science achievement scores; other influential factors are not included in the model that also play critical roles in affecting students' science achievement. Therefore, comprehensive, context-specific research is needed to better understand the complex interactions shaping students' academic performance in Egypt, Morocco, and South Africa.

Conclusion and Recommendations

The multiple regression analysis conducted on data from Egypt, Morocco, and South Africa provided valuable insights into the relationship between students' background variables and science achievement scores in these African countries. The country-specific regression models allowed us to understand the individual contributions of various predictors to science achievement scores in each country. The findings revealed that parental education,

access to technology, and the presence of books at home were significant factors influencing students' science achievement in these countries. In Egypt and South Africa, higher levels of mother and father's education were associated with better science achievement scores, confirming what available literature reports.
However, the unexpected negative correlation between parental education and science achievement in Morocco calls for further investigation into the unique socio-cultural factors influencing academic outcomes in this country.

Across all three countries, access to technology (computer/tablet, internet, and mobile phone) showed a negative relationship with science achievement. This suggests that careful use and monitoring of technology may be necessary to mitigate any adverse effects on students' academic performance. On the other hand, the positive correlation between the number of books at home and science achievement scores highlights the importance of a print-rich home environment in fostering a positive attitude towards learning and academic success. The significance of different predictors varied between countries, emphasizing the need for context-specific research to understand the unique factors influencing academic achievement in each setting. These findings have practical implications for educational policymakers and practitioners, indicating the positive influence of high parental education and equal access to educational resources to support students' academic success. However, it is crucial to acknowledge that the regression models explained only a portion of the variance in science achievement scores, suggesting the presence of other influential factors not accounted for in the analysis. Future research should consider teacher-level variables, such as teaching experience, subject area of certification, and school-level variables, such as administration leadership, disciplinary climate, teacher collaboration, and school science resources, to gain a more comprehensive understanding of the factors shaping academic achievement in these African countries.

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