CREDIT Research Paper

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SCHOOL EFFECTS ON EDUCATIONAL ATTAINMENT IN EGYPT

by

Menshawy Badr

Abstract

Using Trends in International Mathematics and Science Study (TIMSS) data for Egypt in 2007, this paper examines the determinants and gender inequality of educational attainment (test scores in Mathematics and Science). The complicated structure of the data is carefully addressed during all stages of the analysis by employing plausible values and jackknife standard error technique to accommodate the measurement error of the dependant variable and the clustering of students in classes and schools. A detailed analysis of Egyptian students' achievements reveals differential effects of school types, notably being single or mixed sex and Arabic or language schools. Single-sex schools tend to have higher attainment than mixed schools, especially for girls, and single-sex language schools have higher test scores than Arabic single sex schools. The better performance of language schools is related to the socio-economic characteristics of enrolled students.

JEL Classification: H52, I21, I24, O15

Keywords: School inputs; Production function; School types; Test Scores; and Egypt.

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Outline

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1. Introduction

This paper uses data from large comprehensive international student achievement tests – Trends in International Mathematics and Science Study (TIMSS) – to estimate the impact of parental education, other measures of Social-Economic status (SES) and school inputs on students' achievements in Egypt. Although there are now numerous studies on the factors influencing education quality in developed and developing countries (Hanushek and Lavy, 1994, Hanushek and Woessmann, 2007, Lloyd and Division, 2001), few include Arab countries and studies on Egypt focus on education problems such as enrolment and dropout rates and how these affect quality. Human capital quality measured by cognitive achievement tests directly and indirectly influences productivity and long-run growth. It is a research priority to investigate sources of human capital quality. Governments, the main education services provider around the world, should apply rational, efficient, and equitable policies based on true research results (Hanushek and Luque, 2003; Woessmann, 2003).

This study estimates the impact of student characteristics and family background on the one hand (the set of student variables) and teacher's characteristics and school resources on the other (the set of school variables), on cognitive achievement in Egypt. The broad question addressed is: what are the major determinants, distinguishing Social-Economic Status (SES) and school inputs, of students' cognitive achievements (as captured by test scores)? Using test scores for 8th grade (age 14) students in Mathematics and Science for 2007, we examine the influence of SES and school variables. The literature on education production functions reveals no clear systematic relationship between school resources and student achievement; teacher quality is the only factor that usually has a significant influence (Hanushek, 1995).

The paper is structured as follows. Section 2 provides an overview of education in Egypt. Section 3 describes the TIMSS data for Egypt. Section 4 outlines the empirical model and sections 5 to 8 discuss the results: core findings and further analysis with specific attention to school fixed effects and the impact of test language and section 9 concludes.

2. Egypt's education system

With more than 17 million students, 821 thousand teachers and 40 thousand schools, the Egyptian education system is one of the largest in the world and the largest in MENA

(Middle East North African Countries)[1]. The Egyptian education system is divided into Al-Azharite system (Islamic school) and a secular system. The first is supervised by ALAZHAR[2] and accounts for 9.8% of students while the secular system includes Arabic, language and religious schools; the 90.2 percent of all students in the secular system are divided into public and private education sectors (comprising 83 percent and 7.2 percent, respectively)[3]. All are under the supervision of the Ministry of Education. Since 1981, free compulsory education is provided at the primary and preparatory stages.

The school enrolment age is 6 years. The 9 years of basic education is divided into six years primary stage and 3 years preparatory stage. Vocational preparatory education is provided to serve slow learners in primary and preparatory education. The preparatory stage (grade 9 at age 15) exit exam (held at the governorates level) determines whether students are qualified for general or vocational secondary school. The secondary stage is divided into vocational (3 to 5 years) and general academic (3 years) schools. The test scores of the secondary school exit examination (country level) determine their access to higher education which includes universities and institutes (3 to 6 years). Students upgrade to the following year is conditional on their exams' results, so there is grade repetition (Ministry of Education, 2008).

Both mixed and single sex education is provided in Egypt. Typically, boys and girls attend mixed classes at the primary level with single sex-schools being mainly at the preparatory level. In the rural areas where there are insufficient students to create two schools, students enrolled in the same school with either mixed or single sex classes.

Table A.1-A.3 in Appendix A show selected poverty, social, and educational characteristics of Egypt compared to MENA[4] and lower middle income countries. The figures show Egypt in a good position regarding enrolment compared to MENA except for pre-primary enrolment. However, 3.1 percent repeaters in primary stage and 5 percent drop out which is relatively high interruption in the education system.

[1] UNESS, (2008), Arab Republic of Egypt, p 18

[2] ALAZHAR is an Official mosque and university at Cairo, the world centre of Sunni Islamic learning.

[3] "Ministry of Education strategic plan", 2008

[4] Middle-East and North Africa countries

The Egyptian education system is highly centralised regarding administration, curriculum and examination. The Ministry of Education has the main responsibility for all education issues, collaborating with the ministry of Finance and the governorates regarding other organizational and financial issues. The Egyptian education system diagnostic identifies the following as issues: shortage of school buildings at the basic education level, existence of poor quality vocational preparatory education, weak participation of the private and cooperative sectors in education, high repetition rates in basic education, poor reading and writing skills of pupils in basic education, increases in the education wage bill (large number of employees not high wages), administrative jobs are overstaffed (1:1.26), shortages in basic education qualified teachers (41percent do not have university degree), training mismatch with the actual needs of teachers, curricula problems, existence of traditional teaching and evaluation methods, and the spread of private tutoring[5].

3. Data and descriptive statistics

The Trends in International Mathematics and Science Study (TIMSS) carried out by the International Association for the Evaluation of Educational Achievement (IEA), an independent organization, collects data on students at fourth (9-10 years) and eighth (14-15 years) grade for a large sample of countries to give comparative assessments dedicated to improving teaching and learning in maths and science for students around the world.

This study relies on data from TIMSS on student tests results with extensive information from the student background questionnaire and teachers and school characteristics for both maths and science. The TIMSS target population is fourth and eighth grades. Each participant country followed a uniform sampling approach applied by TIMSS team to assure high quality standards. A two stage stratified cluster design was followed: at the first level a random schools sample is selected and within each of these schools one or two classes are selected at the second stage randomly. All students in a selected class were tested for both maths and science. Two main issues need to be addressed in using TIMSS; the complex multi-stage sample design mentioned above and the use of imputed scores or "plausible values" (Foy and Olson, 2009).

[5] National Strategic Plan for Pre-University Education Reform in Egypt (2007/08 - 2011/12), P 249

3.1. Egypt in TIMSS 2007

Egypt has 8,179 schools with 1,342,127 students at the eighth grade. The selected TIMSS sample for Egypt is 233 schools with 6,582 students which produces an estimated population of 1,059,228 students. There are 234 teachers of integrated science and 234 teachers of maths. TIMSS tests for maths and science are administered in both Arabic and English while the background questionnaire is administered only in Arabic.

Table A.4 in the appendix shows average achievement of maths and science in Egypt and some developed and developing countries. The substantial difference in maths scores between Egypt and Spain, US, England, and Japan is evident (it exceeds 100 points). The situation compared to other Arab and MENA countries is mixed; while Egyptian students' achievement is higher than Algeria, Morocco, Kuwait, Saudi Arabia, Oman and Qatar, it is lower than Turkey, Israel, Iran, Dubai, Lebanon, Jordan, Tunisia, Bahrain and Syria. In Sub-Saharan African countries such as Ghana and Botswana, students' achievement in maths is behind that in Egypt.

In Egypt, the TIMSS sample was 49.5 percent girls. The overview concentrates on the Egypt 2007 TIMSS maths scores with some comparison to the 2003 round. Egypt maths scores declined from 406 in 2003 to 391 points in 2007 representing a statistically significant decline of 15 points. Girls' maths achievement scores declined from 406 in 2003 to 397 in 2007, whereas boys' achievement declined significantly from 406 to 384. Gender differences in achievement scores were not significant in 2003 (less than one point difference) whereas they were at the 95% level in 2007 (girls 13 points higher on average).

Science test scores achievements declined from 421 in 2003 to 408 in 2007 on average. This fall of 13 points is statistically significant at the 5% level Appendix A (Table A.5). The distribution of marks from Figure 1 to Figure 5 indicates that students do better in science in general. Girls outperform boys and language schools outperform Arabic schools for both maths and science. The test scores appear to be normally distributed. The TIMSS benchmark scores on achievement scales describe what learners know and can do in maths and science. Table A.6 in the appendix indicates that 53 percent of Egyptian students do not even satisfy the low international benchmark (which is that students have some knowledge of whole

numbers and decimals, operations, and basic graphs) of maths compared to 48% of students in 2003 TIMSS and 45% for science.

Figure 1: Distribution of student achievements by subject

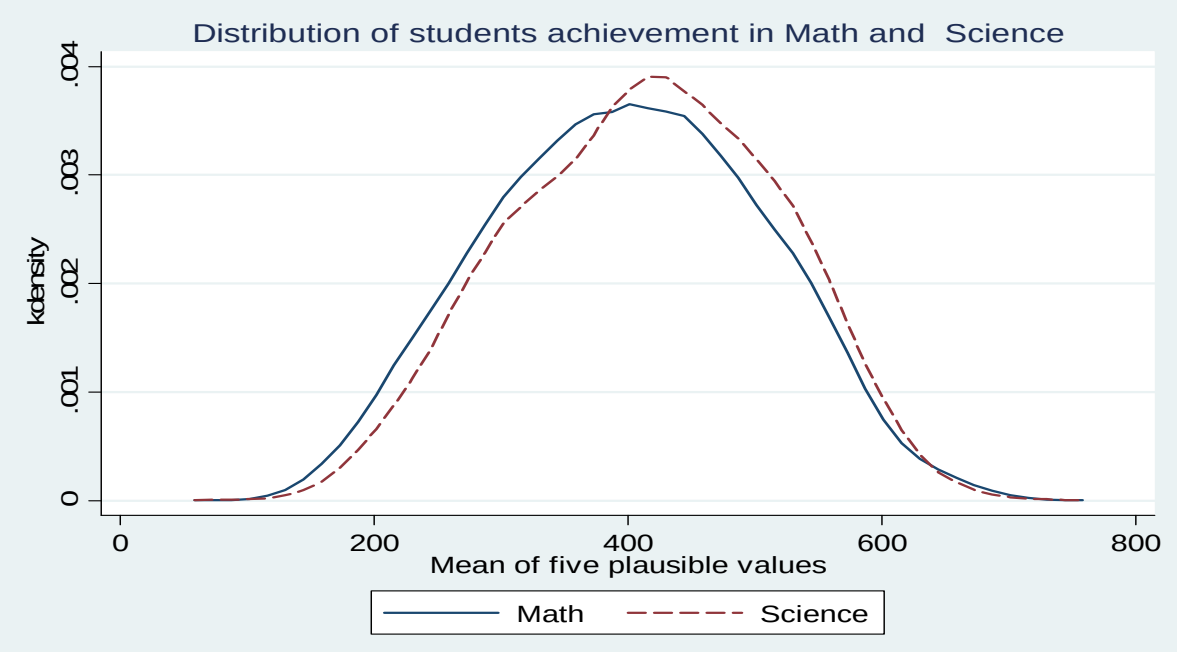


Figure 2: Distribution of student Maths achievement by school language

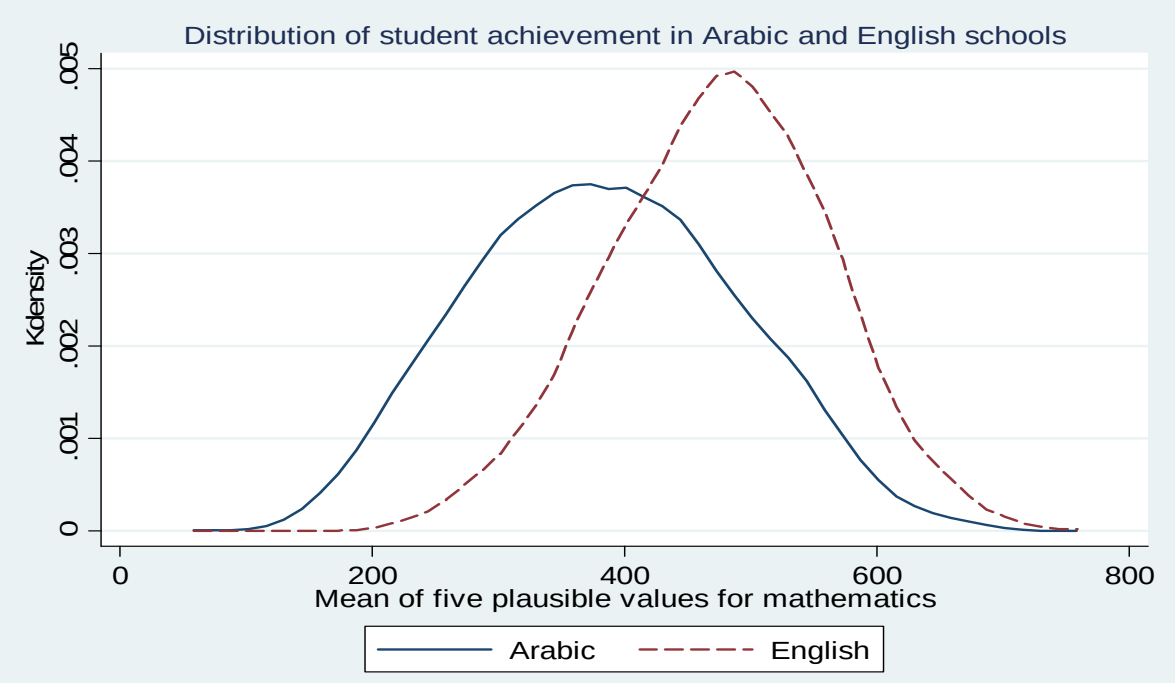


Figure 3: Distribution of student Maths achievement by gender

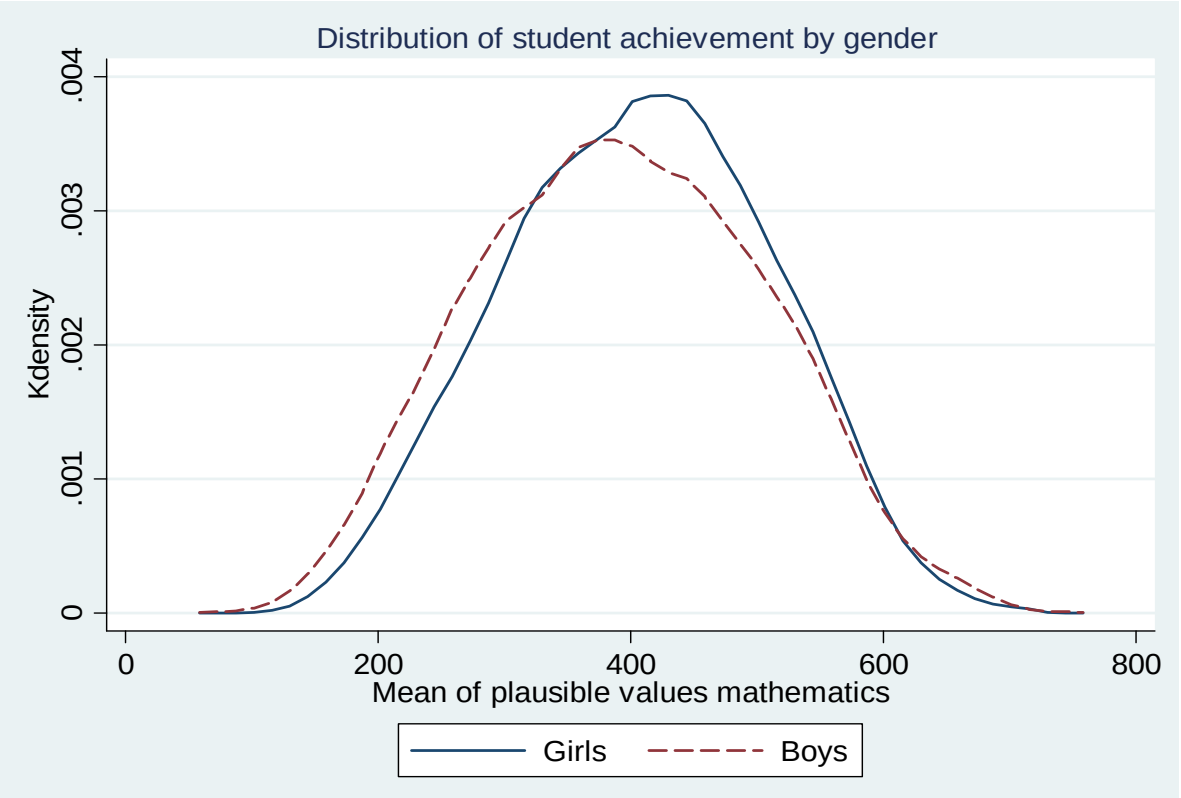


Figure 4: Distribution of student Science achievement by school language

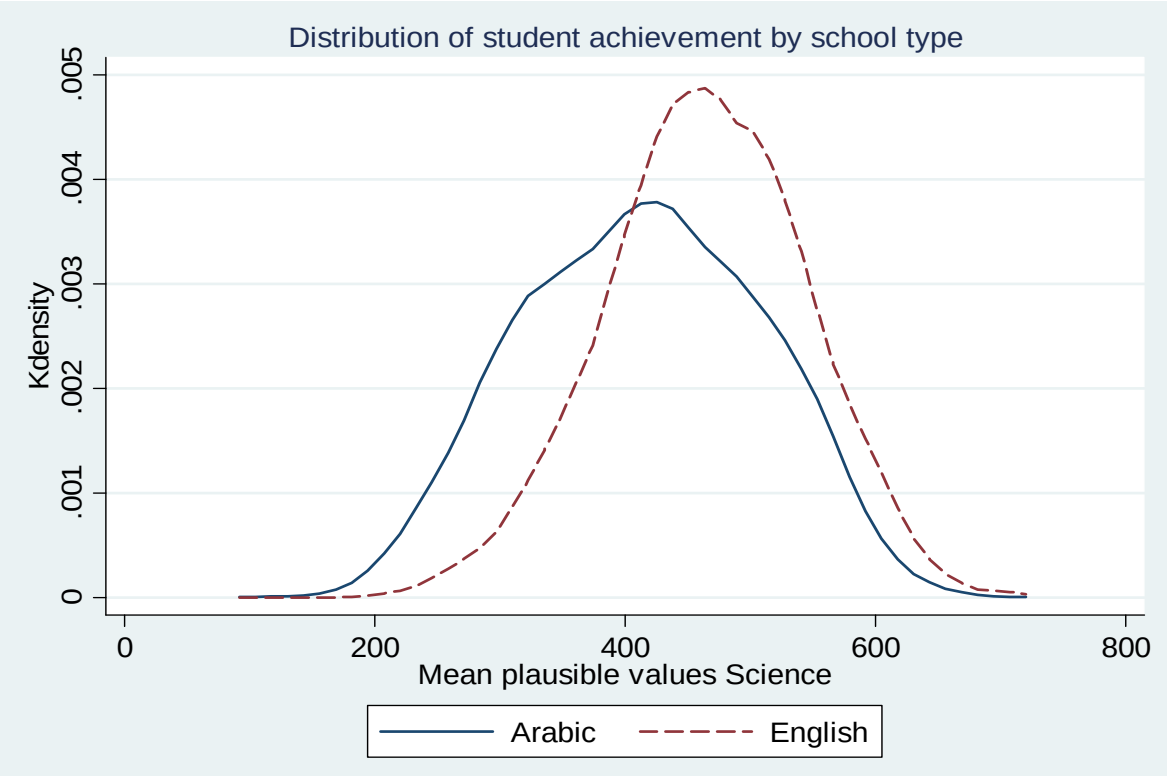
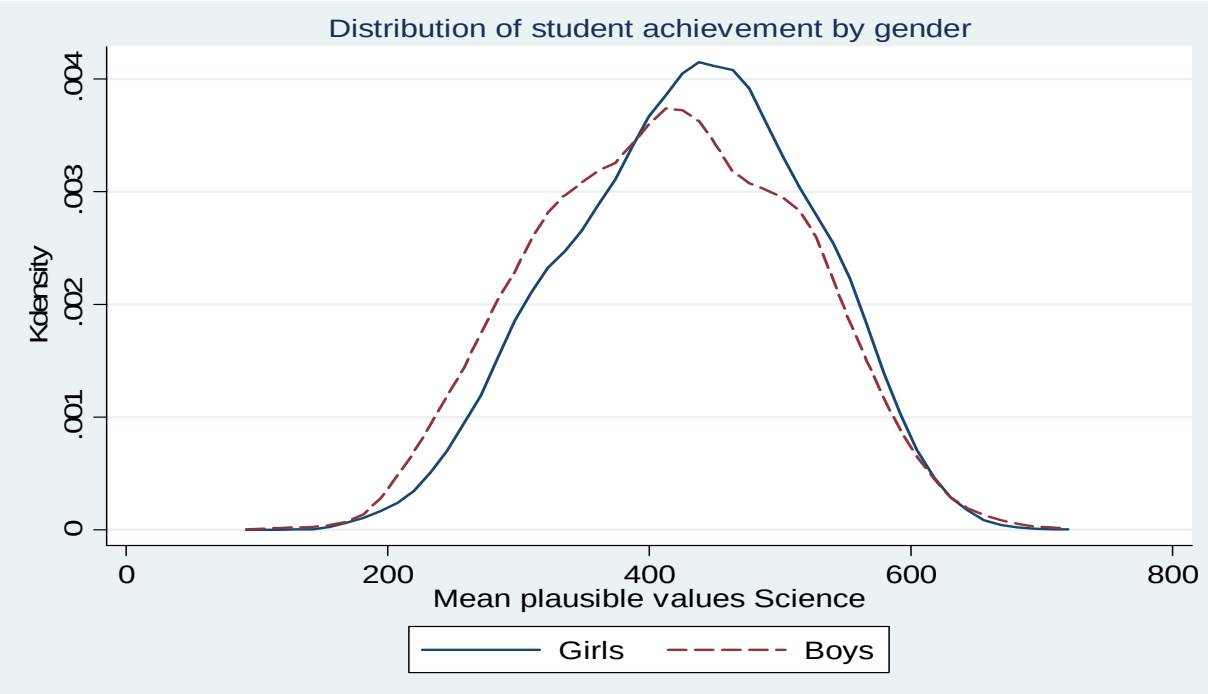


Figure 5: Distribution of student science achievement by gender



Arab countries such as Jordan and Tunisia fare better than Egypt with 39% of students below the low benchmark; Bahrain is slightly better and Syria has the same percentage as in Egypt; in Oman, Algeria, Morocco, Qatar, and Saudi Arabia performance was much worse. Students' average age in the TIMSS 2007 sample for Egypt is 14. Younger and older students perform less well in maths than students of average age.

Student performance in maths with respect to the language of testing shows a large gap in favour of those tested in English. The direct conclusion from these means could be misleading because of the difference in the sample size between the two groups and because some possible third variables could be influential, such as language schools having more school resources and students from higher income families. Egyptian learners performed relatively well in algebra and geometry and less well in the learning domains of numbers, data and chance. The TIMSS 2007 maths was designed to have three main cognitive categories to measure different types of abilities of the learners. The three cognitive domains are: knowing, applying and reasoning. Egyptian students show better performance in knowing and reasoning cognitive skills compared to applying.

3.2. Descriptive statistics on home background and school resources

As mentioned previously, the TIMSS data set is very large and supplemented by different questionnaires with a total of 88 questions: 33 are answered by the students, 33 are answered by teachers, and 22 are answered by school principal.

Table 1: Descriptive Statistics of included variables

(a)			(b)		
Family and student background	**Mean**	**std. dev.**	**Teacher characteristics and school resources**	**Mean**	**std. dev.**
Mother education level			**Test language**[6]		
Not finished elementary school	0.25	0.43	Arabic	0.97	0.16
Elementary/middle school	0.26	0.44	English	0.02	0.16
Secondary school	0.11	0.31	**Teacher gender**		
2 years of post secondary school	0.12	0.32	Male	0.71	0.45
University degree or higher	0.08	0.28	Female	0.20	0.40
Do not know/missing	0.19	0.39	**Teacher years of experience**[7]	12.20	8.61
Father education level			**Teaching certificate**		
Not finished elementary school	0.15	0.35	Yes	0.65	0.48
Elementary/middle school	0.28	0.45	No	0.16	0.37
Secondary school	0.12	0.33	**Availability of school resources MATHS**		
2 years of post secondary school	0.17	0.37	High	0.27	0.44
University degree or higher	0.10	0.30	Medium	0.67	0.47
Do not know/missing	0.18	0.38	Low	0.05	0.23
Parents nationality			**Teacher formal education**		
Both parents are Egyptians	0.77	0.42	Not university degree	0.03	0.16
Only one parent or neither parent	0.19	0.39	University degree	0.82	0.39
Number of books at your home			Postgraduate studies	0.06	0.23
None or few	0.67	0.47	**Type of community**		
One bookcase (26 to 100 books)	0.21	0.41	More than 50000 people	0.46	0.50
Two bookcases or more	0.09	0.29	Less than 50000 people	0.51	0.50
Home possessions			**Perc. of disadvantaged std**		
High	0.12	0.33	Less than 50 percent	0.52	0.50
Medium	0.36	0.48	More than 50 percent	0.43	0.50
Low	0.41	0.49	**Class size for maths**		
Gender of student			Less than 41	0.42	0.49
Boy	0.51	0.50	41 or more	0.56	0.50
Test language spoken at home			SCIENCE		
Always	0.66	0.47	Availability of school resources for science		
Almost always, sometimes, or never	0.32	0.47	High	0.374	0.484
Computer use			Medium	0.570	0.495
Both at home and school	0.21	0.41	Low	0.039	0.194
Either home or school	0.56	0.50			
Pc only at places other than home or none at all	0.16	0.37			
PlayStation or similar games					
Yes	0.37	0.48			
No	0.59	0.49			

Note: Sample size is 6582, all variable are dummy except for teacher experience and class size included in some estimations as continuous. "Do not know" responses are treated as missing; note that it is the students who answer the questions.

For many questions a list of possible answers is provided, for example parental educational attainment lists seven categories. Preliminary analysis using the full range of categories revealed that many variables have no significant effect on test scores and/or have many

[6] The un-weighted descriptive statistics indicates 82% for Arabic and 18% for English

[7] Note: it is included as continuous

missing observations. Where appropriate and justified by this analysis, we have combined or omitted categories. This section outlines the coding we use for the explanatory variables.

Table 1 panel (a) presents the descriptive statistics for student characteristics, family background and Social-Economic status (SES) for Egypt. Parental education includes mother's education and father's education measured by the highest educational level attained for each them measured in six categories: not finished elementary school; finished elementary or middle school; finished secondary school; 2 years of post secondary school; University degree or higher; and "don't know". The share of students in the TIMSS sample of Egypt whose mothers have not finished elementary school is 20 percent compared to 12 percent for fathers; mother's with university degree or higher (postgraduate studies)[8] are 12 percent compared to 16 percent for fathers. Approximately 15 percent of the students reported they do not know their mothers' highest educational level attained, and a similar percentage does not know their fathers' educational level attained.

The number of books in the students' home is coded in three categories: none or few books; one bookcase full of books; and two bookcases or more. The share of students from homes with no or few books is 63 percent compared to 25 percent with one bookcase and 13 percent with two bookcases or more.

The home possessions index, used as a proxy for family SES, is coded as high, medium or low. This index is constructed using data from four selected variables investigating different types of possessions: computer; study desk; internet connection; and satellite TV channels. Those variables were selected out of eight variables indicating home possessions using principal component analysis to identify the most influential variables for constructing the index. The construction of an index is problematic. The absence of a convenient approach of selecting variables to proxy living standards were shown by Montgomery et al. (2000), who argue that most studies used ad-hoc strategy to select variables. Recent studies employed principal component analysis (PCA) to derive Social-Economic Status (SES) indices from data sets which have no income measures such as Demographic Health Surveys (DHS) (Filmer and Pritchett, 2001, McKenzie, 2005).

[8] The coding refers to postgraduate education but may not mean a Masters or PhD; it is likely to refer to other higher or professional qualification.

PCA was employed to capture the most influential variables among eight variables. A home possession index was then constructed using the most influential variables based on their shares in explaining the variation in the PCA. The share of students who coded high is 24 percent, 36 percent coded low and 39 percent coded medium (Appendix B).

Parents' nationality is measured by two categories: both parents are Egyptian; one or both have foreign nationality. Almost 84 percent of students are of Egyptian parents. The test language is either Arabic or English. The majority of students took the TIMSS maths test in Arabic (83 percent of the sample). "How often the language of testing spoken at home?" is measured by two categories: always spoken at home; and with "almost always", "sometimes", and "never" combined into one category[9].

Two more variables were introduced to investigate their impact on student achievement. Computer use is coded in three categories: both at home and school (28 percent); either at home or school (56 percent); and only at places other than home/school or not at all (16 percent). Empirical evidence from a study on "home computer use and development of human capital" indicates that home computer use had significantly lowered the Romanian students' grades in Maths, English, and Romanian especially for low-income children (Malamud and Pop-Eleches, 2011). Students were asked if they have a PlayStation or similar games at home; 42 percent responded yes and 58 percent said no. The effect of this on test scores is ambiguous; it could reduce scores if access to games is a distraction from study at home, but if having such games is an indicator of household wealth it may be positively associated with test scores if students from wealthier households tend to perform better (the index of possessions is our only control for household assets).

Table 1 panel (b) reports descriptive statistics for Teachers' characteristics and school resources. 80 percent of maths teachers are men. Teachers' experience is measured by years of teaching which we coded in three categories: less than 10 years experience (35 percent for maths); 11 to 19 years (38 percent); and 20 years or more (27 percent). Some 82 percent of teachers have a teaching certificate. Teachers' formal education level attained is coded in

[9] 'Almost always' is combined with other group to capture any other language spoken at home (so 'always' means only one language spoken)

three categories: below university degree (two percent); university degree (89 percent); and postgraduate degree.

The type of community is used as a proxy for the population distribution to distinguish urban (the school is in a community with more than 50000 people) and rural (a community with less than 50000 people). School locations are almost evenly divided: 55 percent of students come from communities with more than 50000 people and 45 percent come from communities of less than 50000 people. The percentage of students in a school from disadvantaged homes (a question answered by teachers) is used as a proxy for the impact of being in disadvantaged areas on student performance.

School resources are measured by two variables, class size and an index of availability of school resources for maths instruction. Class size is coded in two categories: classes with 41 students or more (47 percent) and classes with less than 41 students (53 percent). The index of availability of school resources for maths instruction, constructed by TIMSS, is based on school principals' responses to a series of questions about shortages affecting instruction.

Ten areas of shortage or inadequacies (rated on a four point scale: none = 1, a little = 2, some = 3, and a lot = 4) which could affect delivering maths instruction in a proper way were included in the index computation. General areas include: 1) Instructional materials (e.g., textbook); 2) Budget for supplies (e.g., paper, pencils); 3) School buildings and grounds; 4) Heating/cooling and lighting systems; and 5) Instructional space (e.g., classrooms); and maths-specific areas: 6) Computers for maths instruction; 7) Computer software for maths instruction; 8) Calculators for maths instruction; 9) Library materials relevant to maths instruction; and 10) Audio-visual resources for maths instruction (Olson et al., 2008). The index of school resources for maths instruction index is coded in three levels: high; medium (57 percent); and low (four percent).

It is clear from Table 2 that parents' education is associated with achievement. The highest achievers are those whose parents have intermediate to higher education (first degree). The teacher is the core of creating a supportive environment for learning process. TIMSS has information on the teaching staff, academic preparation for teaching, teachers' professional development and their readiness to teach TIMSS curriculum topics. The majority of Egyptian

TIMSS maths teachers are aged between 30 and 39 years. The older the teacher the higher student performance is a clear relation from Table A.7. In Egypt, about 20 percent of maths learners were taught by females and 80 percent by males, without a significant difference in achievement. The average teaching experience of Egyptian teachers is 14.5 years. The results for teacher education level and achievements are mixed and no clear relation could be stated. However, it seems from Table A.8 that teacher satisfaction is positively correlated with teachers' performance and so students' performance. Average scores are also positively correlated with teachers' satisfaction.

Table 2: Percentages of students, Parents education and average test scores

Education level	Mother					Father				
		Maths		Science			Maths		Science	
	Percent	mean	se	mean	se	Percent	mean	se	mean	se
Not finished Elementary	25.66	375.48	5.29	394.82	4.66	15.2	363.91	6.02	384.88	5.24
Elementary/middle	26.35	385.32	4.64	404.54	4.84	29.38	384.1	4.8	403.58	4.11
Secondary	10.93	421.06	6.28	438.82	5.8	12.69	408.13	6.22	423.96	6.1
post secondary (2 years)	12.14	438.34	5.32	451.56	5.32	17.19	437.43	4.92	453.01	5.04
University degree	3.66	404.95	10.56	423.85	9.67	4.38	410.61	7.39	423.49	7.34
Postgraduate studies	4.94	391.12	6.88	394.54	7.81	5.98	394.84	7.29	403.38	8.14
I do not know	16.32	378.65	5.3	398.27	5.48	15.18	372.54	5.24	393	5.42

The average class size in Egypt is 37 students with a great dispersion in sizes. The most common class size is 40 students which is high relative to the top performing countries. Table A.9 shows a tendency towards better performance with lower class size for maths and science. The disadvantage of TIMSS data for Egypt is that they do not include data on regional distribution of school (urban/rural) or on (private/public) status. Schools with a high percentage of students from disadvantaged homes perform worse than those in schools with fewer disadvantaged students (Table A.10).

Table 3: Distribution of students whose peers are affluent at different schools

Percentage of affluent students	Arabic schools		English language schools		Total	
	N	%	N	%	N	%
Less than 10%	2,068	42	38	3	2106	32
11 to 25 %	1,552	31	18	2	1570	24
26 to 50 %	579	12	56	5	635	10
More than 50 %	766	15	990	88	1756	27
Missing	497	9	18	2	515	8
Total	5,462	100	1,120	100	6582	100

Students were tested in either Arabic or English; we assume that those tested in Arabic are enrolled in Arabic schools and the others are in English language schools. The language schools in Egypt are mainly private schools but there are also public experimental language schools, but TIMSS does not identify these. The data indicate a bigger share of affluent students enrolled language schools (Table 3).

4. The Empirical model

The underlying model is very straightforward. The output of the educational process is directly related to a group of inputs by an education production function (EPF). We use student standardized achievements in test scores as a measure of output. Inputs include characteristics of schools, teachers, and other non-student variables; and student SES variables such as family characteristics and home resources.

We estimate an education production function of the following form:

$$A_{is} = \beta_0 + \delta_1 F_{is} + \delta_2 S_s + \varepsilon_{is} \qquad \textbf{(1)}^{10}$$

Where A is the test score of student i in school[11] s, F is a vector of family background variables and S is a vector of school characteristics variables. The coefficient vectors α, δ_1 and δ_2 are to be estimated. The error term ε has two components as we have two-stage stratified sample, the imputation error on student's level and the sample error at the school level. Table 1 described in detail the variables included in our estimations.

School inputs and school choice will be the parents' decision; parents may make residential choice to ensure that their children are taught in a good school (small class size, good teachers or available facilities). Parents, teachers, and schools make choices that might give rise to a non-causal association between school inputs and student achievement even after controlling for family background. This makes the empirical investigation complex seeking identification and examining the sources of the effects by different techniques and methodologies to ensure the right interpretations of results.

[10] We include D, a vector of dummy variables for each variable both in F and S to capture the effect of missing observations; a dummy takes the value 1 for observation with missing data and 0 otherwise (the variables themselves are set to zero if their values are missing).

[11] Egypt's sample selects only one class from each school, simplifying notation to students and schools only.

5. Main Results

The results of estimating the education production functions, equation (1), for TIMSS achievement test scores in Egypt are discussed comparatively for maths and science (Table 4). The explanatory variables are organized in blocks, starting with measures of family background and student characteristics, followed by teacher characteristics and school features. In addition a critical look is paid to possible role of school type, interaction effects, school fixed effects and test language differences. The dependant variables are the plausible values for test scores in maths and Science.

5.1. Students background

We employ three sets of dummy variables to reflect the family background of students: the father's education level, the mother's education level, and the number of books at home. We also include various variables to capture a broader picture of student background and socio-economic status.

5.1.1. Parental education

For Maths, student level variables have the largest and most significant coefficients in the production function. Children of a mother with secondary or two years post-secondary education perform better than children of a mother with elementary or middle school. The results suggest a significant 17 point test score increase for students if their mother has two years' post-secondary education (compared to mother with no education or did not finish elementary school) and 15 point increase if the mother has secondary education. Although scores are lower for students whose mother finished university or postgraduate studies, this is not significant.

Similar results are obtained for father's education. Fathers who completed middle and secondary school increase test score by 13 and 26 points respectively compared to those who did not complete primary education. Having a father with university or postgraduate education has the lowest (and insignificant) impact on test scores compared to a father who did not complete primary education (but not significant), while a father who completed two years post-secondary has the greatest impact (an increase of 35 points).

Table 4: Estimates of Family, School Background on Maths and Science Performance

Dependant variable : students' test scores (the mean of 5 plausible values)	Maths N=6582	R^2 .2422	Science N=6582	R^2 .2193
Family and student background				
Mother education level	*b*	*se*	*b*	*se*
Elementary/middle school	-3.036	*(5.101)*	-1.276	*(4.868)*
Secondary school	14.987**	*(6.216)*	16.464***	*(5.510)*
2 years of post-secondary school	17.584***	*(6.703)*	17.526**	*(7.172)*
University degree or higher	-6.723	*(6.918)*	-9.847	*(6.582)*
No or not finished elementary(omitted)				
Father education level				
Elementary/middle school	13.683**	*(6.561)*	11.773**	*(5.312)*
Secondary school	26.310***	*(6.012)*	21.762***	*(5.680)*
2 years of post-secondary school	35.144***	*(5.403)*	33.667***	*(6.584)*
University degree or higher	10.611	*(6.631)*	5.898	*(6.699)*
Never or not finished elementary(omitted)				
Number of books at your home				
One bookcase	11.126***	*(4.313)*	12.069**	*(4.798)*
Two bookcases or more	0.850	*(6.280)*	-1.033	*(6.761)*
No or few books(omitted)				
Both parents Egyptian=1	49.427***	*(5.106)*	47.361***	*(5.071)*
Home possession index				
High	34.731***	*(4.372)*	35.658***	*(5.997)*
Medium	18.558***	*(3.532)*	18.467***	*(4.228)*
Student gender (male =1)	-9.342*	*(5.422)*	-16.499***	*(5.501)*
Testing Lang. spoken at home (always=1)	-17.994***	*(3.721)*	-16.935***	*(4.165)*
Type of community (more than 50000 people = 1)	9.816	*(6.513)*	13.031*	*(7.234)*
Less than 50000 people (omitted)				
Computer use				
Both at home and school	-21.879***	*(4.965)*	-31.587***	*(6.537)*
Either home or school	-21.822***	*(4.233)*	-25.630***	*(4.457)*
Other places or none (omitted)				
PlayStation or similar games yes = 1	-19.533***	*(3.073)*	-14.602***	*(3.197)*
Teacher characteristics and school resources				
Test language (Arabic=1)	-40.758***	*(12.087)*	-14.025	*(12.033)*
Teacher gender (male = 1)	-0.642	*(7.657)*	-2.516	*(6.353)*
Teacher years of experience	1.065***	*(0.388)*	-0.221	*(0.521)*
Teaching certificate	8.057	*(9.587)*	0.740	*(7.426)*
Availability of school resources for instruction				
Medium	-3.214	*(7.580)*	-1.360	*(8.648)*
Low	-19.639	*(13.745)*	-16.327	*(17.100)*
Teacher formal education completed				
University	-5.361	*(23.189)*	-13.289	*(16.125)*
Postgraduate studies	-13.253	*(24.771)*	-22.468	*(21.729)*
Not university (omitted)				
Percentage of disadvantaged std (more than 50%=1)	-7.040	*(6.254)*	-11.697**	*(5.764)*
Cass size (more than 41 =1)	-4.920	*(6.393)*	-4.934	*(6.546)*
Less than 41 (omitted)				
Constant	400.594***	*(28.554)*	432.479***	*(23.783)*
Controls for missing included	*Yes*		*Yes*	

Sampling weights of TIMSS are used, Jackknife standard errors in parentheses, Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.
Note: Teacher experience square when included all coefficient are essentially the same except teacher experience is insignificant for maths.

These findings are broadly in line with previous studies finding that parental education is important (Hanushek, 2002, Woessmann, 2004). However, one difference compared to

results for many other countries, especially developed countries, is that the effect appears non-monotonic. In Egypt, having more educated parents is associated with higher scores up to parents with post-secondary (but pre-University) education but the effect of more education becomes negative beyond this (although, for fathers, scores are still higher compared to not having completed primary education). The lower impact of parents with university or postgraduate education may be because both parents are working so there is less home support for study, or it could be that the most educated parents have relatively lower aspirations for their children compared to pre-University educated parents (who want their children to have a better education than they had themselves).

Father's education appears more important than mother's for student performance in Egypt. Levels of education attained indicate a larger influence of fathers' education than mothers' on student test scores as well as a positive effect at all levels compared to negative coefficients for mother's highest and lowest levels of education.

Student achievement in science is better than maths: average scores in science are higher by 18 points. The coefficients estimates from the regression for the science test scores are similar to the maths estimates with respect to parent's education and books at student's home.

Parents' education follows the same non-monotonic pattern of impact as for Maths. A student whose mother completed secondary or post-secondary education (but not university) performs better compared to students whose mother did not finish her primary education, by 17 and 18 points respectively. Fathers' education has an increasing impact on performance in science: Completing middle school increases test scores by 12 points compared to a father with no education, completing secondary school improves test scores by 22 points, and completing post secondary (two years) adds 34 points. Parents with university degree or higher have no significant impact on their children's performance in science.

5.1.2. Home possessions and books at home: Socio-Economic Status (SES)

The third indicator of family background is the number of books in the students' home. Only having one bookcase made a significant difference, increasing test scores by 11 points for

maths and 12 points for science compared to students from homes with no or few books. It is surprising that having two bookcases or more was not significant. One possible explanation is that those students who answered two bookcases or more are misreporting (bookcases could be of different sizes or they may be including magazines and newspapers, though the questionnaire told them not to count them). Another explanation supports the conjecture for parental education if highly educated parents have more books at home but give less support to their children in study.

The home possessions index (a proxy for the SES of the family) suggests that the impact of family SES on students' educational achievements is large and significant: a high level of SES increases test scores by 35 and 36 points for math and science respectively and medium levels by 19 and 18 points compared to the reference group of low SES. The effect of high SES is double the effect of medium level SES.

Private tutoring, or 'shadow education', is prevalent in Egypt and is likely to be one mechanism by which SES influences achievement. The tutoring market includes all types of schools and students at different stages of education depend on different types of tutoring. The most focused concentration is on the ninth grade and the secondary stage exit exams. Although, private tutoring is prohibited by law; this is not enforced and hence ignored (Hartmann, 2008). The ninth grade exams determine whether the student will be qualified to go to a 'prestigious' general secondary which will lead to university, and the secondary stage exit exams determine which colleges may admit a student. All grades with yearly exit exams create pressure on families for private tutoring.

5.1.3. Nationality and home spoken language

Native students perform better than non-natives for maths and science (the effect magnitude is slightly less for science). Students of Egyptian parents perform significantly better than students with one or both parents being foreign. The dummy variable for nationality has the largest effect on student test scores of all the significant explanatory variables - a 49 and 47 point test score increase in maths and science respectively. This is in line with findings from Woessmann (2004) on Europe and the US.

One surprising result is that students who always speak the test language at home perform significantly less well than those who speak another language. The results suggest 18 and 17 point increases if the language spoken at home is not always the test language for maths and science respectively. Out of the students who always speak the test language at home (61% of TIMSS sample), 88.7% of them took the Arabic test and only 11.3% took the English version of science test. However both English and Arabic test takers exhibit the counterintuitive result that always speaking the test language is associated with lower performance.

Table 5: Test language frequently spoken at home and students' achievement

Home spoken lang.	Language of testing	N	**% total**	Maths			Science		
				Mean	se	Std.dev	Mean	se	Std.dev
Always	Arabic	3551	54.77	382.96	(4.06)	96.11	401.55	(3.96)	95.31
4003 (61.75)	English	452	6.97	467.4	(10.07)	84.81	456.19	(12.46)	86.64
Almost always	Arabic	797	12.29	415.29	(5.02)	104.59	431.35	(5.45)	104.64
1129 (17.41)	English	332	5.12	490.45	(5.82)	71.88	484.25	(7.4)	74.99
Sometimes	Arabic	861	13.28	398.39	(6.53)	99.83	417.93	(6.21)	101.37
1048 (16.17)	English	187	2.88	492.64	(9.01)	72.11	476.44	(6.1)	73.08
Never	Arabic	160	2.47	370.38	(13.06)	101.31	392.71	(13.29)	101.47
303 (4.67)	English	143	2.21	488.57	(12.86)	87.1	468.01	(15.23)	87.8

Descriptive statistics (Table 5) show that students who took the English test perform better at all levels of regularity of speaking the language at home. Students who speak other languages at home beside the test language perform better than students who either always or never speak the test language at home. Re-estimating using a different default category test language shows that students who speak the language of testing either "almost always", "sometimes" or "never" perform statistically significantly better by 22 points of test scores in maths higher than students who "always" speak the test language at home. As 'natives' perform better this suggest either poor performing non-Egyptian Arabs or better performing Egyptians in 'multi-lingual' households.

5.1.4. Gender Differences

The gender gap in general is weakly significant (10%) except for science where girls outperform boys by 13 points (statistically significant at the 5% level). Nevertheless, girls generally perform better than boys in both TIMSS tests (see further analysis in subsection 6.1). This is only true in 2007- there was no significant difference in 2003 (Table A.5).

5.1.5. Type of community and Poverty Levels

Neighbourhood poverty is represented by the proportion of disadvantaged students in the school. It is not statistically significantly related to students' performance in maths. However, it does have a significant negative impact on science test scores. Students who go to a school with more than 50% of students disadvantaged perform worse by 12 points in science test scores than students who attend schools with less than 50% of students disadvantaged.

We use the type of community as a proxy for the urban or rural nature of the school location. Urban community has positive and significant effect only on science achievements at 10% significance level: cities and bigger communities have more association with achievements in science than rural or small communities. Other divisions of type of community have no significant effect.

5.1.6.Computer usage and game consoles

The availability of home computers and video game consoles like PlayStations or similar games, represent a major innovation in the Egyptian life style, culture and traditions. Surprisingly, students who use a computer at home and/or at school perform significantly worse than those who do not use computer at all (22 points less for maths). The impact of games consoles is similar, presumably providing a distraction to students.

The effect of using computers on test scores is much worse for science. Using computer at both places reduces student test scores by 32 point; using a computer either at home or at school reduces test scores by 26 point. Having games consoles reduces student test scores by 15 points. Including a more disaggregation categorization of computer usage does not change the findings of the chosen categories (Appendix A, Table A.12).

5.2. Teacher characteristics and School background

While intuition suggests that teachers are extremely important in affecting student achievement, few of their observed characteristics is found to have a significant impact. Only teacher experience, measured by years teaching and its square to test for decreasing returns to experience, has a statistically significant impact. While the two forms are not identically

significant, they are jointly different from zero at 5% of significance, and when the squared teacher experience term is dropped, teacher experience in years has a significant positive effect on test scores.

School background and resource endowment are measured by an index for the availability of school resources and by class size. The school resources availability index[12] has no effect on performance, although low school resources are associated with lower test scores for both maths and science. Class size is one of the most important measures of school endowment in the literature but also shows no significant influence on student performance.

We measured class size by dummy variables for three intervals: high (above 41), medium (25 to 40), and low (1 to 24). With "high" as the default, neither the "low" or "medium" dummies were significant. The World Bank has argued it is only when class sizes reach the "large" category that they start to impede performance. However, including only the "large" dummy (and so combining the other two as the default) reveals no significant effect in Egypt. These findings are counter-intuitive but nonetheless in line with many previous studies since the Coleman report in 1966 (Woessmann, 2003, 2004; Hanushek, 2007).

The last remaining finding concerns the impact of the test language used in the TIMSS test. The results differ for maths and science: testing language is insignificant for science, but students who take the maths test in English perform significantly better than those who take the test in Arabic. This striking finding is subject to further investigation later, in subsection 7.2.

6. Further analysis using interactions

To elaborate on the main findings, a series of interaction terms were used to explore three issues: gender differences, home spoken language, and parents' education and how they vary with respect to other influential factors. Table 6 reports significant results for gender interactions (full details in Appendix A).

[12] The index is composed using factor analysis technique including five major school variables and five subject specific indicators for both Math and science (TIMSS Technical report, 2009). Disaggregating the index indicates very few significant effects for some levels and suffers from multicollinearity.

Table 6: Family, School Background and Performance differences between boys and girls

DV: Test scores	Maths	n (6582)	R^2 .243		Science	n (6582)	R^2 .243	
Variables	*B*	*se*	*Interaction for a boy*		*b*	*se*	*Interaction for a boy*	
Elementary/middle school mother	13.92*	(7.85)	-18.19**	(8.57)	13.39*	(7.68)	-18.02**	(8.38)
Both parents Egyptian=1	39.87***	(7.35)	16.35**	(8.17)	39.18***	(7.65)	16.20**	(8.08)
Test Language spoken at home (always=1)	-26.52***	(4.67)	16.38**	(6.84)	-28.61***	(5.17)	20.30***	(7.20)
PlayStation or similar games yes = 1	-13.99***	(4.79)	-10.69*	(6.49)	-13.38**	(5.24)	-10.56	(6.97)
Test language (Arabic=1)	-39.88*	(23.29)	-10.60	(26.46)	-35.12**	(17.19)	-15.01	(20.02)
Medium school resources	10.56	(9.82)	-22.27**	(10.87)	12.24	(10.44)	-25.63**	(11.91)
Teacher education University degree	-0.47	(20.23)	-13.00	(20.84)	-34.46**	(14.02)	39.99*	(20.68)
Teacher postgraduate	-22.14	(24.71)	10.02	(26.62)	-59.91***	(16.32)	75.79***	(28.76)
% disadvantaged students (>50%=1)	-17.71**	(8.71)	19.42*	(10.74)	-18.35**	(8.96)	17.99	(11.94)

Note: Jackknife Standard errors in parenthesis & (*** p<0.01, ** p<0.05, * p<0.1)

6.1. Gender interactions

To elaborate on gender differences in student achievement, a dummy variable for being a boy was interacted with each of the other explanatory variables (Table A.13). Where gender interactions are significant, this implies there are significant differences between the effects of associated explanatory variables on boys and girls (i.e. if the sample were split by sex, the coefficients would be significantly different). Gender differences between coefficients are significant at the 5% level for mother's education, parents' nationality, home spoken language and school resources (game consoles and the proportion of disadvantaged students in the school are significant at the 10% level). Girls tend to do better if maternal education is at elementary or middle levels, whereas boys do better if both parents are Egyptian. This suggests some preference toward boys from Egyptian parents. Girls who always speak the test language (typically Arabic) at home perform less well by 26 points than other girls, but the corresponding effect on boys is less, reducing test scores by 10 points. Interacting test language and home spoken language conditioned on gender indicates no significant difference between boys and girls. Having video games consoles has a worse effect on boys than on girls. Boys therefore seem more vulnerable to distraction by entertainment games, possibly due to peer effects and the greater freedom given to boys at home.

The impact of a medium level of school resources for maths instruction is significantly different; girls seem to do better when there are more school resources. Students go to schools near to where they live if they cannot afford the cost of transportation to go to a

different school. Students who go to a school which has more than 50% of its students coming from disadvantaged families perform significantly different based on their gender. Girls do much worse in such situations, with an 18 point decrease in maths test scores, ceteris paribus. This result might reflect gender bias in poor areas toward boys.

For Science, four significant differences between boys and girls emerged. First, a mother who completed middle school has a significantly larger impact on girls' performance than on boys'. Maternal education at the lowest level has a more important role in girls' education than boys compared to the highest levels of mother's education. Second, parent's nationality affects boys more than girls: both parents of Egyptian nationality correspond to 16 points in favour of boys. This might suggest a gender bias regarding how much attention Egyptian families give to boys (science and math seen as basics for studying medicine and engineering 'the prestigious degrees'). Third, always speaking the test language at home has a significantly more negative effect on girls than on boys. Fourth, the index of school resources availability has more effect on girls. This indicates that more school resources could play a compensating role for the lack of home support for girls learning science.

The teachers' level of formal education has significantly different impacts on the achievement of boys and girls. Teachers with postgraduate education or a university degree are associated with lower girls' performance by 60 and 34 points respectively compared to teachers who have no university education. For boys, the corresponding effects are insignificant. There is no clear explanation for the negative impact of teacher's education on girls' performance or the gap between the impacts on the sexes. The level of education is similar for male and female teachers. Testing for teacher gender effect on boys and girls indicates; a) girls taught by male/female teacher keen to perform better than boys taught by male/female teacher, b) there is no significant effect of teacher gender on girls while boys taught by female teacher do worse than those taught by a male teacher. We have to keep in mind that girls outperform boys on average in maths.

6.2. Parents' Education and high SES

Parents' education's non-monotonic impact on cognitive achievement requires further investigation. Since the information on parental education was provided by students, one

possibility is that it is reporting error which leads to the apparent non-monotonicity. Academically weaker students may exaggerate the education of their parents and this 'top level' may not all mean university, leading to a downward bias in its estimated effect. However, the distribution of parents' level of education from TIMSS is similar to the distribution of population education according to the 2006 population census in Egypt. The only exception is that census data show a lower percentage with postgraduate or equivalent studies.

To investigate further the effect of parents' education we interact parent's education levels with the status of high home possessions index (to proxy high SES). However, one should be careful here in drawing conclusions given the over-representation of postgraduate education in TIMSS. The results in (Table A.15) indicate that a student whose mother has a university degree or higher but does not have a high level of home possessions performs significantly worse than a mother with high home possessions. The impact on performance differs significantly for home possessions and the size of difference is 24.8 points of test scores. This means that students whose mother has a university degree or postgraduate degree and has a high level of home possessions perform better by 12 points (25 - 13). We observe the same patterns for father's education.

Before drawing a general conclusion let us look first at the results from the interaction term of father's education with high home possession index. Fathers who completed higher education and in high SES affects children's performance more than those in low SES. This result is implied from the significant difference between the two cases. This is to say that parents' education at the highest level [university/PG] should be accompanied by high SES to increase students' performance.

6.3. Parents' education effect and Parental support

We use measures of parental support as reported by the students' maths teachers. We excluded this measure from the core estimates because of likely endogeneity but explore it here to see if the puzzling negative effect of having highly educated parents' is related to their lack of support for their children's studies. A high parental support increases student test scores on math and science column (1) Table A.16. However, the inclusion of parental

support variables does not change the no-monotonic effect of parents' education. The parents' level of support is different for different level of education of parents. The share of high supportive parents who got a post secondary education but not a university degree is more than those with university degree.

Column (2) in Table A.16 shows the interaction estimates of father's education with the high level of parental support. The results indicate that there is significant difference for the high level of parental support for highly educated father compared to low level of support. The difference reaches 27 points for maths and 20 point for science achievement. A mother education interaction indicates no significant difference for the highly supportive parents at any level of mother's education. Those results, for parent's education interaction with parental support, indicate that father's support is more important for better achievement than maternal support. In societies where the man has the main earning responsibility better educated fathers may invest more in their children's education. This type of monetary support could be directly related to the phenomenon of private tutoring. The interpretation of parental support here takes the form of the ability to afford the alternative form of education or what is called the shadow education. Similar results apply to science scores column (3) and (4) Table A.16 with one difference that medium parental support would work significantly for better achievements for both mother and father.

6.4. Parental education interaction with computer usage

Social changes are influenced by technological developments. We have looked at how some IT technologies have affected Egyptian students and their families. However, the impact of computing resources could be different across students with different parental backgrounds (i.e. parental education). We explore this by using interaction terms between computer use and parental education. For students whose fathers have a university degree or higher level of education, using computers both at home and at school does not appear to affect their achievement (see Table A.17). In general higher parent's education reduces the negative impact of computer use. Similar results apply to science scores. These results go in line with the findings of Malamud and Pop-Eleches (2011) on the home computer use effect on children in Romania.

Parents with higher education have a significant reducing effect on the harm caused by computer usage by Egyptian students. The negative effects of computer usage on test scores were reduced in families with highly educated parents for both maths and science.

7. School Effects and school types

Controlling for observable school and teacher characteristics in education production function indicates that school level variables are not so important in explaining the variations in students' achievements. It is the ability to control for unobservable school fixed effects that allows the identification of school effects. The school fixed effects accounts for unobserved differences, i.e. All school level factors that do not vary for students in that school and that affect the learning of students.

7.1. School fixed effects

We introduce school fixed effects estimation with student and family characteristics. School invariant variables drop out since they are perfectly collinear with school fixed effects. Under this approach, we estimate the pure effect of student and family level variables (SES), by controlling for the unobserved heterogeneity across schools. Dummy variables for each school absorb the effects on students' achievements particular to each school. This model will assess whether some schools are more productive than others, but cannot determine which school qualities matter (Gamoran and Long, 2006). This strategy will eliminate all variation between schools. To implement school fixed effects, a vector of dummy variables **Z** for each school is included in model (1), leading to equation (2)

$$A_{is} = \alpha_0 Z_s + \delta_1 F_{is} + \delta_2 D_{is} + \varepsilon_{is} \qquad \textbf{(2)}$$

Where ***A*** is the student's test scores of student *i* in school *s*, **Z** is a vector of dummy variables one for each school and **F** is a vector of family background variables. The coefficient vectors α_0, δ_1 and δ_2 are to be estimated. The **D** vector of dummy variables accounts for missing observations as above and **ε** is the error term. Controlling for school fixed effects should also reduce the effect of student unobserved ability if students are grouped across schools by similar levels of ability. We first estimate a null model with only fixed effects ($\alpha_0 Z_s$),

equation (3), to assess the existence and the magnitude of raw differences in student achievement across schools in TIMSS.

$$A_{is} = \alpha_0 Z_s + \varepsilon_{is} \qquad \textbf{(3)}$$

Then we move to the main specification in equation (2) to check the genuine differences at school level in Egypt. The crucial assumption for consistent estimates is that the school dummies *Z* and the student and family characteristics *F* included in the regression equation are not correlated with the error term. While all school and teacher characteristics *S* will be eliminated.

Using normal estimation techniques will not return consistent estimates since it does not correct for 'alpha inflation' and does not take care of measurement error yields from plausible values (Wu, 2005). The alpha inflation emerges from the correlation of students in the same class; if we do not allow for this clustering effect, the estimates will give lower standard errors. The solution proposed by the TIMSS technical report is to use the jackknife technique to calculate correct standard errors. The use of plausible values as mentioned before yields some measurement error since it based on the Item Response Theory. We employ the five plausible values to correct for measurement error in using IRT and employ jack-knife repeated replication to remove standard error bias. Along with the fact that we are seeking population estimates which require using weights, we included all this in the specification for school fixed effects.

From model (1) estimates we obtained a broad picture which shows that the major impacts come from student and family characteristics rather than school level characteristics. The school fixed-effects address the question of how this picture changes once we control for all school level factors including those unobserved.

In the school fixed-effects regression father's education is still more important than mother's. Highly educated mothers reduce maths performance by 12 points compared to mothers without primary education. The non monotonic impact of parents' education is still evident. Student and family background characteristics appear to be the same in terms of sign and significance but with lower values.

Table 7: Estimates of Family, Student and Schools fixed effect on Test scores

DV : Test scores (5 plausible values)	Maths		Science	
Family and student background	*b*	*se*	*b*	*se*
Mother education level				
Elementary/middle school	-1.383	(4.668)	-0.563	(4.271)
Secondary school	8.361	(6.027)	8.388*	(4.946)
2 years of post secondary school	7.411	(6.473)	5.346	(6.042)
University degree or higher	-12.367*	(6.480)	-17.149***	(5.475)
Father education level				
Elementary/middle school	9.278	(7.053)	7.781	(5.349)
Secondary school	19.981***	(6.263)	15.582***	(5.127)
2 years of post secondary school	27.290***	(5.720)	26.154***	(6.182)
University degree or higher	4.950	(6.043)	0.686	(6.230)
Both parents Egyptian	46.604***	(3.843)	46.288***	(4.493)
Books at home (one bookcase)	7.670*	(4.089)	9.800**	(4.646)
Books at home (two bookcases or more)	3.460	(4.015)	2.107	(4.641)
Home possessions index				
High	22.391***	(4.175)	22.752***	(5.818)
Medium	12.360***	(3.219)	12.181***	(4.276)
Student gender (male =1)	2.758	(4.998)	3.502	(5.509)
Testing spoken at home (always=1)	-12.428***	(3.780)	-11.424***	(3.845)
Computer use				
Both at home and school	-20.010***	(4.500)	-29.546***	(6.342)
Either home or school	-18.025***	(3.962)	-21.953***	(4.610)
PlayStation (yes = 1)	-17.746***	(3.238)	-13.413***	(3.045)
Constant	371.562***	(7.239)	371.562***	(7.239)
Missing obs. Controls	*Yes*		*Yes*	
Adjusted- R- squared	*.3889*		.3739	
N	*6582*		6582	

Jackknife standard errors in parenthesis, Significance levels: * p<0.10, ** p<0.05, *** p<0.01

Finally, having estimated the school fixed effects it is of interest to see what percentage of this measure of 'student's achievement' is explained by the observed characteristics for students and families. Table A.18 and A-5.19 show the null model which includes only school dummies panel (4), column (1) estimates without school level variables, column (2) replicates the basic model estimates for comparison, and column (3) gives the school fixed effects estimates. Our controls for students and family background characteristics and school and teacher characteristics explain only about 24% of student's achievements. Column (1) indicates that controls for student and family background only explain 21% of maths achievements and 20% of science. Adding school fixed effects raises the explained variation in 'student achievement' to 39% for maths and 37 for science. School dummies were tested for joint significance and they are jointly highly significant. That finding indicates that there is a large variation in school effects. One possible source of variation might be the difference between different school types, namely single-sex versus mixed (coeducation) schools and/or Arabic and language schooling. Egypt's TIMSS dataset does not provide information on

types of schooling. To overcome this limitation we will use both the gender composition of schools and the test language as proxies for this differentiation.

7.2. Arabic and English schools

Egypt performed TIMSS in two languages: Arabic and English. English test takers would typically attend language schools and the rest of students attend Arabic schools. TIMSS sampled private and public schools but provided no information to classify the schools. Students who took the English TIMSS test performed significantly better than those who took the Arabic version of the test (Table 8). The TIMSS test questions can be categorised into three cognitive domains measuring student's performance in terms of Knowing, Applying and Reasoning for each subject. We tested for the mean differences in each domain between the two samples of students (Arabic and English test language). Taking the test in English could be a proxy for higher SES and for school choice as students who take exam in English, presumably, come from higher status family backgrounds with support at many levels (attending language schools, receiving more home resources and private tutoring).

The mean test scores of students who always speak the test language at home - either Arabic or English - is significantly lower than for students who do not always speak the test language at home (Table A.20).

Table 8: Test scores means for Maths and Science cognitive domains by test language

Subject		**Maths**	**Maths cognitive domains scores**			**Science**	**Science cognitive domains scores**		
Sample *Mean/se*		**Total**	**Knowing**	**Applying**	**Reasoning**	**Total**	**Knowing**	**Applying**	**Reasoning**
Full N=6582		390.56	393.28	392.10	396.50	408.24	403.80	434.03	395.44
		(3.57)	(3.58)	(3.61)	(3.38)	(3.56)	(3.56)	(3.85)	(3.36)
Arabic (A) N=5462		388.01	390.79	389.41	394.27	406.51	402.00	432.64	393.68
		(3.70)	(3.75)	(3.78)	(3.52)	(3.68)	(3.65)	(4.00)	(3.41)
English (E) N=1120		481.98	482.54	488.29	476.39	470.21	468.41	483.96	458.34
		(6.35)	(6.02)	(8.20)	(5.820	(7.49)	(7.80)	(10.48)	(10.77)
T-test	*Dif*	-93.97	-91.75	-98.88	-82.12	-63.69	-66.41	-51.32	-64.66
	Sig	***	***	***	***	***	***	***	***
	(se)	(7.53)	(7.54)	(9.56)	(6.94)	(8.33)	(8.18)	(11.64)	(10.50)

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt. .s.e in parenthesis
T-test for means equality of Arabic and English groups, Dif. Indicates the difference, Sig is the significant

However, introducing interaction terms for how frequently the test languages are spoken at home and natives with test language shows no significant difference between Arabic and English test takers. These findings suggest that it is a matter of SES; it is neither home practice nor nationality as it appears from simple comparisons.

The test language interacted with the index of home possessions – a proxy for SES – allows us to see whether the effect of the test language is different depending on the student's SES (Table A.21). The results show a statistically significant relation between the SES and the test language. High SES background reduces the negative effect of being tested in Arabic. This is in line with the findings on parental support and parental education above. These findings support the assumption made in the main results section that students who took the English test are coming from high income families and this increases their scores. However this finding raises the issue of the endogeneity of school choice. We will return to this issue in the next sub-section, which describes estimates obtained from separate samples for the testing language (to capture the two school type's effects).

7.2.1. Splitting sample using test language

Students who took the English version of TIMSS most probably attended language school while the others, who took the Arabic test, attended Arabic schools (private or public). Descriptive statistics show that of 5462 students that took the test in Arabic only 13% have high SES. By contrast, two thirds of the 1120 students tested in English had high SES. Re-estimating the basic model on separate samples, Table 9 presents the results for language schools and Arabic schools in terms of population (weighted) estimates. Regarding SES and school choice, the findings indicate that the home possessions index has a highly significant effect on student achievements in Arabic schools for maths and science. For English language test takers the effect of SES is insignificant for both maths and science. Not just this but SES is negative, it could be home possessions index not discriminating at higher end or sample selection issue (only smart poor go to language schools). For students that took the test in Arabic, scores are significantly higher for those with high SES.

Parents' education is not significant for students tested in English. For students tested in Arabic, father's education matters more than mother's education with each level of paternal

education below university raising performance. Only maternal education at the middle level (secondary or post secondary) significantly raises student achievement.

Table 9: Splitting TIMSS sample by test language

DV : Test scores(PVs)	Maths				Science			
Family and student background	English		Arabic		English		Arabic	
Mother education level	*b*	*se*	*b*	*se*	*b*	*se*	*b*	*se*
Elementary/middle school	-18.914	(59.977)	-3.104	(5.102)	43.516	(141.108)	-1.272	(4.926)
Secondary school	-6.063	(62.366)	14.440**	(6.240)	32.693	(111.973)	16.550***	(5.583)
2 years of post secondary school	-20.907	(55.128)	19.293***	(6.840)	28.632	(107.381)	19.429***	(7.388)
University degree or higher	-26.795	(59.968)	-8.175	(7.207)	18.674	(108.446)	-11.466*	(6.750)
Father education level								
Elementary/middle school	-2.043	(29.639)	13.489**	(6.595)	56.753	(70.908)	11.590**	(5.329)
Secondary school	1.722	(48.385)	26.451***	(6.083)	62.126	(93.864)	21.802***	(5.713)
2 years of post secondary school	20.486	(24.633)	36.358***	(5.539)	83.055	(66.418)	34.760***	(6.707)
University degree or higher	24.890	(25.880)	8.493	(6.832)	87.730	(68.196)	3.700	(6.874)
Both parents Egyptian=1	22.612***	(8.244)	50.761***	(4.947)	22.137*	(13.056)	48.267***	(4.967)
one book case	17.637***	(6.086)	11.177**	(4.413)	16.198**	(6.960)	12.036**	(4.911)
Two book cases	14.936***	(5.286)	0.841	(6.442)	14.625**	(6.477)	-1.684	(6.994)
Home possession index								
High	-19.623	(18.229)	36.265***	(4.589)	-31.879	(29.672)	37.467***	(6.132)
Medium	-21.912	(20.136)	18.374***	(3.591)	-26.281	(22.132)	18.240***	(4.240)
Boy student	16.737*	(9.900)	-9.729*	(5.565)	2.700	(12.995)	-17.209***	(5.597)
Testing lang. spoken at home (always=1)	-14.333*	(8.535)	-17.613***	(3.806)	-14.514	(9.751)	-16.818***	(4.256)
computer use								
Both at home and school	36.574**	(17.783)	-22.573***	(5.050)	17.081	(24.639)	-32.058***	(6.649)
Either home or school	26.755**	(13.452)	-22.249***	(4.282)	13.130	(17.647)	-25.668***	(4.566)
PlayStation or similar game yes = 1	-15.940**	(6.483)	-19.676***	(3.136)	-14.344**	(6.601)	-14.573***	(3.286)
Teacher characteristics and school resources								
Teacher gender (male = 1)	-6.777	(16.619)	-0.598	(7.793)	1.342	(13.341)	-2.034	(6.459)
Teacher years of experience	0.008	(0.910)	1.102***	(0.405)	-1.424	(2.968)	-0.210	(0.530)
Teaching certificate	1.976	(17.653)	8.402	(9.650)	-25.179	(17.214)	1.398	(7.519)
Availability of school resources								
Medium	-24.227**	(9.701)	-1.864	(7.785)	-36.134**	(18.307)	-0.104	(8.960)
Low	-8.795	(22.848)	-18.159	(14.145)	-13.015	(24.597)	-15.366	(17.566)
Teacher formal education								
University	17.025	(64.303)	-5.995	(23.002)	-10.509	(36.605)	-13.941	(16.228)
Postgraduate studies	0.000	(57.912)	-13.536	(24.780)	-2.225	(26.527)	-24.749	(22.327)
Type of community (>50000 = 1)	-2.927	(16.750)	9.568	(6.565)	-2.827	(10.692)	13.015*	(7.262)
% disadvantaged std (> 50%=1)	-8.822	(16.054)	-6.773	(6.293)	-16.877	(24.318)	-11.660**	(5.827)
class size (more than 41 =1)	8.561	(19.751)	-5.828	(6.608)	-1.316	(22.356)	-5.714	(6.753)
Constant	439.443***	(86.048)	358.361***	(27.205)	418.940***	(101.515)	417.234***	(22.690)
Controls for missing included	*Yes*		*Yes*		*Yes*		*Yes*	
Adjusted- R^2	*.21479*		*.23055*		*.19467*		*.21623*	
N	*1120*		*5462*		*1120*		*5462*	

Jackknife standard errors in parenthesis, Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

In general, the Arabic schools results are the same as the full sample. Native parents affect scores for students tested in Arabic much more than if tested in English. The size of the effect of Egyptian parents on their children's achievements in Arabic schools is twice the

effect for those in language schools. Having one or two bookcases at home increases test scores for students in language schools. Language education might stress more on reading, making the presence of books in the home more important.

The gender effect is different in size and direction between the two types; boys outperform girls in language schools but girls do better in Arabic schools. Computer usage has positive significant effect in language schools. This effect is only for maths, the effect on science in insignificant. Computer use has a highly significant negative impact on maths and science in Arabic schools which seems to dominate in the full model estimation. Play-Station has negative effect on both types of schools for maths and science. Medium school resources reduce achievement in language schools compared to high level of resources. Teacher's experience matters only in Arabic schools with very small effect.

7.2.2. Test language different effect on maths and science achievements

Table 8 shows that the means are significantly different for all three cognitive domains and for the total test scores for both maths and science. The least statistically significant difference and the highest standard errors are in the cognitive domain of applying in the science test. Figure A.1 clearly shows that there are differences in the test scores distributions as well as the superiority of the English language takers for maths. The picture is not so clear for the science (Figure A.2) distributions for cognitive domains, but still indicates higher test scores distributions for the English language students.

Estimates of student, family and school impact on test scores show a highly significant effect of English as the test language on maths test scores for each of the cognitive domains (Table A.22). Given the better performance of students in English language schools, it is expected to have the same performance in science. The striking result is that English schools students are indifferent from their peers in Arabic schools in science achievement. The test language has an insignificant effect on science test scores. For the cognitive domains of knowing and reasoning for science, the effects of English are statistically significant at the 10% level. To understand why language schools do not seem to have an advantage in the applying science domain, we investigated the science curriculum questionnaire which contains the responses

provided by the National Research Coordinators of the participating countries to the TIMSS 2007.

Egypt's science curriculum questionnaire states that the national science curriculum places a lot of emphasis on knowing basic facts and principles, with some emphasis on providing explanations to what is being studied and to link up what students are learning to their daily life. Unfortunately, very little emphasis is placed on observing natural phenomena and describing what is seen, designing and planning experiments or investigations, conducting experiments or investigations, and integrating science with other subjects. The nature of the science curricula does not encourage understanding the application of science, and this may be why scores in the applying science domain is not influenced by the type of school (or testing language).

These findings shed light on some reasons for the frequently stated problem of mismatch between the graduate acquired skills and the required skills of the labour market especially technical and practical skills. There is little provision for the application of subjects learnt in school especially science. As we have argued, this problem stems from the poor nature of the curricula and hence there need for a reform in the science curricula.

7.2.3. Test language and home spoken language

One curious finding was that students who always speak the test language at home perform worse, *ceteris paribus*, than others. We use the sub-samples split by test language to see if this finding holds true for both those tested in Arabic and those tested in English. We find that the overall finding is driven by the results for students tested in Arabic, who perform significantly worse in maths and science if they always speak Arabic at home (compared to sometimes or never). The effects of speaking the test language at home on test scores are weaker or insignificant for those tested in English (Table 9).

We can only speculate on why always speaking the test language at home is associated with lower test scores, particularly if tested in Arabic. The most plausible explanation is that it is related to (lower) SES. For those tested in Arabic a possibility is that households in which a language other than Arabic is spoken (sometimes) at home are higher income and/or have motivated immigrant parents. For those tested in English, it may be that only Egyptian

(Arabic speaking) students from high income families go to language schools. However, as was said, there is not enough information to support those explanations - they need further investigations either by studies on instruction language or on teaching and evaluation methods in Egypt.

7.3. Schools type by sex composition

There is a profound debate on single-sex schools versus coeducation in empirical research. One side supports single sex schools, especially for girls. The empirical evidence, however, indicates mixed findings to support this claim. For example, Lee et.al (1990) claimed that single sex schools improve girls 'performance in maths in Nigeria. Recent reviews though criticized those findings for sample selection bias with teachers' gender in their study. Eisenkopf et.al (2011) natural experiment analysis on upper-secondary school in Switzerland shows positive effect of single-sex education on the maths achievements but not in German. Nonetheless, empirical evidence generally shows it less likely for girls to do better than boys in mixed schools, specifically in science (Carpenter and Hayden, 1987).

The Egyptian education system tends to be single-sex education system after the primary stage. The sample consists of 6582 students in 233 Egyptian 8th grade classes. The TIMSS design sampled a single class in each school, 79 of them mixed and 154 single-sex classes. Of the sample, 34% are boys in boys' school, 34% are girls in girls' school, 17% are boys in mixed school and 15% are girls in mixed school.

Average test scores for maths and science are higher in single-sex schools. The mean gaps are statistically significant 18 and 17 points in maths and science respectively.

Table 10: number of students and schools in the TIMSS sample by school type

Type of school	Number of schools	Percent of total school	Number of students	Maths test scores	Science test scores
Mixed schools	79	32	2084	**379**	**396**
Girls	-	31	997	377	395
Boys	-	33	1087	381	397
Single-sex schools	154	68	4498	**396**	**414**
Girls	74	69	2261	410	429
Boys	80	67	2237	385	398
Total	233	100	6582	**391**	**408**
Test scores gap for girls between mixed and single sex schools				33***	34***
Test scores gap for boys between mixed and single sex schools				4	1

Disaggregation by gender, girls who go to single-sex schools outperform those who go to mixed school but boys' performance is not statistically significantly different between the school types. The results of the education production function across school-type are presented in Table A.25 and Table A.27 for maths and science respectively. Students who attend a single-sex school exhibit more differences in achievement compared to co-educational school. Girls who attend a single-sex school outperform boys in similar schools by 18 points in maths and 26 points in science. Teachers' gender has no effect on academic performance either in single-sex or in mixed school.

Table 11: Effects of Attending Single-Sex vs. Co-education Schools for Boys and Girls (maths)

DV: maths test scores	Boys' schools		Boys in mixed schools		Girls' schools		Girls in mixed schools	
Average maths scores	385		382		408		376	
VARIABLES	B	se	b	se	B	se	b	se
Parents education Upper-sec	28.25**	(11.27)	35.96**	(14.08)	8.74	(8.28)	16.74	(20.61)
One bookcases	15.05**	(6.64)	11.56	(12.31)	7.84*	(4.50)	4.12	(15.61)
Test language Arabic	-83.45**	(35.47)	-22.77	(23.85)	-65.82**	(26.46)	-15.10	(23.58)
Test Language Spoken always	-12.19*	(6.79)	-6.70	(6.94)	-21.63***	(5.43)	-26.23**	(10.37)
PC at H&SCL	-32.63***	(7.03)	-10.05	(15.23)	-21.83**	(9.37)	-27.76*	(16.63)
PC at H/SCL	-29.38***	(6.16)	-8.50	(12.95)	-18.77***	(7.14)	-25.08*	(13.35)
Teacher Experience	1.97***	(0.73)	-0.18	(2.07)	0.40	(0.45)	0.36	(1.76)
Teaching Certificate	-6.19	(16.50)	32.33*	(16.58)	-26.17**	(12.68)	7.63	(16.06)
Medium SCL Resources	-18.68**	(7.89)	-0.23	(33.89)	14.17	(12.52)	7.44	(29.18)
Teacher has University Degree	0.00	(75.17)	0.00	(164.6)	44.41**	(20.30)	-46.09	(140.17)
Poverty 50% Disadvantaged	-1.25	(9.29)	-6.55	(27.76)	-31.17***	(11.54)	-1.60	(18.33)
Constant	370.65***	(107.48)	412.86***	(160.0)	464.89***	(112.71)	442.89**	(193.41)
Observations	2237		1087		2261		997	

Note: Jackknife Standard errors in parenthesis & (*** p<0.01, ** p<0.05, * p<0.1)

Do the educational production functions for boys and girls differ in different types of schools? To answer this question we estimated our model on four subsamples split by gender school type in Table 11 and Table 12. Factors influencing student achievement in mixed schools are fewer than those of single sex schools, and signs vary. Computer usage

affects performance negatively except for boys in mixed schools. Teacher experience increases the performance only in boys' schools. Teaching certificate and teacher's university degree have contradictory effects on girls' performance.

Medium school resources reduce students' performance in boys' schools. Girls' schools located in a socially disadvantaged area have lower maths test scores by 31 points. The number of books at home significantly increases student achievements only in single-sex schools. The effect of number of books for boys is almost twice that for girls for maths.

Table 12: Effects of Attending Single-Sex vs. Co-education Schools for Boys and Girls (science)

DV: science test scores	Boys' schools		Boys in mixed schools		Girls' schools		Girls in mixed schools	
Average science scores	400		399		428		393	
VARIABLES	B	se	b	se	B	se	b	se
Parents education Upper-sec	27.65***	(8.70)	29.09*	(15.58)	5.25	(9.73)	13.90	(15.83)
Post-sec not UNI	37.19***	(9.54)	27.46	(19.28)	23.19**	(9.81)	26.90*	(15.92)
Natives	51.25***	(6.42)	64.51***	(8.37)	33.39***	(8.66)	54.03***	(13.15)
One bookcases	14.59**	(6.87)	16.52	(10.60)	13.03**	(5.93)	8.72	(14.54)
Home possess Medium	18.19***	(5.68)	3.02	(13.16)	18.28***	(5.59)	9.03	(9.38)
Test language spoken Always	-10.74	(7.54)	1.27	(8.99)	-21.15***	(5.40)	-26.64**	(11.92)
PC at H&SCL	-39.24***	(8.54)	-13.98	(17.85)	-23.27**	(10.44)	-36.63**	(15.48)
PC at H/SCL	-31.80***	(6.51)	-8.39	(15.12)	-19.63**	(8.03)	-21.98**	(10.14)
School Resources Medium	-24.34**	(11.48)	1.71	(46.67)	25.49	(15.77)	-5.75	(31.96)
Urban community population>50000	20.68*	(10.92)	13.79	(27.95)	4.08	(12.64)	14.54	(19.58)
Poverty 50% Disadvantaged	-10.16	(12.45)	-2.05	(24.46)	-33.70***	(8.97)	-23.83	(15.17)
Constant	477.42***	(54.96)	425.59***	(55.92)	474.21***	(38.95)	483.09***	(50.45)
Observations	2237		1087		2261		997	

Note: Jackknife Standard errors in parenthesis & (*** p<0.01, ** p<0.05, * p<0.1)

The same findings hold for students' performance in science, except for test language which is not significant on the gender-school type disaggregation. Teacher's factors have no effect on performance in science. A larger community increases boys' science performance in boys' schools. In general, it seems that mixed schools have a different production function than for single sex schools.

8. Extensions

Finally we test for parents and students attitudes using measures of the level of parental support and student motivation. The level of parental support has a clear impact on performance (Table A.23). An increase of parental support from medium to higher levels doubles the effect on test scores (from 15 to 31 point) compared to low levels of parental support. Students with higher educational aspiration perform significantly better compared to students with lower aspiration. Students were asked "How far do you expect to go in school?" Students who expect to go to university or postgraduate studies perform significantly better (by 23 points) compared to students with less expectations (only to complete secondary or middle school education or at most two years post secondary education). The coefficients on other variables are unaffected except that the effect of mothers with university education becomes significant and negative (by 14 points in math) compared to a mother with no education or did not complete primary school. Science estimates indicate the same patterns of effects for parental support and students' aspiration.

Testing for accountability and autonomy

The literature on economics of education describes and discusses different types of reform and their effects. From input based reform to incentive and accountability based reform, many studies address this issue and try to focus on the effectiveness and efficiency of such reforms (Pritchett and Filmer, 1999, Hanushek, 2003, Woessmann, 2003). Accountability is measured by whether data about schools are publicly available and whether parents have a say over the schools affairs. School autonomy involves pedagogical autonomy, facing competition, and freedom to hire and fire besides decentralization of education system. It is difficult to address these issues for Egypt as data on accountability and school autonomy is very limited. School competition and freedom to hire and fire are only applicable for private schools which represent a small percentage of education services suppliers.

TIMSS does ask for information on parental involvement in school activities, although there is no indication of how effective this is. Pedagogical autonomy is measured in TIMSS by asking teachers whether they participated in professional development in subject pedagogy in the past two years. We use these two variables in Table A.24: pedagogical autonomy

appears to have no effect whereas parental involvement in school activity has a significant effect on student performance medium, low and very low levels of involvement are associated with lower test scores than high level of involvement.

9. Conclusions

This paper estimates determinants of educational outcomes for Egyptian students using cross-section data from TIMSS 2007 to estimate a reduced form education production function. The nature of the data requires us to allow for plausible values and employ the jackknife technique to calculate correct standard errors before proceeding in the econometric estimates of the educational production function. We address the influence of family background and school inputs on 8th grade students' performance in the TIMSS achievement tests for maths and science.

A simple set of conclusions could be drawn from this analysis for students' characteristics and home background, and teacher characteristics and school resources. The impact of parental education on students' cognitive skills is strong but appears non monotonic. For example, with father's education both the highest and lowest levels reduce performance relative to intermediate levels. Given the non monotonic effect of parents' education we explored some interactions with different proxies for SES and assets. The estimates suggest that higher home possessions are always associated with significant positive effects on achievements.

The results suggest that socio-economic variables (SES) are more important than school level variables, although not always in the anticipated way. Number of books at home is found to increase achievements when above few, i.e. for one bookcase compared to none, but there is no additional effect of even more bookcases. These results go against the findings of Ammermuller et.al.(2005) which suggest an increasing effect with more books at home in Europe. A likely explanation is that beyond few books the measure is very imprecise. School and teaching practices place too much emphasis on 'spoon feeding' with little encouragement for self-learning through wider reading or going to libraries, so having many books at home may confer no clear benefit.

School fixed effects do show variation, but this is mainly due to unobserved factors rather than measured teacher characteristics or school resources. There were two main suspected effects related to school types through gender composition and the test language. We found a significant link between school type and student performance in Egypt: language schools appears to have better scores than Arabic schools; and single-sex schools do better than mixed schools (especially for girls). Students tested in English (who presumably attend a language school) outperformed students tested in Arabic in maths, but not in science. Splitting TIMSS sample based on test language into Arabic and 'English' schools changed the results dramatically indicating two different production functions. The coefficients' effects for most of the variables differ between Arabic and English language schools. The different effects pattern are similar for math and science for each type of schools except for the effect of urban community which increases science test scores and schools placed in disadvantaged areas which reduces student achievement in science of Arabic schools' students.

Single-sex schools work better than mixed schools especially for girls. Furthermore, single-sex language schools are more effective than Arabic single sex schools. This confirms the dominance of the language schools and is as well related to the style and social-economic status of enrolled students. Those findings should be taken with careful interpretations. The school selectivity issue is a valid point in this context; one should expect higher SES and higher education for those who enrolled in the language schools. However, controlling for SES implies significant effect in Arabic school but not in language schools.

The other general finding is that school observed variables have small and ambiguous effects on test scores, consistent with the common finding in the literature (Hanushek, 1995, Glewwe and Kremer, 2006). Community type and school location have significant effects on science scores. Living in a highly populated area (presumably urban community) has a positive significant impact on achievements. Schools which have more than 50% of the students come from disadvantaged homes exhibit lower student performance while urban communities and rich areas have positive effect on science achievements. Those findings could have some policy implications regarding giving more attention to schools in poor areas and investigating further the possible reasons behind such effects.

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Appendix A: Descriptive statistics and further estimations

Table A.1: Basic statistics on selected characteristics for Egypt

Poverty and Social Status in 2007	Egypt	Middle East& North Africa	Lower middle-income countries
Population, mid-year (millions)	75.5	313	3,437
GNI per capita (Atlas method, US$)	1,580	2,794	1,887
GNI (Atlas method, US$ billions)	119.5	876	6,485
Average annual growth, 2001-07			
Population (%)	1.8	1.8	1.1
Labor force (%)	2.8	3.6	1.5
Most recent estimate (latest year available, 2001-07)			
Poverty (% of population below national poverty line)	..	..	..
Urban population (% of total population)	43	57	42
Life expectancy at birth (years)	71	70	69
Infant mortality (per 1,000 live births)	29	34	41
Child malnutrition (% of children under 5)	5	..	25
Access to an improved water source (% of population)	98	89	88
Literacy (% of population age 15+)	71	73	89
Gross primary enrolment (% of school-age population)	105	105	111
Male	107	108	112
Female	102	103	109

Source: World Bank, Egypt, Arab Rep. at a glance. This table was produced from the Development Economics LDB database.
Note: 2007 data are preliminary estimates.

Table A.2: Basic statistics on education, Egypt and MENA 2007

	MENA	*Egypt*
Gross enrolment rate (%), pre-primary, total	20.86	17.24
Net enrolment rate (%), primary level, total	90.45	95.75
Net enrolment rate (%), secondary, total	66.7	..
Gross enrolment rate (%), tertiary, total	25.89	34.75
Gender parity index (GPI), gross enrolment ratio in primary education	0.96	0.95
Gross intake rate to grade 1, total	..	103.33
Drop-out rate (%), primary	..	3.17
Percentage of repeaters (%), primary	6.53	3.10
Out-of-school children, primary, total	3060056	231884
Primary completion rate, total	91.12	98.45
Percentage of repeaters (%), secondary	..	7.3
Primary education, teachers (% trained)	..	..
Secondary education, teachers (% trained)	..	..
Pupil-teacher ratio, primary	22.05	27.08
Pupil-teacher ratio, secondary	18.66	17.08
Public education expenditure as % of GDP	..	3.75

Source: World Bank, EdStats

Table A.3: Access, Coverage and Efficiency of education in Egypt

	Total	*Male*	*Female*
Gross Intake in Grade 1 (%)	103	105	102
Primary Gross Enrolment Ratio (%) (6 years)	105	108	102
Primary Repeaters (% of primary cohort)	3.1	3.9	2.2
Primary Drop Out Rate (%)	5	6	4
Primary Completion Rate (%)	99	101	96
Expected Primary Completion Rate (%)	98	99	97
Number of Primary Age Children Out of School (thousands)	232	10	222
Primary Gender Parity Index (GER ratio)[13]	0.95		
Secondary Gross Enrolment Ratio (%) (6 years)	88	91	85
Lower Secondary (%) (3 years)	98	102	95
Upper Secondary (%) (3 years)	77	79	75
Vocational and Technical (% of secondary enrolment)	30.3	0.3	0.3
Secondary Gender Parity Index (GER ratio)a	0.94	..	..

Sources: UNESCO Institute for Statistics (UIS), World Bank, UNAIDS, ILO, Household Surveys, IMF, Country. Data are for the most recent year available in 2000-2005.

[13] Gender Parity Index (GPI) refers to the ratio of the female to male gross enrolment ratios. A GPI of 1 indicates parity between sexes.

Table A.4: Average maths and science scale scores of Egypt and some selected countries

COUNTRY	*N of students*	*Maths (Mean)*	*(s.e.)*	*COUNTRY*	*N of students*	*Science (Mean)*	*(s.e.)*
Japan	4312	569.81	(2.41)	**Japan**	5524	553.82	(1.9)
England	4025	513.4	(4.82)	**England**	4048	541.5	(4.48)
United States	7377	508.45	(2.83)	**United States**	7593	519.99	(2.86)
Spain (Basque country)	2296	498.56	(2.99)	**Spain (Basque Country)**	2323	497.71	(2.96)
Italy	4408	479.63	(3.04)	**Italy**	4408	495.15	(2.82)
Malaysia	4466	473.89	(5.03)	**United Arab Emirates (Dubai)**	3315	488.87	(2.76)
Norway	4627	469.22	(1.98)	**Norway**	4743	486.76	(2.19)
Israel	3294	463.25	(3.95)	**Jordan**	5251	481.72	(3.96)
United Arab Emirates (Dubai)	3195	460.62	(2.37)	**Malaysia**	4466	470.8	(6.03)
Lebanon	3786	449.06	(3.98)	**Israel**	3416	467.87	(4.34)
Turkey	4498	431.81	(4.75)	**Bahrain**	4247	467.45	(1.72)
Jordan	5251	426.89	(4.12)	**Iran**	3981	458.93	(3.59)
Tunisia	4080	420.41	(2.43)	**Turkey**	4498	454.16	(3.71)
Iran, Islamic Republic of	3981	403.38	(4.12)	**Syria, Arab Republic of**	4770	451.98	(2.89)
Bahrain	4230	398.07	(1.57)	**Tunisia**	4080	444.9	(2.12)
Indonesia	4203	397.11	(3.81)	**Indonesia**	4203	426.99	(3.37)
Syria, Arab Republic of	4650	394.84	(3.76)	**Oman**	4752	422.5	(2.96)
Egypt	6582	390.56	(3.57)	**Kuwait**	4091	417.96	(2.82)
Algeria	5447	386.75	(2.14)	**Lebanon**	3786	413.61	(5.93)
Morocco	3060	380.78	(2.97)	**Egypt**	6582	408.24	(3.56)
Oman	4752	372.43	(3.37)	**Algeria**	5447	408.06	(1.74)
Palestinian National Authority	4378	367.15	(3.55)	**Palestinian National Authority**	4378	404.13	(3.5)
Botswana	4208	363.54	(2.27)	**Saudi Arabia**	4269	403.25	(2.45)
Kuwait	4091	353.67	(2.32)	**Morocco**	3079	401.83	(2.9)
Saudi Arabia	4243	329.34	(2.85)	**Botswana**	4208	354.53	(3.05)
Ghana	5294	309.37	(4.36)	**Qatar**	7377	318.85	(1.73)
Qatar	7184	306.79	(1.37)	**Ghana**	5508	303.27	(5.36)

Table A.5: T-test of gender differences in test scores for TIMSS in Egypt

		Maths			Science		
Group	**Obs.**	**Mean**	**Std. Err.**	**Std. Dev.**	**Mean**	**Std. Err.**	**Std. Dev.**
				2007			
Girls	3258	397.26	1.71	97.86	416.80	1.70	96.95
Boys	3324	383.98	1.77	102.12	399.86	1.75	101.02
diff		13.27	2.50		16.94	2.44	
t-stats		**5.38**			**6.94**		
				2003			
Girls	3118	406.32	1.60	89.14	421.62	1.79	99.74
Boys	3534	405.50	1.60	94.93	420.54	1.79	106.65
diff		0.83	2.27		1.08	2.54	
t-stats		**0.36**			**0.42**		
				2003 vs. 2007			
2003	6652	405.89	1.13	92.26	421.05	1.27	103.46
2007	6582	390.56	1.25	101.80	408.25	1.22	99.38
diff		15.33	1.69		12.80	1.76	
t-stats		**9.077**			**7.26**		

Table A.6: Percentage of students at each benchmark by gender

		Maths		Science	
	Performance group	**N of cases**	**Percent**	**N of cases**	**Percent**
Girls	Below 400	1389	50	1182	42
	From 400 to 475	922	27	964	29
	From 475 to 550	673	17	766	21
	From 550 to 625	243	5	314	8
	Above 625	31	1	31	1
Boys	Below 400	1616	56	1447	49
	From 400 to 475	827	25	891	26
	From 475 to 550	605	15	679	18
	From 550 to 625	232	4	269	6
	Above 625	45	1	38	1
Total	Below 400	3005	53	2629	45
	From 400 to 475	1748	26	1855	28
	From 475 to 550	1278	16	1445	19
	From 550 to 625	475	5	584	7
	Above 625	76	1	69	1

Table A.7: Teachers age, percentages of students and average scores

Age of teacher	Maths				Science			
	Freq.	Percent	mean	se	Freq.	Percent	Mean	se
under 25	84	1.82	327.8	26.09	104	1.9	410.43	10.41
25 to 29	444	7.87	358.23	17.38	974	18.35	406.34	7.92
30 to 39	2989	52.35	391.28	5.61	2573	39.16	397.66	6.85
40 to 49	2116	33.83	396.13	6.21	2718	38.34	418.4	5.74
50 to 59	321	4.05	432.12	16.01	67	2.25	409.96	29.12
60 or older	38	0.07	533.06	5.18				

Table A.8: Teachers job satisfaction, by average test scores and students percentages

Job satisfaction	Maths				science			
	Freq.	Percent	mean	se	Freq.	Percent	mean	se
very high	1787	25.18	394.53	7.15	1758	25.7	422.84	6.36
high	2099	33.53	394.66	6.58	2606	40.19	408.87	5.46
medium	2165	34.67	388.06	6.5	1753	29.02	396.15	8.65
low	331	4.35	372.35	20	236	3.06	389.65	19.64
very low	105	2.27	357.84	34.19	125	2.02	391.16	26.92

Table A.9: Class size, percentages of students and average test scores

Class size	Maths				science			
	Freq.	Percent	mean	se	Freq.	Percent	mean	se
1 to 24	328	4.02	410.04	12.8	273	3.98	419.52	13.63
25 to 40	3067	53.18	394.72	4.93	3007	53.21	411.37	5.2
41 or more	2981	42.8	386.05	5.59	3027	42.81	404.15	5.42

Table A.10: Percent of Economic Disadvantage Students and Maths scale scores in Egypt

Students economic background (% disadvantaged)	Maths				science			
	Freq.	Percent	mean	se	Freq.	Percent	mean	se
Below 10 %	1148	10.47	416.71	17.44	1148	10.47	430.39	15.93
11 to 25%	735	11.07	399.37	11.31	735	11.07	418.58	11.6
26 to 50%	1130	23.73	390.87	5.52	1130	23.73	410.55	6.17

More than 50%	2757	54.73	379.82	4.76	2757	54.73	397.93	4.77

Table A.11: Allocation of school sample in Egypt- eighth grade

Explicit Stratum	Total sampled schools	Ineligible Schools	Participating Schools			Non-Participating Sampled Schools
			Sampled Schools	1st Replacement	2st Replacement	
Public – Cairo	18	0	18	0	0	0
Public – Alexandria	22	0	22	0	0	0
Public – All other regions	120	0	119	1	0	0
Experimental Language	25	0	25	0	0	0
Free Private	2	0	2	0	0	0
Private	25	0	24	1	0	0
Private Language	25	4	21	0	0	0
Total	237	4	231	2	0	0

Source: TIMSS 2007 Technical Report, p 374.

Table A.12: Estimated effect of computer usage four categories (maths)

VARIABLES	b	se
Pc both at home and at school	-30.13***	(6.13)
Pc at home but not at school	-31.44***	(5.95)
Pc at school but not at home	-24.57***	(5.67)
Pc only at other places	-4.71	(6.78)
Lower-sec EDC	7.64	(5.97)
Upper-sec	23.65***	(6.51)
Post-sec not UNI	34.80***	(6.99)
University degree	4.02	(6.86)
Natives	48.48***	(5.28)
One bookcases	10.68**	(4.36)
Two bookcases	2.14	(6.37)
Home possess H	61.15***	(5.43)
Home possess M	41.58***	(4.80)
Boy student	-10.08*	(5.44)
TL spoken ALs	-20.27***	(3.77)
Male teacher	1.88	(7.59)
T. Experience	1.02***	(0.36)
T. Certificate	8.45	(9.48)
M SCL RCS	-5.07	(7.13)
L SCL RSC	-22.72	(14.23)
T. UNI Degree	0.29	(21.28)
COMMU.>50000	10.77	(6.72)
Pov 50% Disadv	-9.34	(5.93)
Class size	-0.71	(1.35)
Class size Sqr	0.00	(0.02)
Constant	352.23***	(32.43)

Table A.13: Family, School Background and Performance differences between boys and girls

DV: Test scores	Maths	n (6582)	R^2 .243		Science	n (6582)	R^2 .243	
Variables	*B*	*se*	*Interaction for a boy*		*b*	*Se*	*Interaction for a boy*	
Mother education level								
No or not finished elementary	11.44	(9.9)	-9.59	(12.41)	10.03	(9.88)	-9.75	(12.32)
Elementary/middle school	13.92*	(7.85)	-18.19**	(8.57)	13.39*	(7.68)	-18.02**	(8.38)
Secondary school	28.24***	(9.7)	-10.64	(11.51)	28.79***	(9.45)	-12.95	(11.24)
2 years of post-secondary school	25.88***	(9.42)	-2.60	(12.31)	26.79***	(9.55)	-4.81	(12.55)
Father education level								
No or not finished elementary	-8.19	(9.220	-5.92	(13.67)	-9.40	(9.27)	-4.33	(13.93)
Elementary/middle school	-2.62	(9.32)	9.82	(10.32)	-3.04	(9.04)	10.74	(10)
Secondary school	5.37	(9.28)	18.73	(13.25)	5.28	(8.93)	20.20	(13.02)
2 years of post-secondary school	24.87***	(9.19)	-2.91	(9.67)	24.76***	(8.89)	-2.24	(9.86)
Both parents Egyptian=1	39.87***	(7.35)	16.35**	(8.17)	39.18***	(7.65)	16.20**	(8.08)
No of books at your home								
One bookcase	8.17	(5.97)	6.31	(8.6)	6.32	(6.02)	7.45	(8.69)
Two bookcases or more	-1.60	(7.57)	2.71	(11.16)	-1.01	(7.73)	3.54	(11.23)
Home possession index								
High	33.41***	(7.65)	3.19	(10.59)	35.05***	(7.34)	-0.21	(10.21)
Medium	19.18***	(4.25)	-1.63	(7.83)	19.06***	(4.1)	-1.31	(7.63)
Student gender (male =1)	-10.80	(35.7)	-		-36.97	(38.11)	-	
Test Language spoken at home (always=1)	-26.52***	(4.67)	16.381**	(6.84)	-28.61***	(5.17)	20.30***	(7.2)
Computer use								
Both at home and school	-24.85***	(8.82)	5.88	(11.72)	-23.11***	(8.35)	2.33	(11.09)
Either home or school	-23.83***	(6.37)	2.67	(8.16)	-22.17***	(6.02)	0.19	(8.02)
PlayStation or similar games yes = 1	-13.99***	(4.79)	-10.686*	(6.49)	-13.38**	(5.24)	-10.56	(6.97)
Test language (Arabic=1)	-39.88*	(23.29)	-10.60	(26.46)	-35.12**	(17.19)	-15.01	(20.02)
Teacher characteristics and school resources								
Teacher gender (male = 1)	-2.77	(8.14)	7.67	(10.24)	1.81	(8.66)	-7.48	(10.97)
Teacher years of experience	1.03**	(0.42)	0.00	(0.6)	-0.37	(0.61)	-0.17	(0.79)
Teaching certificate	7.40	(10.73)	-3.29	(11.01)	8.31	(9.12)	-13.19	(10.75)
Availability of school resources								
Medium	10.56	(9.82)	-22.270**	(10.87)	12.24	(10.44)	-25.63**	(11.91)
Low	-20.38	(21.71)	2.13	(24.3)	-38.24	(25.77)	27.14	(28.64)
Teacher formal education								
University	-0.47	(20.23)	-13.00	(20.84)	-34.46**	(14.02)	39.99*	(20.68)
Postgraduate studies	-22.14	(24.71)	10.02	(26.62)	-59.91***	(16.32)	75.79***	(28.76)
Type of community (> 50000 people = 1)	6.22	(7.9)	4.77	(9.65)	8.38	(8.16)	7.31	(9.87)
% disadvantaged std (>50%=1)	-17.71**	(8.71)	19.42*	(10.74)	-18.35**	(8.96)	17.99	(11.94)
Class size (more than 41 =1)	-8.45	(7.51)	5.24	(12.23)	-4.65	(8.1)	-5.09	(10.78)
Constant			413.60***	(36.12)			458.69***	(26.71)
Controls for missing included			Yes				Yes	

TIMSS Sampling weights employed, Jackknife standard errors in parentheses, Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data is from TIMSS 2007 for Egypt. Omitted categories are: university degree or higher, foreigners, no or few books, low home possessions, girl, not always, other or none, no, English, female, no, high resources, not university, less than 50000, less than 50%, less than41 .

Table A.14: Population (10 years & over), by educational status & sex in Egypt, results of 2006 pop. Census (percentage)

	Illiterate	Read & write	Illiteracy	Below intermediate	Intermediate	Above intermediate	University degree	Above university degree	NA
Male	22.34	13.41	1.21	20.84	28.18	2.82	10.8	0.32	0.08
Female	37.26	10.45	0.72	17.95	23.31	2.23	7.85	0.02	0.08
Total	29.64	11.96	0.97	19.42	25.8	2.53	9.35	0.24	0.08

Source: Central Agency for Public Mobilization and Statistics (CAPMAS), 2006 Census. (NA: Not Available)

Table A.15: Estimates of Parents' Education Interaction with Home Possession (high)

	Maths				Science			
	(1) mother interaction		(2) father interaction		(3) mother interaction		(4) father interaction	
Mother EDC								
Elementary/middle SCL	-2.215	(5.066)			-1.350	(5.362)		
Secondary school	14.579**	(6.611)			16.194**	(6.872)		
Post secondary SCL	17.644**	(7.050)			19.620***	(7.566)		
Uni or PG	-12.510*	(7.352)			-10.958	(7.800)		
Father EDC								
Elementary/middle SCL			14.647**	(6.614)			14.669**	(6.663)
Secondary school			27.269***	(5.787)			27.523***	(5.918)
Post secondary not uni			37.048***	(5.471)			37.146***	(5.842)
Uni or PG			4.561	(7.269)			4.648	(7.264)
HPI (high) X Elementary	-9.908	(13.140)	-19.827	(16.451)	-9.466	(13.483)	-18.173	(16.545)
HPI (high) X Secondary	3.231	(12.699)	-11.107	(15.701)	2.487	(13.671)	-10.354	(16.357)
HPI (high) X Post sec	1.895	(10.186)	-9.591	(11.779)	2.615	(10.356)	-7.077	(11.945)
HPI (high) X Uni/PG	24.856*	(12.806)	21.991**	(10.961)	25.623**	(13.031)	22.143*	(11.336)
Home Possessions (high)	32.078***	(7.305)	38.098***	(8.635)	32.655***	(7.762)	37.822***	(9.172)
Constant	398.338***	(28.701)	397.594***	(28.879)	434.905***	(23.174)	433.858***	(23.461)
Other variables and controls for missing	Yes		Yes		Yes		Yes	

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

Table A.16: Estimates of Parents' Education Interaction with High Parental Support (PS)

	Maths				Science			
	(1)model with PS		(2) Interaction of father education X PS		(3) model with PS		(4) Interaction of father education X PS	
Mother education								
Elementary/middle Scl	-2.60	(5.06)			-2.21	(5.46)		
Secondary school	14.40**	(6.31)			15.79**	(6.42)		
Post-secondary Scl	16.57**	(6.67)			17.22**	(7.40)		
Uni or PG	-7.69	(6.83)			-5.99	(7.26)		
Father Education								
Elementary/middle Scl	13.75**	(6.57)	13.318**	(6.599)	12.80*	(6.67)	12.989*	(6.949)
Secondary Scl	26.23***	(6.01)	24.767***	(6.687)	25.22***	(6.11)	26.981***	(6.700)
Post-secondary school	35.21***	(5.51)	37.733***	(5.614)	34.48***	(5.79)	38.392***	(6.711)
Uni or PG	10.23	(6.58)	4.975	(7.102)	9.02	(6.67)	2.354	(8.291)
PS (high)	26.66***	(8.72)	23.338**	(11.072)	31.34***	(8.64)	32.202***	(10.009)
PS (Medium)	8.52	(6.54)	8.587	(6.547)	14.95*	(7.94)	14.699*	(7.951)
PS (high) X Elementary			2.861	(10.541)			-0.864	(10.369)
PS (high) X Secondary			10.547	(13.229)			-6.738	(12.408)
PS (high) X Post sec			-11.008	(10.544)			-11.715	(9.852)
PS (high) X Uni or PG			27.225**	(12.395)			19.253*	(10.747)
Constant	366.59***	(26.64)	367.602***	(27.322)	406.17***	(26.56)	405.745***	(26.099)
Other variables and controls for missing	yes		yes		yes		yes	

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

Table A.17: Interaction of Parents' highest level Education and computer use PC (both at home and school)

	Maths		Science	
Parents highest level of EDC	*b*	*se*	*b*	*se*
lower-secondary	11.637*	(6.183)	7.436	(5.160)
upper-secondary	29.164***	(6.861)	23.400***	(5.548)
post-secondary not uni	35.791***	(7.140)	29.443***	(7.231)
university degree	-3.632	(7.240)	-11.099*	(6.112)
Lower SEC X PC	-1.938	(11.445)	-1.298	(11.666)
Upper SEC X PC	7.446	(11.867)	1.603	(11.031)
Post SEC X PC	20.969*	(11.072)	23.176*	(11.888)
Uni X PC	39.162***	(11.774)	33.125***	(10.609)
PC home and SCL	-34.105***	(8.368)	-42.187***	(10.454)
PC home or SCL	-21.435***	(4.160)	-25.176***	(4.422)
Constant	399.747***	(28.788)	437.151***	(24.375)
Other variables and controls for missing	Yes		Yes	

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt

Table A.18: Estimates of Family, Student and Schools on Test scores and fixed effect estimates (Maths)

DV : Test scores (5 plausible values)	(1)		(2)		(3)	
	OLS no school controls		**OLS school controls**		**School Fixed Effects**	
Family and student background	*b*	*se*	*b*	*se*	*b*	*se*
Mother education level						
Elementary/middle school	-1.355	(5.068)	-3.036	*(5.101)*	-1.383	(4.668)
Secondary school	18.809***	(5.936)	14.987**	*(6.216)*	8.361	(6.027)
2 years of post secondary school	25.365***	(6.791)	17.584***	*(6.703)*	7.411	(6.473)
University degree or higher	0.114	(7.085)	-6.723	*(6.918)*	-12.367*	(6.480)
Father education level						
Elementary/middle school	15.136**	(6.591)	13.683**	*(6.561)*	9.278	(7.053)
Secondary school	28.509***	(6.107)	26.310***	*(6.012)*	19.981***	(6.263)
2 years of post secondary school	41.145***	(5.475)	35.144***	*(5.403)*	27.290***	(5.720)
University degree or higher	15.773**	(6.552)	10.611	*(6.631)*	4.950	(6.043)
Both parents Egyptian	49.557***	(5.348)	49.427***	*(5.106)*	46.604***	(3.843)
Books at home (one bookcase)	9.737**	(4.440)	11.126***	*(4.313)*	7.670*	(4.089)
Books at home (two bookcases or more)	0.275	(6.501)	0.850	*(6.280)*	3.460	(4.015)
Home possessions index						
High	47.605***	(4.728)	34.731***	*(4.372)*	22.391***	(4.175)
Medium	22.654***	(3.836)	18.558***	*(3.532)*	12.360***	(3.219)
student gender (male =1)	-10.569*	(5.393)	-9.342*	*(5.422)*	2.758	(4.998)
Testing lang. spoken at home (always=1)	-19.586***	(3.905)	-17.994***	*(3.721)*	-12.428***	(3.780)
Computer use						
Both at home and school	-21.085***	(5.183)	-21.879***	*(4.965)*	-20.010***	(4.500)
Either home or school	-22.008***	(4.301)	-21.822***	*(4.233)*	-18.025***	(3.962)
PlayStation (yes = 1)	-19.289***	(3.192)	-19.533***	*(3.073)*	-17.746***	(3.238)
Teacher characteristics and school resources						
Test language (Arabic=1)			-40.758***	*(12.087)*		
Teacher gender (male = 1)			-0.642	*(7.657)*		
Teacher years of experience			1.065***	*(0.388)*		
Teaching certificate			8.057	*(9.587)*		
Medium school resources			-3.214	*(7.580)*		
Low school resources			-19.639	*(13.745)*		
Teacher formal EDC (university=1)			-5.361	*(23.189)*		
Teacher formal EDC(PG=1)			-13.253	*(24.771)*		
Type of community (> 50000 = 1)			9.816	*(6.513)*		
% of disadvantaged std (> 50%=1)			-7.040	*(6.254)*		
Class size (more than 41 =1)			-4.920	*(6.393)*		
Constant	365.975***	(8.602)	400.594***	*(28.554)*	371.562***	(7.239)
Missing obs. Controls	*Yes*		*Yes*		*Yes*	
Adjusted- r square	.2124		*.2422*		*.3889*	
N	*6582*		*6582*		*6582*	
(4) The Null Model					*Maths*	
Only School Dummies Included					R^2.2972	
N					*6582*	

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

Table A.19: Estimates of Family, Student and Schools on Test scores and fixed effect estimates (Science)

DV : Test scores (5 plausible values)	(1)		(2)		(3)	
	OLS no school controls		**OLS school controls**		**School Fixed Effects**	
Family and student background	b	se	b	se	b	se
Mother education level						
Elementary/middle school	-0.000	(4.690)	-1.276	(4.868)	-0.563	(4.271)
Secondary school	19.525***	(5.220)	16.464***	(5.510)	8.388*	(4.946)
2 years of post secondary school	22.429***	(6.837)	17.526**	(7.172)	5.346	(6.042)
University degree or higher	-5.148	(6.649)	-9.847	(6.582)	-17.149***	(5.475)
Father education level						
Elementary/middle school	12.985**	(5.422)	11.773**	(5.312)	7.781	(5.349)
Secondary school	23.775***	(5.614)	21.762***	(5.680)	15.582***	(5.127)
2 years of post secondary school	38.545***	(6.343)	33.667***	(6.584)	26.154***	(6.182)
University degree or higher	9.680	(6.780)	5.898	(6.699)	0.686	(6.230)
Both parents Egyptian	49.138***	(4.803)	47.361***	(5.071)	46.288***	(4.493)
Books at home (one bookcase)	12.326**	(4.904)	12.069**	(4.798)	9.800**	(4.646)
Books at home (two bookcases or more)	-1.239	(6.947)	-1.033	(6.761)	2.107	(4.641)
Home possessions index						
High	44.628***	(5.793)	35.658***	(5.997)	22.752***	(5.818)
Medium	21.734***	(4.326)	18.467***	(4.228)	12.181***	(4.276)
student gender (male =1)	-14.159***	(5.249)	-16.499***	(5.501)	3.502	(5.509)
Testing lang. spoken at home (always=1)	-18.339***	(3.926)	-16.935***	(4.165)	-11.424***	(3.845)
computer use						
Both at home and school	-30.885***	(6.687)	-31.587***	(6.537)	-29.546***	(6.342)
Either home or school	-26.122***	(4.572)	-25.630***	(4.457)	-21.953***	(4.610)
PlayStation (yes = 1)	-14.804***	(3.089)	-14.602***	(3.197)	-13.413***	(3.045)
Teacher characteristics and school resources						
Test language (Arabic=1)			-14.025	(12.033)		
Teacher gender (male = 1)			-2.516	(6.353)		
Teacher years of experience			-0.221	(0.521)		
Teaching certificate			0.740	(7.426)		
Medium school resources			-1.360	(8.648)		
Low school resources			-16.327	(17.100)		
Teacher formal EDC (university=1)			-13.289	(16.125)		
Teacher formal EDC(PG=1)			-22.468	(21.729)		
Type of community (> 50000 = 1)			13.031*	(7.234)		
% of disadvantaged std (> 50%=1)			-11.697**	(5.764)		
Class size (more than 41 =1)			-4.934	(6.546)		
Constant	390.212***	(7.869)	432.479***	(23.783)	392.628***	(6.520)
Missing obs. Controls	Yes		Yes		Yes	
Adjusted- r square	.2016		.2193		.3739	
N	6582		6582		6582	
(4) The Null Model					Science	
Only School Dummies Included					R^2 .2807	
N					6582	

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

Table A.20: Average test scores on student's home spoken language, parents' nationality, and test language

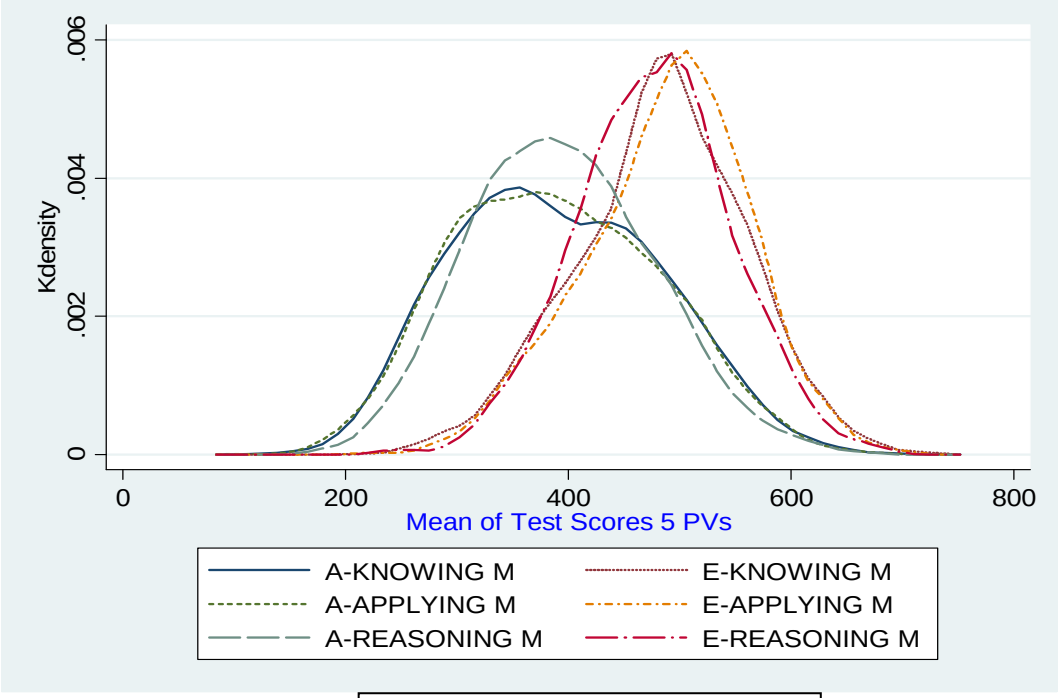
Home spoken lang.	Born in country	N	% total	Maths			Science		
				Mean	se	Std.dev	Mean	se	Std.dev
Always	Both parents	3274	52.06	396.25	3.78	95.21	414.25	3.89	93.72
3904 (62.08%)	Only one parent	441	7.01	341.32	9.07	89.75	357.89	7.9	90.4
	Neither parent	189	3.01	331.51	8.03	79.27	355.01	7.22	78.22
Almost always	Both parents	945	15.03	433.98	5.01	100.07	448.08	5.19	100.79
1109 (17.63%)	Only one parent	129	2.05	372.2	12.37	101.34	387.84	13.46	98.75
	Neither parent	35	0.56	340.62	22.29	91.07	361.03	24.16	85.4
Sometimes	Both parents	838	13.32	417.12	6.54	96.65	435.16	6.41	97.79
992(15.77%)	Only one parent	118	1.88	358.14	14.85	97.69	374.89	13.61	95.88
	Neither parent	36	0.57	389.94	22.31	90.46	400.01	19.86	92.47
Never	Both parents	227	3.61	410.41	10.75	101.82	424.35	12.29	99.02
284 (4.52%)	Only one parent	43	0.68	332.9	23.32	98.43	357.03	33.48	100.77
	Neither parent	14	0.22	311.25	41.2	87.99	344.93	45.3	78.03

Table A.21: Interaction of test language and Home Possession Index

Dependant Variable : students' Maths Test Scores (5 Plausible Values)	Maths		Science	
Family and student background	*b*	*se*	*b*	*se*
ARABIC TEST LANGUAGE	-86.533***	(29.436)	-86.086***	(25.488)
High Home possess	-19.975	(23.585)	-17.834	(21.974)
Medium Home possess	-15.459	(20.233)	-16.675	(21.378)
Arabic X High possessions	56.487**	(24.506)	55.145**	(23.088)
Arabic X Medium possessions	33.893	(20.757)	35.638	(21.962)
Other variables and Controls for missing included	yes		yes	

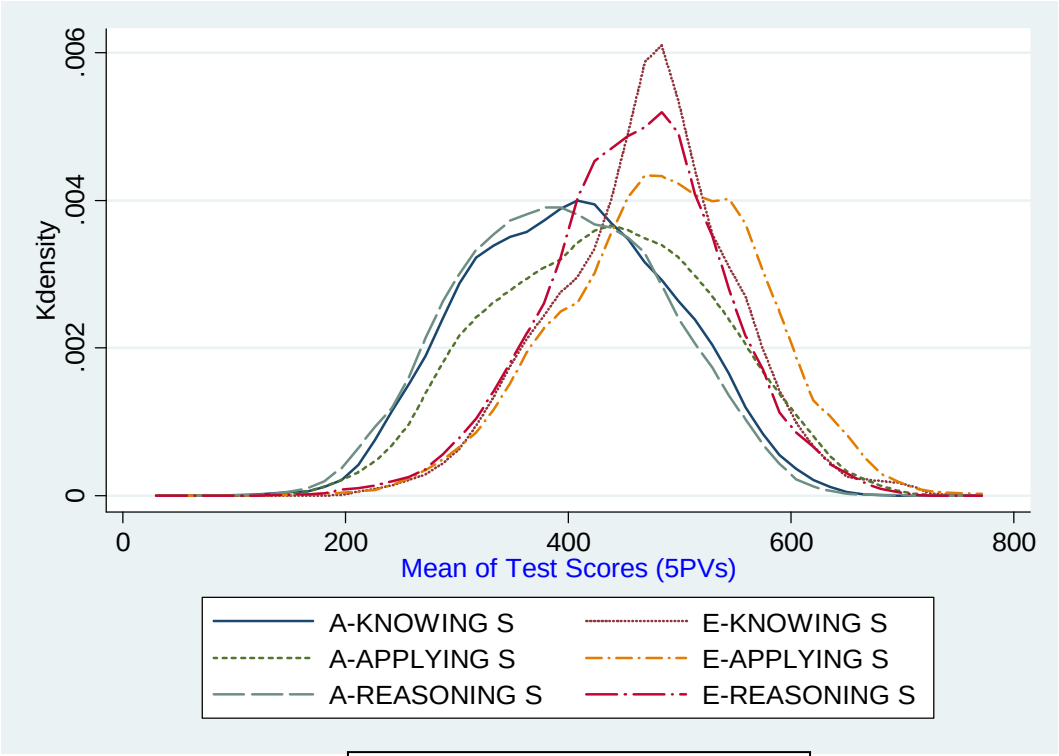
Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

Figure A.1: Distribution of students test scores for Maths cognitive domain by test language



(A: Arabic and E: English)

Figure A.2: Distribution of students test scores for Science cognitive domain by test language



(A: Arabic and E: English)

Table A.22: Family, School Background (TEST LANGUAGE) and test scores

Dependant Variable : Test Scores (5 Plausible Values)								
	Maths	Science	Knowing		Applying		Reasoning	
			Maths	Science	Maths	Science	Maths	Science
Family controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arabic Test language	-40.758*** (12.087)	-14.025 (12.033)	-43.656*** (12.714)	-18.952* (11.475)	-45.696*** (14.384)	0.664 (13.945)	-33.211*** (12.761)	-22.120* (12.857)
School controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Missing O. controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	400.594*** (28.554)	432.479*** (23.783)	402.050*** (28.965)	433.873*** (24.913)	412.824*** (34.570)	446.340*** (26.752)	401.147*** (24.418)	426.953*** (21.786)

Jackknife standard errors in parentheses, Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007

Table A.23: Parental support and student's motivation

DV : Test scores(PVs)	Maths		Science	
	b	*se*	*b*	*se*
Level of parental support				
High/very high	25.507***	(8.808)	31.124***	(8.096)
Medium	8.673	(6.489)	14.819*	(7.817)
Low/very low (omitted)				
Student's expectation of education level				
University or higher	24.026***	(3.689)	23.305***	(3.788)
Below university (omitted)				
Other controls included	Yes		Yes	
Controls for missing observations	Yes		Yes	
Constant	358.239***	(28.431)	389.339***	(25.768)

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

Table A.24: Parental involvement and teachers pedagogical autonomy effects on test scores

DV : Test scores(PVs)	Maths		Science	
Parental involvement	*b*	*se*	*b*	*se*
Medium	-24.912**	(11.175)	0.184	(9.967)
Low	-29.535***	(11.143)	-13.515	(10.229)
Very low	-40.689***	(11.953)	-17.992*	(10.814)
High/very high (omitted)	-	-	-	-
Autonomy (yes = 1)	-0.047	(7.810)	-3.620	(8.022)
Other controls included	Yes		Yes	
Controls for missing observations	Yes		Yes	
Constant	402.779***	(20.225)	440.996***	(23.411)

Significance levels: * p<0.10, ** p<0.05, *** p<0.01. Data are from TIMSS 2007 for Egypt.

Table A.25: Estimates across different schools for maths test scores

DV: maths test scores	All schools		Mixed schools		single-sex schools	
VARIABLES	b	se	b	se	b	se
Lower-sec EDC	7.60	(5.92)	4.29	(10.73)	5.83	(6.84)
Upper-sec	23.48***	(6.42)	24.92*	(14.96)	18.57**	(7.59)
Post-sec not UNI	33.29***	(6.99)	32.84**	(15.25)	28.65***	(7.51)
University degree	1.31	(6.82)	-0.46	(14.23)	-1.66	(7.30)
Natives	48.65***	(5.19)	60.87***	(9.09)	45.79***	(4.90)
One bookcases	10.29**	(4.33)	8.02	(9.23)	10.10**	(3.96)
Two bookcases	1.95	(6.23)	-0.46	(12.28)	6.01	(6.33)
Home possess H	56.66***	(5.20)	43.55***	(12.88)	54.79***	(5.68)
Home possess M	41.17***	(4.79)	37.27***	(7.44)	38.15***	(5.45)
Boy student	-9.87*	(5.42)	4.59	(5.34)	-17.50**	(7.93)
Test language Arabic	-42.83***	(11.32)	-18.29	(20.86)	-53.33***	(16.05)
TL spoken ALs	-18.94***	(3.79)	-16.09***	(5.78)	-17.75***	(4.54)
PC at H&SCL	-26.33***	(5.08)	-17.60*	(10.68)	-28.51***	(5.20)
PC at H/SCL	-23.69***	(4.24)	-16.39*	(9.04)	-25.08***	(4.53)
Male teacher	1.27	(7.59)	7.69	(20.35)	-2.58	(7.04)
T. Experience	0.98***	(0.36)	-0.08	(1.79)	1.20**	(0.54)
T. Certificate	7.22	(9.47)	21.12	(12.95)	-1.57	(11.96)
M SCL RCS	-2.63	(7.26)	1.53	(30.60)	-7.57	(7.26)
L SCL RSC	-19.55	(13.85)	-27.44	(32.53)	-1.81	(13.00)
T. UNI Degree	0.14	(20.69)	-9.07	(70.88)	20.00	(22.90)
COMMU.>50000	10.06	(6.61)	23.82	(31.13)	7.60	(6.51)
Pov 50% Disadv	-8.18	(5.85)	-4.15	(20.95)	-12.94**	(6.28)
Class size	-0.62	(1.33)	-3.71	(4.96)	0.28	(1.58)
Class size Sqr	0.00	(0.02)	0.03	(0.07)	-0.00	(0.02)
Constant	390.94***	(32.89)	416.09***	(97.81)	382.77***	(42.38)
Observations	6582		2084		4498	

Note: Jackknife Standard errors in parenthesis & (*** p<0.01, ** p<0.05, * p<0.1)

Table A.26: Effects of Attending Single-Sex vs. Co-education Schools for Boys and Girls (maths)

DV: maths test scores	Boys' schools		Boys in mixed schools		Girls' schools		Girls in mixed schools	
Average maths scores	385		382		408		376	
VARIABLES	b	se	b	se	b	se	b	se
Lower-sec EDC	5.88	(9.87)	10.29	(14.88)	5.41	(7.92)	-0.55	(12.75)
Upper-sec	28.25**	(11.27)	35.96**	(14.08)	8.74	(8.28)	16.74	(20.61)
Post-sec not UNI	33.75***	(10.49)	32.66*	(17.56)	22.71**	(8.83)	36.88*	(19.95)
University degree	0.83	(10.72)	11.83	(14.13)	-3.19	(9.17)	-8.60	(20.77)
Natives	54.70***	(6.29)	63.28***	(8.52)	31.56***	(7.14)	54.88***	(14.07)
One bookcases	15.05**	(6.64)	11.56	(12.31)	7.84*	(4.50)	4.12	(15.61)
Two bookcases	6.74	(9.72)	4.42	(15.88)	3.10	(9.05)	-5.97	(18.12)
Home possess H	48.21***	(8.68)	41.10**	(16.18)	58.82***	(6.28)	44.57***	(16.40)
Home possess M	31.82***	(7.84)	30.76**	(14.03)	42.60***	(6.29)	44.69***	(12.85)
Boy student	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Test language Arabic	-83.45**	(35.47)	-22.77	(23.85)	-65.82**	(26.46)	-15.10	(23.58)
TL spoken ALs	-12.19*	(6.79)	-6.70	(6.94)	-21.63***	(5.43)	-26.23**	(10.37)
PC at H&SCL	-32.63***	(7.03)	-10.05	(15.23)	-21.83**	(9.37)	-27.76*	(16.63)
PC at H/SCL	-29.38***	(6.16)	-8.50	(12.95)	-18.77***	(7.14)	-25.08*	(13.35)
Male teacher	4.23	(10.28)	9.66	(25.04)	-6.39	(8.98)	4.29	(18.80)
T. Experience	1.97***	(0.73)	-0.18	(2.07)	0.40	(0.45)	0.36	(1.76)
T. Certificate	-6.19	(16.50)	32.33*	(16.58)	-26.17**	(12.68)	7.63	(16.06)
M SCL RCS	-18.68**	(7.89)	-0.23	(33.89)	14.17	(12.52)	7.44	(29.18)
L SCL RSC	12.05	(25.69)	-35.98	(32.63)	13.10	(37.81)	-15.51	(43.52)
T. UNI Degree	0.00	(75.17)	0.00	(164.6)	44.41**	(20.30)	-46.09	(140.17)
COMMU.>50000	14.57	(10.12)	21.08	(36.48)	2.24	(8.36)	24.06	(28.15)
Pov 50% Disadv	-1.25	(9.29)	-6.55	(27.76)	-31.17***	(11.54)	-1.60	(18.33)
Class size	2.11	(2.92)	-5.71	(5.37)	-2.42	(5.45)	-1.18	(7.85)
Class size Sqr	-0.04	(0.05)	0.07	(0.09)	0.03	(0.07)	-0.01	(0.11)
Constant	370.65***	(107.48)	412.86***	(160.0)	464.89***	(112.71)	442.89**	(193.41)
Observations	2237		1087		2261		997	

Note: Jackknife Standard errors in parenthesis & (*** p<0.01, ** p<0.05, * p<0.1)

Table A.27: Differences across schools for science test scores

DV: science test scores	All schools		Mixed schools		single-sex schools	
VARIABLES	b	se	b	se	b	se
Lower-sec EDC	6.24	(4.91)	1.30	(7.84)	5.61	(5.90)
Upper-sec	21.33***	(5.40)	17.81	(11.43)	19.00***	(6.80)
Post-sec not UNI	33.24***	(6.43)	27.23*	(14.78)	32.72***	(6.64)
University degree	-4.47	(5.71)	-9.52	(12.99)	-5.04	(6.57)
Natives	48.49***	(5.21)	61.33***	(9.04)	42.23***	(5.29)
One bookcases	12.96***	(4.77)	11.81	(9.66)	13.15***	(4.51)
Two bookcases	0.53	(6.69)	-3.64	(14.41)	2.26	(6.75)
Home possess H	32.36***	(5.59)	33.72***	(12.42)	29.46***	(6.09)
Home possess M	16.21***	(4.04)	6.70	(8.67)	18.88***	(4.15)
Boy student	-16.21***	(5.75)	6.06	(5.61)	-26.32***	(7.97)
Test language Arabic	-16.21	(12.33)	-8.66	(19.31)	-32.84*	(17.08)
TL spoken ALs	-17.47***	(4.22)	-12.81	(8.59)	-16.38***	(4.69)
PC at H&SCL	-32.59***	(6.62)	-24.94**	(11.37)	-32.56***	(6.89)
PC at H/SCL	-25.94***	(4.52)	-16.84*	(8.90)	-25.83***	(4.68)
Male teacher	-1.40	(6.44)	8.83	(15.13)	-3.96	(6.51)
T. Experience	-0.14	(0.55)	-1.37	(1.05)	0.38	(0.71)
T. Certificate	1.17	(7.34)	-2.68	(14.77)	7.05	(8.83)
M SCL RCS	-2.53	(9.54)	-3.31	(38.91)	0.86	(10.56)
L SCL RSC	-19.69	(17.25)	-47.17	(36.28)	-1.70	(22.26)
T. UNI Degree	-11.82	(16.17)	-35.05	(33.77)	-4.83	(20.08)
COMMU.>50000	13.40*	(7.71)	14.67	(22.69)	11.02	(8.32)
Pov 50% Disadv	-13.14**	(5.84)	-13.63	(17.79)	-17.04***	(6.42)
Class size	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Class size Sqr	-1.18	(1.36)	-2.49	(3.40)	-0.54	(1.63)
Constant	438.45***	(25.67)	448.04***	(43.47)	444.19***	(27.72)
Observations	6582		2084		4498	

Note: Jackknife Standard errors in parenthesis & (*** p<0.01, ** p<0.05, * p<0.1)

Table A-0.28: Effects of Attending Single-Sex vs. Co-education Schools for Boys and Girls (science)

DV: science test scores	Boys' schools		Boys in mixed schools		Girls' schools		Girls in mixed schools	
Average science scores	400		399		428		393	
VARIABLES	B	se	b	se	B	se	b	se
Lower-sec EDC	7.95	(7.40)	4.05	(11.85)	-0.19	(8.32)	0.87	(11.07)
Upper-sec	27.65***	(8.70)	29.09*	(15.58)	5.25	(9.73)	13.90	(15.83)
Post-sec not UNI	37.19***	(9.54)	27.46	(19.28)	23.19**	(9.81)	26.90*	(15.92)
University degree	-2.48	(10.37)	2.37	(15.05)	-10.46	(9.50)	-17.15	(19.02)
Natives	51.25***	(6.42)	64.51***	(8.37)	33.39***	(8.66)	54.03***	(13.15)
One bookcases	14.59**	(6.87)	16.52	(10.60)	13.03**	(5.93)	8.72	(14.54)
Two bookcases	2.68	(10.17)	-1.89	(18.93)	4.02	(9.04)	-12.79	(17.99)
Home possess H	26.91***	(7.51)	32.87*	(19.87)	31.79***	(8.48)	34.07**	(15.93)
Home possess M	18.19***	(5.68)	3.02	(13.16)	18.28***	(5.59)	9.03	(9.38)
Boy student	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Test language Arabic	-58.78	(38.72)	-13.57	(23.42)	-41.47	(28.93)	-4.90	(20.64)
TL spoken ALs	-10.74	(7.54)	1.27	(8.99)	-21.15***	(5.40)	-26.64**	(11.92)
PC at H&SCL	-39.24***	(8.54)	-13.98	(17.85)	-23.27**	(10.44)	-36.63**	(15.48)
PC at H/SCL	-31.80***	(6.51)	-8.39	(15.12)	-19.63**	(8.03)	-21.98**	(10.14)
Male teacher	-9.96	(9.99)	6.51	(19.35)	-4.34	(11.10)	10.49	(13.55)
T. Experience	-0.86	(1.00)	-0.86	(1.33)	0.78	(0.87)	-1.73	(1.06)
T. Certificate	1.23	(14.23)	-7.68	(15.47)	9.24	(13.04)	1.28	(15.39)
M SCL RCS	-24.34**	(11.48)	1.71	(46.67)	25.49	(15.77)	-5.75	(31.96)
L SCL RSC	10.92	(32.28)	-44.32	(37.12)	11.34	(72.51)	-47.29	(38.47)
T. UNI Degree	-1.95	(33.27)	-48.48	(41.18)	-31.58	(19.34)	-33.02	(30.38)
COMMU.>50000	20.68*	(10.92)	13.79	(27.95)	4.08	(12.64)	14.54	(19.58)
Pov 50% Disadv	-10.16	(12.45)	-2.05	(24.46)	-33.70***	(8.97)	-23.83	(15.17)
Class size	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00	(0.00)
Class size Sqr	-2.11	(1.96)	-0.90	(3.77)	-0.54	(1.85)	-3.77	(3.33)
Constant	477.42***	(54.96)	425.59***	(55.92)	474.21***	(38.95)	483.09***	(50.45)
Observations	2237		1087		2261		997	

Note: Jackknife Standard errors in parenthesis & (*** p<0.01, ** p<0.05, * p<0.1)

Appendix B: Principal component for home possessions

In this appendix we explain how we adopted the student's home possession index using principal component factor. The TIMSS data do not provide a measure of income or expenditure for family or students; however students were asked if they have certain items at their home. The items were basically related to the learning purposes but in the meanwhile could be seen as a reflection of socio-economic status. Egyptian students were asked if they have calculator (bs4gth01), computer (bs4gth02), study desk (bs4gth03), dictionary (bs4gth04), internet connection (bs4gth05), TV (bs4gth06), satellite TV channels (bs4gth07) and Telephone (bs4gth08). We use this information to construct an index for home possessions using principal factor analysis.

```
. pca bs4gth01 bs4gth02 bs4gth03 bs4gth04 bs4gth05 bs4gth06 bs4gth07 bs4gth08 , comp(2)

Principal components/correlation                  Number of obs    =       5806
                                                  Number of comp.  =          2
                                                  Trace            =          8
    Rotation: (unrotated = principal)             Rho              =     0.4985
```

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	2.7373	1.48644	0.3422	0.3422
Comp2	1.25086	.450344	0.1564	0.4985
Comp3	.80052	.0319532	0.1001	0.5986
Comp4	.768566	.0505991	0.0961	0.6947
Comp5	.717967	.0598983	0.0897	0.7844
Comp6	.658069	.0681024	0.0823	0.8667
Comp7	.589967	.113224	0.0737	0.9404
Comp8	.476743	.	0.0596	1.0000

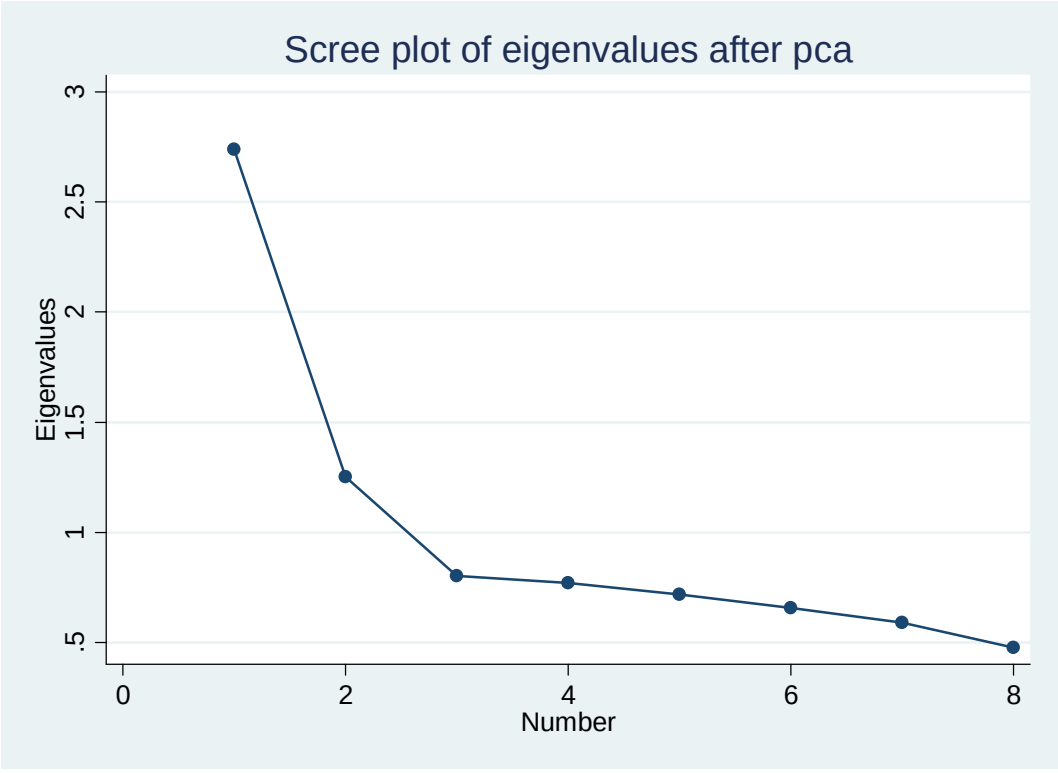
Principal components (eigenvectors)

Variable	Comp1	Comp2	Unexplained
bs4gth01	0.2871	0.3980	.5762
bs4gth02	0.3866	-0.4005	.3903
bs4gth03	0.3629	-0.0333	.6381
bs4gth04	0.3396	0.1862	.6409
bs4gth05	0.3736	-0.4950	.3114
bs4gth06	0.2878	0.5473	.3986
bs4gth07	0.3856	-0.2022	.5418
bs4gth08	0.3873	0.2447	.5144

Rotated components

Variable	Comp1	Comp2	Unexplained
bs4gth01	-0.0541	0.4878	.5762
bs4gth02	0.5554	-0.0377	.3903
bs4gth03	0.2914	0.2188	.6381
bs4gth04	0.1270	0.3659	.6409
bs4gth05	0.6091	-0.1165	.3114
bs4gth06	-0.1537	0.5990	.3986
bs4gth07	0.4216	0.1087	.5418
bs4gth08	0.1231	0.4413	.5144

Principal Component Analysis is a multivariate statistical technique used to reduce the number of variables in a data set from *n* correlated variables by creating uncorrelated indices or components. Each component is a linear weighted combination of the initial variables. The weights are given by eigenvectors of the correlation matrix or co-variance matrix if the data are standardized. The assets that more asymmetrically distributed among households are given more weights in PCA. The eigenvalue (variance) indicates the explained percentage of variation in the total data for each Principal component. A common method in PCA is to select the components which eigenvalue exceeds one. PCA could be used as a guidance to figure out the most influential variables among number of variables measuring wealth of households.



PCA indicates two factors with Eigen value greater than one. The choice might be to incorporate only one factor. The first factor has four variables explaining the most of its variations. The index could be chosen and include in the model as a continuous independent variable, though the interpretation of the estimates of this index would not be clear. Alternatively, the index might be categorized to indicate some reasonable meaning. Another approach is to use the PCA analysis to determine the main variable which then could be average together to give some indicator of the difference among the sample.

Scoring coefficients for orthogonal varimax rotation
sum of squares(column-loading) = 1

Variable	Comp1	Comp2
bs4gth01	-0.0541	0.4878
bs4gth02	0.5554	-0.0377
bs4gth03	0.2914	0.2188
bs4gth04	0.1270	0.3659
bs4gth05	0.6091	-0.1165
bs4gth06	-0.1537	0.5990
bs4gth07	0.4216	0.1087
bs4gth08	0.1231	0.4413

From the variable loading weights of factor one above, we can see that the main influential variables of the first factor are (2, 3, 5 and 7): computer, study desk, internet connection and satellite TV channels. We used the average of those variables to generate a three level index of home possessions. Besides including the chosen index other indexes have been tried out and it did not change the main findings. In the mean while the chosen index is more of representative to the important home possessions which reflect the socio-economic status of students' family and easy to interpret.