The Impact of Teacher Gender on Students' Academic Performance: Evidence from China

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Abstract. This research focuses on gender gaps and urban-rural gaps as two aspects that educational inequality is expressed in many areas. To close the achievement gap, this research is to examine the impact of same-sex teachers on pupils. I used data from roughly 20000 Chinese students who were chosen at random from 2013 to 2014, with the data being derived from the China Education Panel Survey. And 12730 students made up the final sample of my study after data cleaning. The results show that female teachers have no significant impact on the three subjects of female students, and no significant impact on the performance of male students is found when male teachers are involved. There is no substantial evidence to prove that same-sex teachers have a positive impact on students' performance. At the same time, the conclusion shows that female teachers have no significant impact on the performance of the other two subjects except for the English performance of female rural students, which is significantly improved by 1.342 points.

Keywords: gender gaps urban-rural gaps student-teacher interaction

1   Introduction

It is well known that one of the most common topics of debate in the study of economics is how education affects potential earnings in the future. The disparities in schooling have received increased focus in recent years. Education is a fundamental human right that is available to everyone. From a micro perspective, good education can pave the way for future success in terms of wealth and social standing. From a macro perspective, education is crucial for fostering social and economic progress[18]. However, it is no longer a positive situation that there is existing educational inequality. Inequity in education can be seen in a variety of ways, including in the varied origins, opportunities, and resources of students. As an illustration, biased or unfair educational practices result in the unfair treatment of students[17] disparities in family socioeconomic status (SES) or educational attainment result in educational gaps among students[20]. Students' gender may also have an impact on educational possibilities due to prejudices[11], as well as educational resources and economic discrepancies across various locations, leading to differences in the educational resources that students receive[6]. The gender

gap and the disparity between urban and rural areas are the key educational disparities explored in this research.

The urban-rural gap has been deeply explored as a case of educational inequality by a large number of researchers, and naturally, the study findings of the literature are varied. Early research revealed that the gap between urban and rural areas was not particularly significant[1 8 10]. However, a few scholars discovered that there seemed to be certain differences between rural and urban students as time went on. Some individuals believe that since urban students have greater advantages than rural students in terms of school resources, teacher resources, parental economic position, and other things, their grades are generally higher[19 22]. The traditional belief that rural students' grades must be lower than those of urban students owing to a lack of resources was challenged by researchers who discovered that rural students' grades were higher than those of urban students[14 21].

Another educational inequality that this paper focuses on is the gender gap. The gender gap is also constantly changing, and scholars' research covers every stage of students' learning: primary school[2], middle school[5] and higher education[12]. Among them, early research found that girls perform better in reading and literacy subjects, while boys have a relative advantage in mathematical science subjects[9]. As the research continues, some scholars found that girls were doing better and better, and the gap with boys in mathematics was constantly narrowing or even disappearing[13 15]. In order to narrow the gender difference, assigning teachers of the same sex becomes a better solution. A large number of existing articles have studied the influence of teachers' gender on students' educational outcomes. These studies either discover little connection between the two[4 13] or discover that same-sex teachers have a positive and significant effect on student's performance in school[3 5 7].

However, only a few works of literature have further subdivided the research object. For instance, Antecol and his co-workers further refined the research object and further explored the influence of female professors with strong mathematics backgrounds on same-sex students by using the moderating effect model[2]. Due to the specificity of the data in this paper, I was able to separate the students into two groups, urban students and rural students, using information from the questionnaire that included both types of student data. By doing this, I could examine the educational disparity between urban and rural middle school students in China and further investigate how teachers' gender affects the outcomes of rural and urban students.

With the data from China Education Panel Survey (CEPS), I attempt to address the following four points: (1) Does gender make a difference in academic performance? (2) Do students with urban and rural registration households perform differently academically? (3) Does having teachers of the same gender benefit student's performance? (4) What impact do same-sex teachers have on students' academic achievement in both urban and rural settings?

2   Data and Methods

2.1   Data

To address the ideas above, the China Education Panel Survey (CEPS) is the database which gathers a lot of personal data about students and teachers, and serves as the data source for this study. CEPS mainly distributes different questionnaires to five groups: students, parents, teachers of various subjects, homeroom teachers, and school administrators. The study sample consisted of around 20,000 students in the seventh and ninth grades. The PPS method resulted in the initial selection of 28 county-level units, the selection of 112 schools from these county-level units, and the subsequent selection of 438 classes. Lastly, for the investigation, students from these classes were chosen. The final samples consisted of 12730 students after screening the samples for missing characteristics. Notably, Chinese education has always included three core disciplines: Chinese, English, and mathematics. And the original score is on a scale of 150 points, for the regression analysis. The database supplied a simpler standardized test result in the 2013 midterm that I used (mean 70, standard deviation 10).

2.2   Summary Statistics

2.2.1 Descriptive Statistics

The article examines the effects of teacher gender on Chinese, math, and English grades, and whether student gender has a moderating effect. It uses grades in Chinese, math, and English as the explanatory variables. The statistical findings for each variable are shown in Table 1.

Table 1. Descriptive Statistics of characteristics of students, teachers, and school

Variable	Obs	Mean	Std.Dev.	Min	Max
Chinese	12,730	70.12494	9.757102	13.48523	94.16098
Math	12,730	70.16531	9.86617	8.421687	145.1149
English	12,730	70.02069	9.884604	11.34946	107.8161
Student sex	12,730	0.4956009	0.5000003	0	1
Teacher sex	12,730	0.9157895	0.2777142	0	1
Registration type	12,730	0 .551139	0.4973975	0	1
Student age	12,730	14.51296	1.229702	12	18
Parental education level	12,730	0.1251375	0.3308877	0	1
income	12,730	2.681775	0.6907735	1	5
Teaching experience	12,730	15.19411	8.555005	0	50
School location	12,730	0.6383346	0.4805015	0	1

According to Table 1, which shows the analysis of the findings of the student's background characteristics, the standard deviations of the students' three grades are all reasonably high (all larger than 9), indicating that the gap between the grades of the students is fairly apparent. The research sample has a comparatively low percentage of female students, as indicated by the mean student gender value of 0.495. The students' ages have a standard deviation of 1.229, which shows that although there is some variance in the ages of different students, they are largely the same age. The parents of the pupils have educational backgrounds that are generally poor, with the average educational level of the parents being 0.125, which means that a majority of the parents' educational backgrounds are junior college or below. Simultaneously, the average parental income is 2.68, which indicates that the majority of kids' parents have incomes that are below average. The student's family is primarily in the middle class or above, according to the average value of the economic region where they reside, which is 1.843. The analysis of the background characteristics of teachers reveals that women make up the majority of teachers, with a mean gender value of 0.915. Each teacher has a very distinct amount of experience teaching (standard deviation is 8.555).

2.2.2 Differentiation Analysis

This study uses an independent sample T-test and a difference analysis of the students' English, maths, and Chinese test scores. Table 2 displays the findings of gender gaps in students' achievement, whereas Table 3 displays the differences between urban and rural students' achievement.

Table 2. Student scores by subject and gender

Variables	Boy (0)	Mean1	Girl (1)	Mean2	MeanDiff
Chinese	6421	67.28	6309	73.03	-5.751***
Math	6421	69.58	6309	70.76	-1.174***
English	6421	67.20	6309	72.89	-5.689***
Teacher gender	6421	0.915	6309	0.917	-0.00200
Student gender	6421	0	6309	1	-1
Registration type	6421	0.555	6309	0.547	0.00800

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

According to the test scores for the three subjects in Table 2, girls generally perform higher than boys do, and at the 1% level are significant, demonstrating that there is a noticeable difference between the two groups' scores. However, it turns out that mathematics continues to have a minor gap between girls' and boys' performance—just 1.174 points separate the two. Girls significantly outperform boys in literacy subjects (i.e. Chinese and English), with differences of 5.751 points and 5.689 points, respectively. This pattern has also been observed in earlier research[16].

Table 3. Student scores by subject and household registration type

Variables	Urban (0)	Mean1	Rural (1)	Mean2	MeanDiff
Chinese	5714	70.23	7016	70.04	0.184
Math	5714	70.19	7016	70.15	0.0390
English	5714	70.32	7016	69.78	0.545***
Teacher gender	5714	0.908	7016	0.922	-0.014***
Student gender	5714	0.500	7016	0.492	0.00800
Registration type	5714	0	7016	1	-1

t statistics in parentheses
* p < 0.05, ** p < 0.01, *** p < 0.001

Table 3 shows that urban students outperform rural students in every subject, with an especially significant advantage for urban students in English. Additionally, I discovered that the significance values for both Chinese and Mathematics are higher than 0.1, indicating that there is not a significant distinction between urban and rural kids' test scores, while urban students' scores are slightly greater than those of students in rural areas. In particular, for the subject of English, I found that the average English score of urban students is 70.32, the average English score of rural students is 69.78, and at the 1% level, there is a significant difference between the two of them of 0.545. That means the English scores of urban students are significantly higher than those of rural students.

2.3   Model Specifications

Regression will be used to evaluate the effect of female teachers on student achievement in the manner described below:

$$Score_{ic} = \alpha + \beta female_{ic} + \gamma X_{ic} + \sigma + \varepsilon \tag{1}$$

Where $Score_{ic}$ represents the test score in subject i in classroom c, the indicator variable $female_{ic}$ represents If the teacher is female, the value is 1. Otherwise, it is 0. X_{ic} is a control variable which could also influence the scores of students, including student background characteristics, teacher background characteristics and school background characteristics. Student background characteristics include age, parents' income, the economic status of students, and the highest education level of parents. Teacher background characteristics include the experience of teaching. The school background characteristic is the location of the school. Finally, σ represents the school fixed effects, and ε is an error term. The average difference between male and female teachers' effects on male student achievement is represented by this coefficient β.

Similarly, I run the following regression model to account for the residence households of students:

$$Score_{ic} = \alpha + \beta female_{ic} + \varphi girl_{ic} + \rho rural_{ic} + \theta female_{ic} * rural_{ic} +$$
$$\delta female_{ic} * girl_{ic} + \mu female_{ic} * girl_{ic} * rural_{ic} + \gamma X_{ic} + \sigma + \varepsilon \qquad (2)$$

Where $girl_{ic}$ represents whether student i is a girl, the interaction term represents $rural_{ic}$ represents whether student i has the agricultural household registration. The interaction term $female_{ic} * rural_{ic}$ is equal to 1. It denotes a female instructor and a rural student. $female_{ic} * girl_{ic}$ if the teacher and the student are both female, and the rest of the variables are set up as they were before. The interaction term $female_{ic} * girl_{ic} * rural_{ic}$ is equal to 1, it refers to a female teacher and a female rural student. And φ indicates the average difference in academic performance between female and male students assigned to male teachers, while the difference between the effect of female professors on female students and male students is represented by δ. ρ implies the average influence in academic performance between rural and urban students assigned to male teachers. At the same time, θ represents how differently female professors affect students in rural and urban areas. μ measures how differently female professors affect girls and boys in rural and urban areas.

3   Findings and Discussions

3.1   Discussion of equation 1 and the regression findings

In order to study the impact of teacher gender on the achievements of various subjects, I conducted benchmark regression. The baseline regression results for Equation 1 are displayed in Table 4.

Table 4. Baseline regression: The impact of teacher gender on student performance

	(1) Chinese	(2) Math	(3) English
Teacher gender	-0.139	-0.186	0.377
	(-0.27)	(-0.37)	(0.74)
Student age	-0.699***	-0.575***	-0.740***
	(-7.33)	(-6.00)	(-7.84)
Parental education level	2.465***	3.002***	2.995***
	(5.45)	(7.36)	(7.40)
Income	0.153	0.190	0.109
	(0.73)	(0.93)	(0.53)
Teaching experience	0.0680***	0.0490**	0.0309
	(3.63)	(2.63)	(1.69)
School location	1.662	2.034	0.864
	(1.04)	(1.18)	(0.51)
Student economic status	0.298	0.538	0.668*
	(1.02)	(1.88)	(2.27)

Students dummy	included	included	included
R-squared	0.0214	0.0183	0.0229
F-statistics	2.22***	1.97***	2.32***
_cons	76.07***	73.18***	75.43***
	(39.92)	(38.12)	(40.73)
N	12730	12730	12730

t statistics in parentheses
$^{*} p < 0.05$, $^{**} p < 0.01$, $^{***} p < 0.001$

It can be seen from the regression results of the model that each model has passed the F test at the 1% level, indicating that the model can accurately anticipate regression. In order to study the impact of teacher gender on the grades of various subjects, I conducted a benchmark regression, and Table 4 reports the test results of the benchmark regression. The following will conduct a preliminary analysis of the results of Table 4. First of all, the first row of regression results shows the impact of teacher gender on the grades of three subjects. It can be seen that the impact of female teachers on the grades of three subjects is not significant. However, it is worth noting that female teachers have a slightly negative impact on the grades of Chinese and mathematics compared with male teachers. On the contrary, female teachers have a slight advantage in teaching English compared with male teachers ($\beta=0.377$).

3.2   Discussion of equation 2 and the regression findings

In order to expand our understanding of the effects of urban and rural backgrounds on educational results, I consist of these characteristics and further investigate the effects of same-sex teachers on the academic achievement of urban and rural students. The following conclusions may be derived by examining the most crucial variable in Table 5: the interaction term between female professors and female rural students.

Table 5. The different effects of female professors on female students with household registration in both rural and urban areas

	(1) Chinese	(2) Math	(3) English
Female teacher	1.511	1.804*	1.799*
	(1.68)	(2.15)	(2.14)
Female student	6.496***	1.908*	5.605***
	(8.65)	(2.55)	(7.75)
Rural student	1.635	2.736***	1.406
	(1.86)	(3.38)	(1.72)
Female Teacher*Female student	-1.029	-0.811	-0.383
	(-1.25)	(-0.97)	(-0.48)

Female Teacher*Rural Student	-1.793	-2.216[*]	-2.308[**]
	(-1.92)	(-2.53)	(-2.64)
Female Teacher*Female student*Rural Student	0.485	-0.0851	1.342[**]
	(1.10)	(-0.18)	(3.00)
Student age	-0.596[***]	-0.568[***]	-0.625[***]
	(-6.52)	(-5.93)	(-6.92)
Parental education level	2.496[***]	3.175[***]	2.947[***]
	(5.62)	(7.66)	(7.40)
Parental income	0.156	0.202	0.105
	(0.79)	(0.99)	(0.54)
Teaching experience	0.0506[**]	0.0456[*]	0.0110
	(2.82)	(2.45)	(0.62)
School location	1.056	2.130	0.0706
	(0.67)	(1.22)	(0.04)
Student economic status	0.363	0.561[*]	0.728[**]
	(1.29)	(1.96)	(2.63)
Students dummy	included	included	included
_cons	70.50***	70.15***	70.40***
	(35.96)	(34.92)	(37.36)
N	12730	12730	12730

t statistics in parentheses

[*] $p < 0.05$, [**] $p < 0.01$, [***] $p < 0.001$

In all three subjects, female students do better than male students when teachers of the same sex have been allocated to male students, according to the regression result of the second row. Particularly in Chinese and English, they significantly exceed 6.496 and 5.605 at the level of 1%, respectively. This shows that female students have a major advantage over male students in literacy topics like Chinese and English. However, despite the fact that female students outperform male students in mathematics, it is clear that the gap between the two genders is not as large as it is in the other two subjects, which is in line with the findings of the analysis of the grade gaps between male and female students in Table 2. According to the third row, I discovered that male teachers have a better educational impact on rural students than urban students, particularly in mathematics, by examining the regression findings.

The difference in how female teachers affected students of different sexes is shown in the fourth row. It is true even though the difference between the scores of the female teachers for female students and the scores of the male teachers for other students was not statistically significant. The regression findings for the other control variables are similar to those in Table 4. In comparison to other students (including male rural students assigned to female teachers, male urban students assigned to female teachers, and

students taught by female teachers), female teachers have a slight advantage over female rural students in Chinese and English achievement, particularly English achievement, which can be significantly higher by 1.342 points, reaching the significant level of 5%.

4   Conclusion

This paper proposes four research questions, which are analyzed through a series of empirical studies, and draws corresponding conclusions. Firstly, the purpose of the first two questions is to determine whether there is now any educational disparity among the middle school pupils polled. For the first study question, regardless of whether there is a gender gap, the majority of past studies revealed that females were more dominant in literacy subjects while boys were more dominant in science and mathematics. This study found that girls scored higher than boys in all three required subjects, reversing the disadvantage in mathematics, although the advantage of girls in this subject was not as obvious as that in the other two literacy subjects. For the second research question, whether there is a difference between urban and rural areas, I found two cases: one case is that when taught by male teachers, rural students performed better than urban students in all subjects. The other case is that when taught by female teachers, rural students performed worse than other students in all subjects, and this difference was particularly obvious in mathematics. These findings demonstrate the persistence of various types of educational inequality in China.

Secondly, the final two questions largely investigate how the gender of teachers affects the academic performance of various student groups. The main goal of the third question is to explore how same-sex teachers affect students' academic performance. This study indicates neither a significant influence of female instructors on the three subjects of female students nor a significant impact of male teachers on the achievements of male students, while it does not offer strong evidence to support the positive effect of same-sex teachers on student achievement. The majority of literature focuses on the effects of same-sex teachers on students, but this paper's final research question further divides the research subjects into four types of students (Male and female students with rural registration households, male and female students with urban registration households) to examine the effects of same-sex teachers on educating achievement of urban and rural students. It has been discovered that the assignment of same-sex instructors is impacted by the introduction of urban and rural household backgrounds.

My research results show that the allocation of teachers of the same sex only has a significant positive increase in the English achievement of female rural students. And it has no significant impact on the other two subjects. This research result is only a preliminary attempt to introduce the urban and rural background factors. More and more research required to determine the reasons. In order to promote educational fairness and raise the standard of education, it is necessary to do a more in-depth study on the effects of same-sex instructors and background variables from urban and rural areas on the achievement of students.

However, a few limitations must be taken into consideration. First of all, students' various psychological and learning states are likely to shift as they mature since we all know how quickly youngsters grow up. Nevertheless, the study data CEPS utilized in this article is cross-sectional data. It is not feasible to examine the temporal trend because of the features of cross-sectional data, so the observation of students' states is relatively limited and cannot be guaranteed. Second, due to the limitation of data sources, the randomness of data cannot be guaranteed. The vast majority of school administrators (83.56%) feel that students are randomly assigned to various classrooms in the questionnaire data from schools, thus I assume that both instructors and students are distributed at random. Further suggestions for future research are that, if conditions permit, a larger time span of data should be used for the study to determine whether the difference in student achievement and the impact of teacher gender on student achievement changes over time. In addition, when taking data, it is necessary to ensure that students are randomly assigned to teachers in each subject when they enter the school, and that students are taught by the teacher assigned at the beginning of the survey, which can effectively reduce the bias of the results.

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