The Role of Teacher Gender on Students' Academic Performance

By Natasha Mulji

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Department of Economics

Thesis Supervisor: Jan Bietenbeck

Abstract

A prominent class of explanations for the gender gap in student performance focuses on the gender based interactions between students and teachers. This has led to a rise in discussions in education talks centred on controversial claims that teachers consistently privilege boys over girls.

In this study, I examine whether assignment to a same sex teacher influences student performance. The empirical analysis conducted in this paper uses data from the Trends in Mathematics and Science Study (TIMMS) whereby each student takes standardised tests in each subject. This provides comparable student achievement data in both Mathematics and Science for nationally representative students. In addition, data on the gender of both students and teachers, as well as the income level of the different areas in which each school is situated can be obtained from the dataset. Most importantly each student is observed twice, once in each subject, which allows this study to implement an identification strategy that includes student fixed effects.

I show that assignment to a same gender teacher improves student performances in low-income areas, but not in high-income areas.

Keywords: teacher gender, TIMMS, gender gap, student performance, student

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"*If we educate a boy, we educate one person. If we educate a girl, we educate a family, and a whole nation*" ***(Wolfensohm, 1995).***

1. Introduction

The sources of gender differences in educational outcomes have been a subject of considerable study and debate. There has been an increasing interest in both academic and policy discussions about ways to improve the educational performance of students, more specifically girls, in developing countries. One reason for such debates has been the increase in society's fundamental interest in fairness and equal opportunity. In addition, highlighted in the latest Global Gender Gap Report of 2015 is the fact that on key measures, the gender gap has widened since 2006 in nearly a quarter of the 145 countries surveyed over a span of 10 years. More specifically, the gap between women and men's literacy rate and educational attainment within these countries has worsened (World Economic Forum, 2015).

Nevertheless, recent research has provided concrete calculations showing that educating females yields far-reaching benefits for girls and women themselves, their families, and the societies in which they live. Despite these findings, girls continue to underperform in school and are still heavily deprived of education and employment opportunities in most developing countries (King and Hill, 1997).

One possible way to close such gender gaps in education, which has been a topic of continual interest in development economics, is to improve the teacher- student gender match i.e. to match teachers to students based primarily on gender. This involves analysing the impact of having a teacher of the same sex as opposed to one of different sex. Several studies in recent years have sought to explain the gender gaps in class performance. One explanation for these gaps involves the gender-based interactions between students and teachers, and such has led to a rise in discussions in education talks centred on controversial claims that teachers consistently privilege boys over girls. To expand on this Spilt et al., (2012) state that affective relationships between students and teachers are a key factor in students' school adjustment, and research demonstrates pervasive effects of relationship quality on the academic achievement for both boys and girls. The way in which teachers relate to individual students is a fundamental aspect of teaching. Students with positive relationships with their teachers are better adjusted and more engaged in learning activities thereby more likely to perform better as compared to students who have negative relationships with their teachers. Dee (2007) elaborates more on this by suggesting that assignment to the same gender teacher

could be educationally relevant and that there are three explanations as to why it might influence the educational experiences of boys and girls; the preference explanation, the stereotype explanation and lastly the role model explanation. The preference explanation is based on the idea that male and female teachers have unique biases with respect to how they engage boys and girls in the classroom. For example, cognitive process theories suggest that teachers may subtly communicate that they have different academic expectations of boys and girls. The biased expectations of teachers may then become self-fulfilling when students respond to them. The other class of explanations for the educational relevance of teacher gender involves how students respond to their teacher's sex and not how the teacher actually behaves. For example, having a same sex teacher could influence student engagement or behaviour through role model effects, where students view teachers as role models, and through stereotype threat, where student performance suffers when students fear being reviewed through the lens of a negative stereotype.

The empirical analysis conducted in this paper analyses the effect of teacher gender on student performance in Tunisia, in two subjects; Mathematics and Science whereby I test the hypothesis to find out if having a female teacher in Mathematics and Science enhances the performance of girls since boys generally outperform in these subjects. To the best of my knowledge, there has been no research on the impact of teacher gender on student performance in Tunisia, and therefore knowledge for this process is limited for this country. In addition, this topic is one of crucial interest especially since education is incredibly important in the development of an economy. More specifically, in Tunisia, not only has the female to male ratio in literacy rates been quite low since 2006 all the way to 2011, but the country also ranks in the bottom 10% in the gender gap in economic participation and opportunity. This highlights the astonishing differences in economic participation and opportunities of men and women in the country. What is interesting here is that Tunisia has still been close to the gender equality threshold in primary school education enrolment. Therefore, the fact that girls are attending school but still not participating as much in the labour market calls to question students' performance in schools. It could be that girls are not performing well enough to enter the labour market (World Economic Forum, 2014, p.352).

The empirical analysis uses the Trends in International Mathematics and Science Study (TIMMS) which is a cross sectional assessment of students in both Mathematics and Science at fourth and eighth grade. The TIMMS data set is uniquely suited for this analysis mainly because it provides comparable achievement for all students in the sample. Moreover, each student takes administered standardised tests in each subject, which makes test scores

comparable across students. In addition, from the TIMMS data set, I am able to observe the gender of all students and their teachers in both subjects, which is crucial for my analysis. The identification strategy employs student fixed effects in the model mainly because of the non-random matching of teachers to students. It is crucial to use fixed effects in the model in order to mitigate omitted variable bias. To be able to include such student fixed effects, one needs data that contains multiple observations per student which, as previously mentioned, is something that the TIMMS data set provides i.e. I can observe each student twice; once for Mathematics and once for Science (Mullis et al, 2009).

The results from my analysis, when looking at the overall impact of teacher gender on eighth grade student scores in Tunisia as a whole, show that female teachers have no significant impact on test scores of both boys and girls. I find that a female teacher has a negative insignificant effect of 0.944% of a standard deviation on the performance of all students, however, the interaction effect (i.e. the impact of a female teacher on a female student) shows a positive coefficient of 2.84% of a standard deviation but is shy of significant at a 10% level of significance. Nevertheless when looking at the effects of teacher gender on student performance within schools located in low income areas alone, I find that female teachers have a negative significant impact on their students' scores; significantly reducing their scores by 6,68% of a standard deviation at a 5% significance level. In addition, I also find that the overall impact of a female teacher on the performance scores of female students is approximately 0. Therefore in low-income areas, girls may neither lose nor win from having a female teacher, however, boys lose out from having a female teacher. The results from the schools located in high income areas show that female teachers actually have a positive significant impact on all students' scores; significantly increasing their scores by 4,16% of a standard deviation at a 5% level of significance. To add on, the interaction effect is positive at 0.902% of a standard deviation but is insignificant. Therefore in high-income areas, all students, regardless of gender, will benefit from having a female teacher.

The remainder of the paper is organised as follows. Section 2 describes the literature review, section 3 describes the education and gender gaps in Tunisia. Section 4 explains the preference, role model and stereotype explanations. Section 5 presents the data and descriptive statistics. Section 6 describes my empirical methodology and section 7 presents my results. The paper will end with section 8, which presents my conclusion.

2. Literature review

Several previous studies have investigated the role of teacher gender on student performance thus addressing the issue on whether or not female teachers play a significant role on enhancing students' grades, more specifically female students. The topic is still widely debated due to the varying results obtained from the different studies.

In the context of the United States, Dee (2007) shows that girls outperform boys in measures of reading achievement while generally underperform in Science and Mathematics, and that one major class of explanations for these gaps involves gender-based interactions between students and teachers. His study was carried out in the United States and examines whether assignment to a same gender teacher influences eighth grade student achievement, teacher perceptions of student performance, and student engagement. The identification strategy in his paper exploits a unique matched- pairs feature of a major longitudinal study, which provides contemporaneous data on student outcomes in two different subjects. The results suggest that a year with a female teacher would close the gender gap in Science achievement among eighth graders by half and eliminate entirely the smaller achievement gap in Mathematics. However, how these interactions may contribute to the gender gaps in educational outcomes also depends critically on the gender distribution of teachers by subject. The main policy implication of these results is simply to underscore that the gender interactions between students and teachers do appear to constitute an important 'environmental' influence of educational outcomes for both girls and boys. A policy alternative might be rooted in the conjectured existence of stereotype threat among students or of biases in the teacher behaviour and expectations. Discriminating among these explanations and designing appropriately targeted policies is a promising avenue for shaping the gender patterns of educational outcomes.

Carrington et al., (2008) examine quantitative data to test the hypothesis that male teachers produce more positive attitudes amongst boys and female teachers amongst girls. The paper is based on the assumption that 'like is good for like'; women should teach girls and men should teach boys. The study was carried out in England and uses data from the Performance Indicators in Primary Schools project (PIPS), which was examined using multilevel models controlling for background factors. The results show no empirical evidence to support the claim that there is a tendency for male teachers to enhance the educational

performance of boys and, conversely, for female teachers to enhance the educational performance of girls. One reason for the insignificant impact of teacher gender on student performance could be that the study included no information about the length of time spent with those teachers for the sample of pupils analysed. In addition, there was no random assignment of teachers to classes, such could be employed to investigate the issue more rigorously. However, when it comes to attitudes, children taught by women- both boys and girls alike- were more inclined to show positive attitudes towards school than their peers taught by men.

Another study conducted by Lee et al., (2015) estimates the impact of peer gender composition on student achievement, exploiting the random assignment of Korean middle school students several types of schools: single sex schools, coeducational schools with single sex classes, and coeducational schools with mixed gender classes. The results of this paper show that teacher gender has no effect on female students' outcomes. However, of the boys attending coeducational schools, those in single sex classes perform worse than boys in mixed gender classes.

Another paper depicting the large effects of having a 'teacher like me' is a study by Aslam and Kingdon (2011), which analysed the Pakistani schooling system. The paper concludes that the consensus is that many of the standard teacher characteristics such as certification, training and experience do not matter to pupil achievement. The paper uses unique school-based data, which allows exploitation of an identification strategy that permits the matching of students' test scores in two subjects to the characteristics of teachers who teach those subjects. The results of the study show that female students appreciably benefit from being taught by same sex teachers - their standardised mark increases by about 0.2 standard deviations. Nevertheless, the paper also includes a striking finding that a students' standardised mark in a subject taught by a female teacher is 0.5 standard deviations lower than if the same student were taught by a male teacher. As mentioned in the previous section this result can be linked to either the preferences explanation, the stereotype explanation or the role model explanation. The role model explanation in this case would be the most convincing explanation for two reasons; firstly the first two explanations can be ruled out since the tests taken by pupils in this study were neither administered nor graded by their teachers. Secondly, in light of the cultural norms in Pakistan where adolescent girls suddenly face strict mobility restrictions, these girl students may see female teachers as role models who can then motivate them to perform better in school.

Looking at all these studies, the effect of teacher gender on student performance remains ambiguous especially since knowledge for this process is limited for Tunisia. Moreover, since all studies conducted on this topic for several other countries all produce varying results, it makes it unclear whether such results generalise to the context of Tunisia. One reason for these varying results could be that each study was conducted in different types of countries; studies conducted in developed countries such as the United states and England are bound to differ to those conducted in developing countries such as Pakistan. Since Tunisia is also a developing country, Aslam and Kingdon's (2011) study is one that could potentially be closely related to mine. To add on, a debate in recent years maintains that focussing on differences in achievement across the government and private sector may be too simplistic as there are large variations within the two. In both sectors schools range from elite institutions to extremely poor ones with abysmal conditions, lacking even the basic facilities that form a prerequisite for generating an environment conductive to learning. Therefore, variations in achievement among the good and bad schools within a sector may be as important as the gaps between the two school types. In addition, not all government schools have poor performing pupils and not all private schools have high achievement distributions. Hence, my study goes further by eliminating the differences between private and public schools but rather looks at the impact of teacher gender on students' performance in a country as a whole, and then only in schools situated in high income areas then after those in low income areas, within the country. It should not be presumed that the achievement production function is a universal constant, applicable to all school types and all settings. Therefore, the impact of teacher gender on student performances may differ in various parts of the world. With this is mind, it is also possible that such impact may also differ within a country depending on the income level of the areas in which schools are situated in. For example, the role model effect may be more evident in a rural area as opposed to an urban, high-income level area (Aslam and Kingdon, 2011).

As previously mentioned, in the Global Gender Gap Report of 2014, Tunisia has shown to have a low female to male ratio in literacy rates and has ranked reasonably low in the gender gap in economic participation and opportunities. However, the country has still been close to the gender equality threshold in primary school education enrolment. These statistics make my research important especially it is evident that girls are attending school but still not participating as much in the labour market. It could be that they are simply not performing well enough in school and hence cannot enter the labour market and thus it becomes important to analyse ways to improve their performances. One way to do this is to

analyse the effect of teacher gender on the scores of the students (World Economic Forum, 2014, p.352).

3. Preference, stereotype and role model explanations

As previously stated, three explanations can be used to explain how knowledge is transmitted from teachers to students; the preferences explanation, the stereotype explanation, and the role model explanation. Recent studies on education have highlighted the importance of teacher - student interactions to pupil motivation, achievement, and attainment. Teachers often perpetuate sex-role stereotypes directly and indirectly through what they teach, through their behaviour and interactions with students, and through their assumptions about the different skills and abilities of girls and boys. Female teachers may inspire girls to high achievement and accomplishment or direct them towards conformity with prevailing domestic ideals (King and Hill, 1997)

One important factor that this paper focuses on in order to portray the gender differences in educational outcomes is the gender dynamics in classrooms. The preference, stereotype and role model explanation can be used to explain how knowledge is transmitted to students of different genders and understanding the distinctions among these theoretical explanations is an important antecedent to designing well-targeted policy interventions (Dee, 2007).

The preferences explanation suggests that teachers of a given sex have preferences for students of the same gender, and may reward same-sex students in terms of higher grades. The stereotype explanation argues that teachers own stereotypes may influence their evaluations of pupils (Holmlund and Sund, 2008).

The last explanation is the role model explanation, which argues that students of the same gender may perform better if taught by same sex teachers viewed as role models. A growing body of research has also shown that girls are more likely than boys to drop out of school before they complete their school cycle. Female teachers may be able to identify girls at risk of dropping out and provide special care and encouragement needed to keep them in school. This hypothesis is convincing in light of cultural norms in countries where adolescent girls suddenly face strict mobility restrictions and may see female teachers as effective role models King and Hill (1997). To prove the role model effect, as mentioned in Carrington et

al., (2008), a number of countries are actually running role model recruitment drives under the assumptions that like is good for like; women should teach girls thus raising controversy on what actually matters to improve student's school scores.

Whether these three explanations exist or not is an empirical question. This paper analyses the effect of teacher gender on the performance of students and uses these explanations as possible justifications of the results.

4. Education and the gender gaps in Tunisia

Girl education is an important aspect in the development process of an economy because of the multiplier effect it possesses. The multiplier effect of girl education on several aspects of development as well as its impact on economic growth is now commonly accepted. An increase in the education of girls reduces high fertility rates, lowers infant and child mortality rates, lowers maternal mortality rates, increases labour force participation rates and earnings, and most importantly, fosters further educational investment in children. Therefore, the cost of girls' exclusion from education considerably hinders the productive potential of an economy and its overall development (World Economic Forum, 2014).

Several studies show the long term returns to education; Lucas (1988) shows that education increases economic growth in a country, Rozenzweig (1996) shows that education increases technological adoption, Schultz (1997) proves that education improves health and reduces fertility. Furthermore, there are still current studies that continually prove the importance of education, and more importantly educating girls.

In addition to this, a study by Knowles et al., (2002) states that educating girls has a catalytic effect on every dimension of economic development, including higher productivity and faster economic growth. The paper set out to examine the implications of educational gender gaps on development and, in particular, whether increasing female schooling leads to higher levels of labour productivity across countries in the long run. The empirical results suggest that female education has a statistically significant positive effect on labour productivity. This suggests that educational gender gaps are an obstruction to economic development.

Furthermore, King and Hill (1997) find that the level of female education has a positive significant impact on the level of Gross National Product (GNP) and that larger

gender disparities in educational attainment are associated with lower levels of GNP. That is, for given levels of female education, higher levels of male education reduce GNP.

As previously mentioned education improves health by lowering high fertility rates, lowering infant and child mortality rates, as well as maternal mortality rates. The impact of health on economic growth is well documented in the Global Gender Gap Report of 2014, which explains that a one-year increase in health expectancy could raise Gross Domestic Product (GDP) by up to 4%. In addition the report emphasises the positive effect of education on labour force participation rates and earnings; having more women in the workforce contributes to economic performance through several pathways. Studies have shown that greater female participation in the United States workforce since 1970 accounts for a quarter of current GDP. In addition, the report explains that a reduction in the male-female employment gap has been an important driver of European economic growth in the last decade. Therefore, improving the school performance of girls would have massive economic implications for developing economics since more educated girls will be able to participate in the labour market (World Economic Forum, 2014).

Furthermore, as women become more economically independent, they also become more significant consumers of goods and services, and likewise, they acquire more bargaining power in their households. Research has shown that women are more likely than men to invest a larger proportion of their household income to the education and health of their children. Proof of this can be seen in a study by Qian (2008) who investigates whether changes in relative female income, as a share of total household income, affects the relative outcomes for boys and girls. She finds that an increase in relative adult female income, while holding male income constant, has an immediate and positive effect on the child survival rate of girls as well as the educational attainment for both boys and girls. However, increasing male income, while holding female income constant, decreased both survival rates and educational attainment for girls, and had no effect of educational attainment for boys. This suggests certain implications for policy makers; factors that increase the economic value of women are also likely to increase the survival rates of girls and the education investment for all children, hence escalating the importance of improving girls performance in school.

Interestingly, according to ground breaking research released at the Women Deliver Conference 2016 by the McKinsey Global Health Institute, narrowing the gender gap in the global economy could reap $12 trillion in 2025 and one way to do this is to reduce the gender gap in education performance. It is therefore vital to invest in ways to enhance female student scores thereby increasing the economic value of women (McKinsey Global Institute, 2016).

Tunisia is a member of the ‘Arabo' Muslim world, also known as the Maghreb. It is argued that Islamic culture, with the emphasis on modesty and gender segregation, discourages female education and labour market participation. To add on, there exists social pressure for Tunisian girls to marry early and fully care for their large-sized families. Past research has supported these assertions on the cultural, social, and economic disadvantages of women and girls. When it comes to the educational system, Tunisian girls generally underachieve in Mathematics and Science and one argument for this is that the unfavourable cultural, social and economic conditions undermine the academic achievement of girls (Shafiq, 2013).

Since Tunisia gained its independence in 1952 from France, the country has experienced certain developments in its education systems. In recent decades Arab education, including the Tunisian education system, has achieved substantial growth in quantitative terms with enrolments and other indicators expanding dramatically, including for females. Recent cultural, social and economic changes in particular revised interpretations of the Quran are leading to advances in women’s rights in marriage and opportunities in the labour market. In addition Tunisian students have a variety of opportunities now, including private educational institutions, English-medium schools, religious-curriculum institutions, and study abroad (Rugh, 2002).

Despite these improvements in the Tunisian educational system, girl education has still not peaked. The lower educational attainment of girls and women has been a result of low enrolments combined with high attrition and repetition of grades (King and Hill, 1997).

To understand more on the gender gaps in the Tunisian education system, one can consider the Global Gender Gap Report of 2014, which includes rankings and scores of 142 different countries in different aspects of their gender gaps. The rankings were designed to create greater awareness among a global audience of the challenges posed by gender gaps and the opportunities created by reducing them. These rankings provide robust comparative information since the methodology of the index has remained stable since its development in 2006. In the report Tunisia ranked 107 out of 142 in its gender gap in education however it still reported an educational attainment score of 0.9506 (whereby 1 entails equality and 0 inequality). The fact that Tunisia has been close to the equality threshold in its educational attainment score can perhaps be explained by the Millennium Development Goals, established in 2000, which included a goal for universal primary education and gender equity at all education levels. This is probably why enrolment to primary education is closest to the equality threshold. Nevertheless, the report also shows that this female to male ratio in both

literacy rates and primary school enrolment have actually remained smaller than the equality threshold since 2006 all the way to 2011. However, what is in fact interesting here is that when we look at the gender gap in economic participation and opportunity Tunisia ranks at 130 out of 142 with a score of 0.4634, which entails the astonishing differences in economic participation, and opportunities of men and women in Tunisia. As indicated previously limiting women's access to the labour markets is costly to a country. The fact that girls are attending school but still not participating as much in the labour market therefore calls to question female student performance in school; perhaps girls are not performing well enough to enter the labour market (World Economic Forum, 2014).

One explanation for the poor performance of girls can be explained by the Mincer model which gives a general idea of how parents in Tunisia, and globally for that matter, perceive their children's education. Education is an investment of current resources in exchange for future benefits. The Mincer model states that the cost of an additional year of schooling is the opportunity cost of a student's time and the resulting proportional increase in the student's future earnings, which is constant over a lifetime. For simplicity we will assume that the returns to education are linear. Therefore it follows that the log earnings is linearly related to the years of schooling and that the slope of this relationship could be interpreted as the rate of return to investment in schooling, as shown below:

$$ln(y) = a + b * S$$

Every additional year of education increases the child's future wage by '*b'* per cent;
'b' is known as the economic returns to schooling. Parents are the ones who tend to make the schooling decisions for their children and hence their utility is a function of schooling (*S*) and the earning of the child when he grows up (*y*)

$$U(y, S) = m * \ln(y) - h(S)$$

By substituting the first equation into the second one and then solving the maximisation problem we obtain the following;

$$mb = h'(S)$$

In addition, we can assume *h'(S)=r+* ϕS. Whereby *r* is the fixed cost of schooling and ϕ is the marginal cost of schooling. We then obtain the following function, which determines the optimal number of years of schooling for each child as perceived by their parents:

$$S^* = (mb - r)/\phi$$

This model shows that the optimal number of years of schooling per child increases with the economic return to schooling, which is determined by the child's parents, and reduced with fixed cost of schooling and the marginal cost of schooling (Mincer, 1974).

Nonetheless, it's important to note, as previously mentioned, that following the Millennium Development Goals primary education worldwide was made costless and therefore we can disregard the cost of schooling in the model. However, what the mincer model can help to explain is the low performance of girls. The model states that parents decide on the optimal years of schooling for their children based on two things; the economic return to schooling for each child and the fixed (and marginal) cost of schooling. For now we can focus on the economic return to schooling for each child, which is perceived by their parents. According to the study by King and Hill (1997), it is generally known that parents' attitudes, expectations and, more relevantly, the support they provide for their daughters' educational and occupational aspirations depend on the family's socioeconomic status and specific characteristics. Whether or not parents demand education for their children is determined not only by their attitudes and values but also by their assessment of the outcome of educational choices. Under certain circumstances parents may feel that the economic return to sending girls to school is low and would therefore prefer engaging their daughters in income-generating activities or marriage. Girls who don't receive enough educational support from their parents are more likely to drop out of school and perform poorly in school. By acknowledging this, female teachers are more willing to provide extra support to such girls whereby they act as role models to help lower drop-out rates and poor performances. As shown in a study by Klem and Connell (2004), students with caring and supportive interpersonal relationships in school report more positive academic attitudes and values. This is a potential way in which teacher gender affects educational performances of students.

As previously noted this study focuses on analysing the effect of teacher gender on student performance in two subjects; Mathematics and Science. The reason for focussing on these two subjects is because research shows that the direction and magnitude of gender gaps in achievement vary by academic subject, and furthermore girls in Tunisia generally have been seen to underperform in both Science and Mathematics (Shafiq, 2013).

5. Data and descriptive statistics

5.1 TIMMS 2011 dataset

The empirical analysis conducted in this paper uses data from the Trends in International Mathematics and Science Study (TIMMS). TIMMS is a cross sectional assessment of students in both Mathematics and Science at the fourth and eighth grade which was evaluated by the International Association for the Evaluation of Educational Achievement (IEA). In addition TIMMS has been conducted in 63 different countries every four years since 1995. However, my focus for this study will be on only eighth grade students mainly because in Tunisia it is extremely common that fourth grade students have the same teacher for both Mathematics and Science thereby eliminating the possibility for comparison between a student's grades in both subjects based on differences in teacher gender.

TIMMS collects its data by first randomly selecting schools, after which different classes in Science and Mathematics are randomly sampled within each of the selected schools. All students in the selected classes take administered standardised tests. In addition, background information, including student and teacher gender as well as data on the income area in which each school is situated, is obtained from students and their teachers in both subjects via questionnaires. The sampling design therefore implies that all students are observed twice in the data – once in Mathematics and once in Science- while teachers are usually observed once with one class, thus providing me with a nationally representative sample of Tunisian eighth grade students which is crucial for my analysis (Mullis et al., 2009).

The TIMMS 2011 data set is advantageous for my study for various reasons; firstly, because it provides comparable student achievement data in Mathematics and Science for nationally representative students. Secondly, it provides me with background information which includes data on the gender of both students and teachers as well as the income level of the different areas in which each school is situated. Thirdly, each student is observed twice; once in Mathematics and once in Science, which allows me to implement the methodology that includes student fixed effects.

5.2 . Sample selection

The TIMMS 2011 data set for Tunisia consists of 5128 students whereby each student takes both a Mathematics and Science class. Therefore the data set consists of 10256 observations.

However I exclude from this sample 179 students (hence 358 observations) whose teachers cannot be linked to any gender. The reason for this is that the gender of the teacher is our variable of interest and therefore keeping unknown genders in the data set could cause possible bias. Therefore the final sample for the first set of regressions i.e. disregarding income level of area of school location is 9898 observations consisting of 4949 students taking both Mathematics and Science.

In addition, my study further analyses the effect of teacher gender on students in Tunisia for schools located in high income areas only and then in low income areas only. In doing so, I further eliminate 312 observations from the data set and the reason for this is that the income level of the area in which these students' school is located is unknown. Again, since the main interest in these sets of regressions is to find the effect of teacher gender on student achievement primarily based on the income level of the area in which the school is situated, it is reasonable to exclude such unknowns from the sample. It is important to note that the TIMMS 2011 database included missing data in some of the control variables, which occurred for questions that should have been answered but were not. Such missing data could easily be excluded from the data set however this would further reduce the number of observations, which could potentially affect the final result. In order to account for this issue without further reducing the sample size missing values are set to '0' and dummies for missing observations for each control variable are included in the regressions. The results are however quite robust to dropping all observations with a missing value in any of the control variables, which reduces the sample size by approximately 27%. These results from this reduced sample are available upon request.

5.3 Descriptive Statistics

For both sets of regressions, the basic controls are indicators for female teachers, female teachers who teach female students (the interaction effect), the teacher's years of experience; which is split into either more or less than 10 years of experience, the teacher's

education level; which is either that they have completed university (or above) or not, and the class size; which is either a big class of 25 or more students or a small class of less than 25 students. Later in the paper, I include further controls for both teachers and students, all of which are drawn from the TIMMS 2011 questionnaire. Table 1-3 depicts the means and standard deviations of these variables.

TIMMS achievement results are reported on a scale from 0 to 1000, with a TIMMS scale average of 500 and a standard deviation of 100, in all sampled countries. Tunisia reported a mean score in both Mathematics and Science of 426.7809 which is below the international average thereby depicting the fact that Tunisian students in eighth grade are, on average, underperforming compared to the other 63 countries from the TIMMS 2011 dataset. When it comes to the performance scores of students, the data set shows that boys generally perform better than girls in both Mathematics and in Science whereby the average score for boys in both subjects is higher than that of girls. This shows that the gender gap in educational performance in Tunisia for these two subjects does in fact exist (see appendix 1).

In reference to the eighth grade students in the sample, 51% of the students are girls while 49% are boys. Looking at both subjects together, female teachers report a mean of 0.51, and out of these female teachers who teach female students only reported a mean of 0.26. In addition, the data set shows that of the Mathematics teachers, 34% are female while 67% of them are male. However in Science, 66% of the teachers are female and 33% are male. Therefore, it is evident that in Tunisia there are more male teachers who teach Mathematics and more female teachers who teach Science. When considering the income level of areas in which the selected schools are located in, it is still the case that there continues to exist a higher percentage of female teachers teaching Science and male teachers teaching Mathematics in both income areas. What could be worth mentioning is that from the TIMMS executive summary in Mathematics and Science, Tunisia has experienced a decline in the performance of eighth grade students in Mathematics however, in the Science subject Tunisia saw an increase in eighth grade performance scores. The interesting aspect here, as mentioned above, is that the majority of Science teachers were female and the majority of Mathematics teachers were male (IEA, 2012a; 2012b).

Looking at the basic controls, the teacher's years of teaching experience has a mean of 0.63 for experience of 10 years or more, and mean of 0.31 for experience less than 10 years. To add on, the educational level of teachers showed a mean of 0.78 above university level and 0.20 below university. Therefore, most teachers have attended university. For class size, a

small class (25 or less students) reported a mean of 0.29 while a big class(more than 25 students) had a mean of 0.66.

As previously mentioned, for the later regressions, I include further controls for both students and teachers. The selection of control variables is inspired by Aslam and Kingdon's (2011) study, which uses unique school-based data to analyse which teaching characteristics and teaching practices matter most to pupil achievement. It is important to note that the further control variables for teachers include four 'process-type' variables i.e. how often the teacher gives students explanations in class, how often teachers assign homework to their students, how often the teacher tests/quizzes students, whether or not the teachers follow the subject curriculum. The reason for using these process variables as teacher controls is that teacher un-observables may be correlated with student achievement. For instance, researchers cannot often observe teachers' effort, motivation or ability. These un-observables residing in the error term can potentially determine student achievement e.g. the higher the teacher's effort, the higher the student's achievement in that subject. Such biases associated with this sort of endogeneity may somewhat be reduced through inclusion of the teacher process variables which are used as proxy variables for the un-observables. According to Frost (1979) endogeneity bias is always smaller when one includes a proxy variable if the measurement error is a random variable independent of the true regressors. For example, teachers with higher motivation are more likely to put in greater effort in teaching by planning lessons, test students frequently, and ensuring students participate in class by making them explain their answers. Therefore by including these process type variables which may be correlated with unobserved effort, ability and motivation of teachers, we may be able to reduce, even if not completely eliminate, some of the biases generated with this source of endogeneity.

In reference to the other control variables, they are included because they have direct impact on the student achievement score and also vary with the different subjects hence creating room for comparison between the different genders of teachers e.g. students may have a different desire to learn in a subject taught by a female compared to another subject taught by a male. I therefore seize to include other obvious control variables such as mothers education and number of books owned at home, which were included in Aslam and Kingdon's (2011) study, since such variables do not vary between the two subjects.

6. Methodology

The ideal experiment to investigate the effect of teacher gender on student performance requires random assignment of teachers of different genders to students. However, in the real world this doesn't happen and hence the observational data included in TIMMS 2011 dataset is not random. One reason for this non-random assignment of students to teachers could be that students select into schools and classrooms according to their parents preferences for particular teacher gender. For example, it is likely that students with parents who don't believe in the competency of female teachers in important subjects such as Mathematics and Science may prefer that their child be taught by a male. In this case any estimation of the effect of teacher gender on student performance that doesn't account for this sorting pattern may be biased. Another reason could be that teachers adjust their teaching practices based on the gender of the students they face as explained by the preferences explanation i.e. that teachers of a given sex have preferences for students of the same gender, and may reward same-sex students in terms of higher grades. This could also work in the opposite direction whereby students with high-unobserved ability may prefer male teachers, and this could result in an understatement of the impact of female teachers on student performance. If teacher attitudes are a function, or partially a function, of student-level determinants of test scores and are not controlled for in the regressions, this will again lead to a bias in the estimated coefficients of interest.

One way to go about this could be to run a simple Ordinary Least Squares regression of teacher gender on student achievement including some measure of the student-teacher gender match. However, this is not ideal mainly because the results cannot be interpreted as causal for the principle reason that there exists no random assignment of teachers to students, due to the reasons mentioned above, and hence results could be biased.

A common way to mitigate such biases is to include student fixed effects in the empirical model. Models with student fixed effects have been previously used in various studies such as the one by Aslam and Kingdon (2011). By including fixed effects one can control for the average differences across any observable or unobservable predictors. The fixed effect coefficients remove all the across-group action, which reduces the threat of omitted variable bias. Another reason fixed effect regressions are important in this case is because our data falls into categories of subject teacher gender (since we are looking at the effect of teacher gender on student performance in both Mathematics and Science), and hence without fixed effects one will have to worry about unobservable factors that are correlated

with the variables that are included in the regression which could result in possible omitted variable bias. However if such unobservable factors are subject-invariant, a fixed effects regression will eliminate omitted variable bias. If the un-observables are not subject-invariant, then it is still possible to have some omitted variable bias. Therefore one may never be able to fully rule out this possibility of bias. Nevertheless, in sum, bias through the channel of teachers' adjustment of teaching practices to their students is likely to be minimal due to the inclusion of student fixed effects (Dranove, 2008).

In order to include student fixed effects in the empirical model, one needs data that contains multiple observations per student either at different points in time or in different subjects at the same point in time. The TIMMS 2011 dataset, with its two observations per student (one in Mathematics and one in Science), fulfils this requirement. I exploit this and identify the effect of interest using the variation of teacher gender between the subjects for each student. Equation 1 refers to the student when observed in the specific subject *s* i.e. in Mathematics or Science. The estimates of the following empirical model are presented in table 4:

$$y_{ijs} = \propto + \beta_1 FT + \beta_2 FTFS + X_{js} + \lambda_i + \varepsilon_{ijs} \qquad (1)$$

Where student *i*'s test score in subject *s* taught by teacher *j*, y_{ijs}, is determined by the gender of the student's teacher, *FT*, and more specifically by the interaction effect i.e. the impact of a female teacher on their female student's score, $FTFS$. In addition X_{js} consists of the other observed determinants of y_{ijs}, which vary at the level of the classroom and teacher i.e. teacher and class characteristics. λ_i is the student fixed effect which controls for subject-invariant student-level determinants of test scores, and ε_{ijs} is a student-by-subject specific error term. In addition since students are observed twice in the same school, the student fixed effect will also control for any school characteristics that influence test scores.

Similar to the study by Dee (2007), there are some possible biases that may remain in the results. First, the student-level un-observables that vary between Mathematics and Science could be correlated with assignment to a teacher of a specific gender and student achievement, which could lead to omitted variable bias. For example, if it is the case that students with a propensity for lower achievement in Mathematics and Science are more likely to be assigned to a female teacher in either subject. Second, un-observable teacher characteristics (e.g. teacher motivation) that are associated with both teacher gender and student achievement may

also cause an omitted variable bias problem. As previously mentioned, the inclusion of measures of teaching methods, i.e. the teaching process variables, should mitigate such bias. However, it may be the case that the bias is still not fully eliminated.

The following section will present the results from two sets of regressions. In the first set of regressions y_{ijs} represents the overall Mathematics and Science score for all students in the sampled schools in Tunisia. In the second set of regressions, y_{ijs} will represent the score of students whose schools are located in high-income areas alone and thereafter for those whose schools are located in low-income areas alone. Therefore, this study is able to estimate separately the effects of teacher gender on student performances in the country as a whole, in low-income areas alone, and in high-income areas alone. The reason for this, as previously mentioned, is that it may be possible that the impact of having a same sex teacher may differ within a country depending on the income level of the areas within that country. However, to the best of my knowledge, research analysing the impact of teacher gender on student performance has only been assessed for countries as a whole, or particular regions, but no research has paid attention to the different income level of areas in which schools are situated. This is an aspect that makes my research unique. The parameters of interest in Equation 1 are β_1 and β_2.

7. Results

Table 4 presents the estimates of the model in equation 1 where the dependant variable is the overall test score in Mathematics and Science for all schools in the TIMMS 2011 Tunisian database. Table 5 then presents the estimates of the model in equation 1 in two columns; the first column shows results for schools situated in low-income areas and the second column for those situated in high income areas. For both tables, the mean coefficient estimates as well as the average R-squared values are presented.

Table 4 shows no significance of teacher gender on overall scores for students in both Mathematics and Science. The estimated coefficient of the female teacher index to student scores has a small, negative effect on student performance and, regardless of whether it is included in the regression as a single treatment variable (column 1) or together with the basic student and teacher controls (column 2) or, additionally, with the further controls (column 3), is never statistically significant. More specifically, inclusions of both the basic and further

controls have very little impact on the coefficient estimate. In comparison, the interaction effect, which is the estimated coefficient of a female teacher to a female student's scores, is approximately identical for all specifications. However, it is also never significant.

The coefficients of interest in my preferred specification in column 3 of table 4, which includes both basic and further controls for students and teachers, implies that having a female teacher has an insignificant effect of -0.944% of a standard deviation on the performance of all students. More specifically the interaction effect depicts an insignificant coefficient of 2.84% of a standard deviation thereby showing that the impact of a female teacher on the score of a female student is 1.896% (-0.944+2.84) of a standard deviation, and is shy of significance at a 10% level of significance. One possible explanation for this shyly insignificant result could be that the sample size for Tunisia is too small to pick up the total effect of teacher gender on student scores. Despite their insignificance, when considering the size of both the coefficients of interest, it is evident that both effects are quite small and that magnitude of the effect of female teachers on female students is greater than the effect of female teachers on male students. Nonetheless, these results are similar to those found in Carrington et al., (2008) who show that female teachers have no significant impact on the educational performance of girls.

Looking at the other basic controls for teachers and students, being taught by a teacher who has less than 10 years of work experience significantly increases a students' score by 3.96% of a standard deviation at a 1% level of significance. This is a plausible result since it could be the case that teachers who are new in the teaching profession are perhaps more enthusiastic and keen to teach, and such is portrayed in the positive impact they have on their students' scores. It could also be the case that teachers with less experience are generally younger and hence have a closer connection to students who feel more comfortable around them, and such has a positive effect on the students' scores. The level of education of a teacher has a positive insignificant impact of 1.27% of a standard deviation on a students' score. Therefore, a teacher having an education level below university level does not significantly matter to their students' scores. Nonetheless class size does matter for a student's score. Being in a large class of more than 25 students significantly reduces a student's score by 4.05% of a standard deviation at a 5% level of significance. This result is plausible for many reasons for example it could be that teachers teaching a large amount of students at a time are unable to provide the specific attention needed to each student.

As previously mentioned one should not assume that the achievement production function is a universal constant applicable to all school types and settings. Aslam and

Kingdon (2011). It could therefore be that the effect of teacher gender will vary in different schools depending on the income level in which they are situated. The reason for this is the possibility that the role model, stereotype and preference explanations work differently depending on how teachers view students, and likewise, how students view teachers. For example, it could also be the case that in low income areas there exist higher attrition of girl education due to basic traditional concepts, which entail that girls should be prepped for household work and marriage as opposed to a career. Due to such traditions, female teachers would be more inspired to motivate female students to perform better as well as stay in school since they would want them to succeed for a better life, and such has a positive impact on the female students' score. Nonetheless, it could also be that in high income areas parents are more likely to have a higher education level and more likely to understand and value education, thus ensuring all their children, disregarding gender, are educated. In such a case, the role of teacher gender via the role model explanation becomes weaker. To add on, as previously stated, it could be that the Tunisian data set is too small to pick up the entire effect of a teacher's gender on students' scores, and hence it therefore becomes ideal to divide the country into two parts based on the income levels. My study therefore further analyses the impact of teacher gender on student scores for schools located in low-income areas alone and then after for those located in high-income areas alone, within Tunisia.

To do this, I re-run the regressions for schools located in only low-income areas and thereafter in high-income areas so as to get a more accurate result of how teacher gender affects the performance of student. The same preferred specification is used which, as previously mentioned, includes teacher and student basic controls as well as further controls. Table 5 depicts these estimations.

The results for schools located in low-income areas are in line with previous studies, which have shown that teacher gender does in fact have an impact on a student performance. In low income areas, female teachers have a negative significant impact on their students' scores; significantly reducing their scores with a large coefficient of 6,68% of a standard deviation at a 5% significance level. From this result we can see that in low-income areas male students lose out from having a female teacher. However, the interaction effect depicts an equivalently high coefficient of 6,542% of a standard deviation at a 10% level of significance thereby suggesting that the overall impact of a female teacher on the performance scores of female students is approximately 0 (-6,68+ 6,542) i.e. female students neither benefit nor lose out from being taught by a female teacher. These results are in line with the

study by Aslam and Kingdon (2011) who found that students' standardised mark in a subject taught by a female teacher is lower than if that same student were taught by a male teacher.

On the contrary, when considering the results for the schools located in high income areas, we see that female teachers actually have a positive significant impact on all students' scores; significantly increasing their scores by 4,16% of a standard deviation at a 5% level of significance, the opposite result of that from low income area schools. However, this coefficient is smaller than 6,68% thereby suggesting that female teachers have a larger effect on students' scores in low-income areas than in high income ones. The surprising aspect here is that for schools in high income areas, the interaction effect reports a small, positive, insignificant result of 0.902% of a standard deviation, thereby suggesting that teacher gender plays no significant role in enhancing a female student's scores. These results are in line with Lee et al., (2015) who also show that boys benefit from being taught by female teachers and that teacher gender has no effect on female students' outcomes.

The varying results from schools located in high income and low-income areas support Aslam and Kingdon's (2011) assumption that the achievement production function is not a universal constant, and that the effect of teacher gender will differ in different schools depending on the income level of the area in which they are situated. The impact of female teachers on all students are different in both income areas; in low income areas, having a female teacher in Mathematics and Science lowers the students' overall score but in high income areas it's the exact opposite and students benefit from having a female teacher in these subjects. In addition, when looking at the effect of a female teacher on the scores of only female students, we find that in low income areas having a female teacher neither benefits nor caveats the scores of female students, and in high income areas female teachers have no significant impact on females students' scores. Likewise, the results show that in low-income areas boys will lose out from having a female teacher, while in high income areas boys will benefit from having a female teacher.

The role model, preference and stereotype explanations can be utilised to elucidate the differences in the results between high and low-income areas.

As previously mentioned by King and Hill (1997), in low income areas there is more likely to exist a high level of attrition for girl education which may affect how teachers view students. In this context it could be that a male teachers' own stereotype of girls being destined to marry rather than study lead them to undermine female students' abilities and skills, and favour male students. It could also be that male teachers simply prefer male students. Both of these could influence the way in which knowledge is transmitted from teachers to students,

which could thereby affect a student's grades. This is a possible reason why, in low-income areas, male students lose out from having a female teacher and may benefit from a male one instead. Nonetheless, the high attrition of girls in low-income areas can also affect how students view teachers. As previously mentioned, it is likely that girls coming from low income families don't receive the educational support they need from their parents. It is a therefore a valid argument that female teachers in low income areas are more likely to provide special care and encouragement needed to keep and motivate girls in school, as well as to help girls understand the benefits of an education. It is possible that the role model effect is existent in low-income areas despite the fact that the over-all effect of female teachers on female student scores adds up to 0. The reason for this, as mentioned earlier, is that the interactive effect reports a positive significant coefficient (6,542% of a standard deviation). Perhaps the effect of teachers acting as role models is counteracted by the low support girls receive from their homes. In such a case without role models female students would lose out. In the same context, it is also plausible that male students will lose out from having a female teacher because female teachers exert more effort towards their female students as compared to the male ones.

Nevertheless, in high-income areas, students experience an increase in their score by 4,16% of a standard deviation if taught by a female teacher and this could simply be because female teachers are generally more experienced and intelligent in their subject area. The TIMMS 2011 database for Tunisia supports this since it also shows that high-income areas have a larger amount of female teachers with both more experience and a higher education level compared to those in low-income areas. However, what is interesting here is that, despite the high level of education and experience of female teachers, the interaction effect reported an insignificant result of 0.902% of a standard deviation thus suggesting that female teachers have no impact of female students' scores. It could be the case that in high-income areas female teachers don't feel obliged to specially care for female students. A liable reason for this could be that students attending schools in these high income areas are more likely to come from high income families who understand the importance of education, can afford to send their children to school, and provide the needed support to their sons and daughters to perform well and stay in school. This reduces the possibility of the role model explanation since female teachers don't feel the need to provide special attention to female students. Therefore female teachers become beneficial to all students regardless of their gender.

All in all these results show that in low income areas girls significantly gain from being taught by a female teacher and boys from a male teacher. However, in high income areas female teachers are beneficial to all students regardless of gender.

8. Conclusion

There is an on-going debate about the effect of teacher gender on student performance. The Global Gender Gap Report of 2014 shows that, in Tunisia, the female to male ratio in literacy rates has remained low and additionally, girls in Tunisia are considered to underperform in both Mathematics and Science. Moreover, the report shows that Tunisian women are generally under-represented in the labour market and one possible reason for this could be that girls are simply not performing well enough in school to enter the labour market. Recent economic evidence suggests that such gender gaps in performance can be bridged by providing students with a teacher of the same sex as this has possible positive effects on the educational performance of girls (World Economic Forum, 2014).

The empirical analysis conducted in this paper analyses the effect of teacher gender on student performance in Tunisia, in two subjects: Mathematics and Science. I test the hypothesis to find out if having a female teacher in Mathematics and Science enhances the performance of girls since boys generally outperform in these subjects. The results obtained provide evidence that, in Tunisia, female teachers promote the test scores of students depending on the income level of the area in which their school is situated; in low income areas girls significantly gain from being taught by a female teacher and boys lose out from being taught by a female teacher. However, in high income areas female teachers are beneficial to all students regardless of gender.

An important issue to note is that this study uses fixed effects to reduce the threat of omitted variable bias in an attempt to deal with the issue of non-random assignment of teachers to students. Nevertheless, it may be the case that not all potential biases are eliminated which implies that caution should be exercised when it comes to formulating policy recommendations.

With this in mind, the results from this study have an important policy implication. In low-income areas where there exists high attrition for girl education, since having a female teacher plays a significant role in improving test scores for girls, teachers should be allocated

to students based on gender; female teachers to girl students and male teachers to boys. In addition to this, it could also be beneficial to have programs in schools, such as role model programs, whereby girls are able to be associated with older females who they can look up to and who can advise them on the importance of schooling. Such a policy doesn't need to be concentrated in high-income areas, where students already receive educational support from their parents, since teacher gender does not have any significant effect on female student performance. In this way girls who don't receive enough educational support from their parents, and society as a whole, could be motivated to perform better in school and are more prone to stay in school since they are encouraged to do so by their teachers. Such could contribute to closing the gender gap in educational performance in Tunisia and as a long-term result girls become more likely to participate in the labour market. This could further enable girls to become more economically independent and empowered in the long run. As stated by Qian (2008), factors that increase the economic value of women are also likely to increase the survival rates of girls and the education investment in all children. Therefore, improving the school performance of girls is a possible way to reduce the existing attrition level of girl education for future generations of children. Likewise, improving girl education will have an impact on various socio-economic factors such as reducing fertility rates, lowering infant and child mortality, and lowering maternal mortality. Furthermore, according to research released at the Women Deliver Conference held 2016, by the McKinsey Global Health Institute, narrowing the gender gap in the global economy could reap $12 trillion in 2025. It is therefore vital to invest in ways to enhance female students' scores thereby increasing the economic value of women (McKinsey Global Institute, 2016).

One recommendation for future research could be to collect data on parents' perceptions of girl education whereby parents either support their daughters' educational aspirations, as well as ensure that their daughters receive an education, or parents prefer their daughters to engage in income generating activities and marriage rather than attending school. Such data is not included in the TIMMS 2011 dataset. The model can then be implemented for students whose parents support girl education only, and then for those whose parents don't. It could be interesting to see if such results produce the expected results i.e. students who lack the parental support benefit from having a same sex teacher.

In addition, perhaps implementing this study with a larger dataset could be more desirable. Nonetheless, more research on this topic is ideal.

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10. Appendices and tables

Appendix 1:

Math

Male students	Observations	Mean	Standard Deviation	Min	Max
score	2508	**426.576**	72.47674	214.424	648.814

Female students	Observations	Mean	Standard Deviation	Min	Max
score	2620	**413.495**	70.87048	221.95	640.224

Science

Male students	Observations	Mean	Standard Deviation	Min	Max
score	2508	**441.194**	63.56778	222.655	631.181

Female students	Observations	Mean	Standard Deviation	Min	Max
score	2620	**428.132**	61.90594	235.968	638.659

Table 1:

Descriptive statistics: Basic controls

	Mean	SD
Score	426.79	67.80
Female teacher	0.51	0.50
Female teaching female student	0.26	0.44
Teaching years of experience		
>=10 years (1)	0.63	0.48
<10 years (2)	0.31	0.46
Education level		
>= University level (1)	0.78	0.41
<University level(2)	0.20	0.40
Class size		
<=25 students (1 small class)	0.29	0.45
>25 students (2 big class)	0.66	0.47

Table 2:

Descriptive statistics: Further controls for students

	Mean	SD
Student further controls		
Students desire to learn		
High (1)	0.39	0.48
Low (2)	0.65	0.48
Time spent on homework per week		
>45 mins(1)	0.42	0.49
<=45 mins (2)	0.53	0.50
Usually does well in subject		
Yes (1)	0.87	0.33
No (2)	0.11	0.31

Table 3:

Descriptive statistics: Further controls for teachers

	Mean	SD
Further controls		
Teachers		
Content with profession		
Yes(1)	0.96	0.20
No (2)	0.03	0.18
Lack of nutrition		
No(1)	0.51	0.50
Yes(2)	0.47	0.50
Teacher gives explanations in class		
Every or almost every lesson (1)	0.86	0.34
Some of the lessons (2)	0.13	0.33
Never (3)	0.001	0.03
How often teacher assigns homework		
Every day (1)	0.47	0.50
More than once a week (2)	0.47	0.50
Less that once a week (3)	0.38	0.48
How often tests		
About once a week (1)	0.02	0.13
About every two weeks (2)	0.03	0.17
About once a month(3)	0.60	0.50
A few times a year(4)	0.33	0.47
Follows curriculum		
Yes (1)	0.60	0.49
No (2)	0.36	0.48
Asks student to explain answers		
Every or almost every lesson (1)	0.79	0.41
Some of the lessons (2)	0.20	0.40
Never (3)	0.002	0.05
Safe and orderly school		
Safe and orderly(1)	0.24	0.43
Somewhat safe and orderly(2)	0.59	0.49
Not safe and orderly (3)	0.16	0.37
Instructions affected by lack of resources		
Not affected(1)	0.04	0.19
Somewhat affected (2)	0.94	0.23
Affected a lot(3)	0.02	0.13

Table 4

Teacher gender and overall scores

	(1)	(2)	(3)
Female teacher to all students	-0,3297(-0,33)	-0,5503(-0,54)	-0,6398(-0,60)
Female teacher to female student	2,1287(1,64)	2,0647(1,59)	1,9226(1,49)
Years of experience			
less than 10 years(2)	-	2,9119(3,34)***	2,6849(2,69)***
Education level			
Below university level(2)	-	1,0551(1,25)	0,8725(0,97)
Class size			
Big class(2)	-	-1,5061(-1,25)	-2,7447(-2,16)**
Controls			
Teacher controls			
teacher content with job		-	
no(2)	-		-0,145(-0,08)
Teachers lack of nutrition			
has lack of nutrition	-	-	-0,0290(-0,04)
Teacher gives explanation			
some of the lessons(2)	-	-	-1,2093(-1,10)
Never(3)	-	-	-11,367(-0,93)
Teacher assigns homework			
more than once a week(2)	-	-	-2,7003(-2,26)**
less than once a week(3)	-		-3,1630(-2,26)
Teachers give quizzes			
about every two weeks(2)	-	-	4,6314(1,32)
about once a month(3)	-	-	-1,0763(-0,42)
a few times a year(4)	-	-	-0,8502(-0,33)
Teachers follow curriculum			
no(2)	-	-	0,2629(-0,98)
Asks students to explain			
Some of the lessons(2)	-	-	2,7282(3,00)***
Never(3)	-	-	4,7220(0,84)
safe and orderly school			
somewhat safe and orderly(2)	-	-	2,4739(2,65)***
not safe and orderly(3)	-	-	2,1986(1,51)
Lack of resources			
somewhat affected(2)	-	-	-1,0673(-0,46)
affected a lot(3)	-	-	7,9559(1,54)
student controls			
Students desire			
Low desire(2)	-	-	-0,7368(-0,87)
Time spent on homework			
45 mins or less(2)	-	-	-1,3122(-1,59)
Usually does well in subject			
No(2)	-	-	-7,096(-5,76)***
Number of students	9898	9898	9898
Average R-squared	0,1688	0,1719	0,1903

*Note: t-values in parentheses. * p<.1; ** p<.05; *** p<.01*

Table 5

Teacher gender and overall scores per income area

	Low income area	High income area
Female teacher	**-4,1903(-1,99)****	**2,8676(2,06)****
Female teacher to female student	**4,1038(1,89)***	0,6217(0,38)
Years of experience		
less than 10 years(2)	4,7760(2,85)***	4,4336(3,49)***
Education level		
Below university level(2)	1,4813(0,69)	1,4505(1,29)
Class size		
Big class(2)	-0,9937(-0,49)	-2,5702(-1,29)
Further Controls		
Teacher controls		
teacher content with job		
no(2)	6,300(2,02)**	-4,6628(-1,71)*
Teachers lack of nutrition		
has lack of nutrition	-1,5340(-1,00)	2,2888(2,13)**
Teacher gives explanation		
some of the lessons(2)	7,6517(2,23)**	-4,1542(-3,31)***
Never(3)	-	-20,6821(-1,67)*
Teacher assigns homework		
more than once a week(2)	1,5607(0,69)	-5,67156(-3,70)***
less than once a week(3)	-2,6314(-0,91)	-2,8455(-1,62)
Teachers give quizzes		
about every two weeks(2)	-20,173(-2,75)***	9,8582(2,09)**
about once a month(3)	-16,305(-2,81)***	0,15336(0,04)
a few times a year(4)	-14,099(-2,39)**	0,6398(0,17)
Teachers follow curriculum		
no(2)	0,9780(0,56)	1,6088(1,57)
Asks students to explain		
Some of the lessons(2)	0,7271(0,44)	4,1884(3,25)***
Never(3)	6,9515(0,95)	-
safe and orderly school		
somewhat safe and orderly(2)	2,8268(1,56)	1,2091(0,93)
not safe and orderly(3)	0,4143(0,15)	0,15826(0,08)
Lack of resources		
somewhat affected(2)	3,7161(0,59)	-0,3745(-0,15)
affected a lot(3)	-	21,945(1,96)**
student controls		
Students desire		
Low desire(2)	-2,9776(-1,68)*	-1,0715(-1,00)
Time spent on homework		
45 mins or less(2)	-0,7763(-0,56)	-1,1783(-1,15)
Usually does well in subject		
No(2)	-6,7834(-3,32)***	-7,0429(-4,50)***
Number of students	3426	6160
Average R-squared	0,2890	0,1661

*Note: t-values in parentheses. * p<.1; ** p<.05; *** p<.01*