Faculty Gender and Student Performance in Male- and Female-dominated Fields*

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Abstract

This paper examines the effect of teacher gender on the academic performance of students in higher education, with a focus on male- and female-dominated fields. Using comprehensive administrative records of students, teachers, and classes from a private university in Chile over a ten-year period, we estimate fixed-effects models and focus on first-semester students to achieve identification. Our results reveal that teacher gender has an impact on student grades, with notable differences across program types. In female-dominated fields, female students benefit from having a female teacher in comparison to a male teacher, experiencing a grade increase of 0.112 SD. In male-dominated fields, female teachers have an even greater impact, improving grades by 0.286 SD and 0.185 SD for female and male students, respectively. Furthermore, this positive effect of female teachers is amplified in larger classes and among high-achieving students. These findings highlight a complex interplay between teacher bias and role model effects, with female teachers potentially favoring female students and inspiring them as aspirational figures. The heterogeneity of effects across program types underscores the importance of context in understanding the classroom gender dynamics and their implications for academic performance.

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1 Introduction

Despite global efforts to reduce gender inequalities, significant gaps persist, as evidenced by women's limited access to quality employment and enduring wage disparities (World Economic Forum, 2023). These gaps are especially pronounced in STEM fields, where women are underrepresented and face barriers to securing high-paying roles in male-dominated sectors (Aguirre et al., 2020).

Research attributes these disparities to factors such as societal stereotypes (Carrell et al., 2010; Gong et al., 2018), biases (Hoffmann and Oreopoulos, 2009; Lavy and Sand, 2018), a lack of female role models (Paredes, 2014; Hand et al., 2017), workplace preferences (Zafar, 2013), self-perception of abilities (Lindberg et al., 2013; Sansone, 2019), and gender-related social norms (Nollenberger and Rodríguez-Planas, 2017). Together, these elements reinforce occupational disparities and limit women's representation in STEM fields.

According to UN Women, a key contributor to the wage gap is the concentration of women in lower-paying sectors. Historically, women have been associated with caregiving, teaching, and healthcare roles, which typically offer lower wages compared to male-dominated fields such as engineering, technology, and finance (International Labour Organization, 2019).

In Chile, as in most OECD countries, women's enrollment in higher education surpasses men's (OECD, 2022). However, women remain underrepresented in STEM fields and overrepresented in humanities, education, health, and the arts (Bettinger and Long, 2005; Zafar, 2013; Bordón et al., 2020). This underrepresentation restricts access to economic opportunities and reinforces wage inequalities.

Educational environments play a critical role in shaping career trajectories. From early schooling, gender differences in academic performance are evident, with girls excelling in reading and boys in mathematics. These differences influence traditional gender roles and career aspirations. Teachers, who are central to students' academic development and performance, as well as their program preferences, may contribute to these dynamics (Brenøe and Zölitz, 2020).

Teacher gender might be particularly relevant in male- and female-dominated fields. In male-dominated fields, stereotypes and biases create challenges for female students, reinforced by the lack of female role models (International Labour Organization, 2019). Conversely, male students in female-dominated fields may face challenges tied to societal expectations and limited role models, leading to perceptions of them as atypical. These dynamics raise the question of whether faculty gender influences students' academic performance differently across male- and female-dominated programs.

Research on the effect of teacher gender spans primary, secondary, and higher education. At the primary and secondary levels, studies have shown mixed results, with some indicating modest benefits of gender matching (Paredes, 2014; Dee, 2007), while others find limited effects (Gong et al., 2018; Lavy and Sand, 2018).

In higher education, the impact of teacher gender varies by context and field of study. Hoffmann and Oreopoulos (2009) analyze gender interactions between professors and first-year undergraduates at the University of Toronto and find that teacher gender has a limited influence on academic performance and subject interest. Students taught by professors of the same gender are slightly less likely to drop a course and achieve marginally higher grades, with these effects most pronounced among low-performing students.

In contrast, Carrell et al. (2010) investigate the role of teacher gender in STEM courses at the U.S. Air Force Academy using a quasi-experimental approach. They find that teacher gender significantly affects female students' performance in mathematics and science and their likelihood of pursuing STEM programs. Female students taught by male professors are less likely to remain in STEM fields, underscoring the importance of female role models in reducing gender gaps in these disciplines. These contrasting findings highlight the need for further research on how teacher gender influences academic outcomes across male- and female-dominated fields.

In this paper, we contribute to the literature by estimating the impact of teacher gender on students' immediate academic performance in higher education, focusing on three types of degree programs: male-dominated fields such as STEM, female-dominated fields such as Health and Education, and gender-balanced fields such as Law and Business.

We use administrative records from *Universidad de los Andes*, a private university in Chile offering undergraduate degrees in various disciplines. We have access to student-level information, such as socioeconomic background, high school academic performance and final grades, and class-level characteristics for each subject taken. Additionally, we have teacher-level data that enables us to isolate the effect of teacher gender on student grades.

Our identification strategy leverages the restriction of the sample to first-year students in first-semester classes, where students have no autonomy in selecting subjects, teachers, or schedules, as these are automatically assigned by the institution. For subjects with multiple classes, students are randomly assigned to classes. This automatic and randomized assignment effectively mitigates self-selection biases related to teacher gender.

To further strengthen identification, we include student fixed effects in our regression models, exploiting the fact that students are observed across multiple classes during their first semester. This controls for unobserved individual heterogeneity that varies between students but remains constant across their classes. Under the assumption that, conditional on student fixed effects and observed class and teacher characteristics, remaining errors are uncorrelated with teacher gender, we interpret the teacher gender effect as causal.

In male-dominated programs, we find that female teachers positively influence student performance compared to male teachers. Male students improve their grades by 0.185 SD on average when taught by a female teacher, while female students experience a larger increase of 0.286 SD. This effect is driven by high-achieving students and is amplified in classes with a higher proportion of female students, where grades increase by 0.309 SD for both genders. Larger classes see even greater improvements, with increases of 0.415 SD for male students and 0.525 SD for female students. These results align with the role model hypothesis, as the underrepresentation of female teachers in STEM fields amplifies their impact. Notably, the positive effect of female teachers is stronger among older teachers without doctoral degrees.

In female-dominated programs, only female students benefit from having female teachers, with an average grade increase of 0.112 SD. This finding suggests a teacher bias channel, where female professors may teach female students more effectively and interact with male students differently due to stereotypes. However, deeper analysis reveals that high-achieving male and female students both experience improvements of 0.122 SD when taught by female teachers. Similar to male-dominated programs, the effects are concentrated among non-doctoral female teachers, with grade increases of 0.130 SD for male students and 0.276 SD for female students.

In gender-balanced programs, however, teacher gender does not significantly affect student performance. The observed heterogeneity across fields highlights the importance of context in shaping the impact of teacher gender, with teacher bias and role model effects playing distinct roles in male- and female-dominated fields.

This paper adds to the literature on gender effects by focusing on gender-dominated contexts and demonstrating that the gender composition of both faculty and students matters when evaluating teacher effectiveness. Understanding these dynamics is crucial for developing strategies to promote gender parity and equitable opportunities, particularly in lucrative, male-dominated fields. By increasing the representation of female educators in traditionally male-dominated disciplines, universities can help bridge gender disparities in STEM fields.

The remainder of this paper is organized as follows. Section 2 presents the data and descriptive statistics. Section 3 outlines the methods used to estimate the effect of teacher gender. Section 4 discusses the results, while Section 5 provides an in-depth analysis. Finally, Section

6 concludes.

2 Data and Descriptive Statistics

We use administrative data from *Universidad de los Andes*, a leading private university in Chile that offers 27 undergraduate programs across fields such as Social Sciences & Business, STEM, Health & Medical Sciences, Humanities, Education, and Law. Chilean universities follow a semester-based academic calendar, with two semesters per year: the first semester runs from March to July, and the second semester spans August to December. Most students enroll in the first semester of a given year. Each subject (course) lasts for a full semester, meaning students complete it within that period before progressing to the next. In smaller programs, a subject and a class are often the same, while in larger programs, a subject may be offered in multiple classes within a semester, each covering the same content but potentially scheduled at different times or taught by different teachers.

For every semester from 2012 to 2022, we have access to all undergraduate student records, along with faculty and class information. Student records include socioeconomic and academic data such as gender, date of birth, nationality (Chilean or foreign), municipality of residence, high school's funding scheme (private, voucher, or public), national standardized admission scores (PSU average score), type of enrollment (standard or special), and degree program. Teacher data includes gender, date of birth, nationality, educational level (bachelor's, master's, or Ph.D.), and type of contract (full-time or adjunct). Class records contain information such as subject name, teacher and student identifiers, final grades and pass/fail indicators. We generate additional class-level variables, including class size and class female proportion, to account for classroom dynamics in our regression models. Using individual identifiers, we merge class information with student and teacher characteristics, resulting in a final database where each observation corresponds to a unique student-class record.

To address potential self-selection biases, we limit our analysis to the sample of calendar first-semester enrollees in classes that belong to the first semester of the program curriculum. This restriction ensures that students are automatically and randomly assigned to teachers, as discussed in detail in section 3. Our final sample consists of 74,668 records, covering 11,666 students, 757 teachers, and 3,152 classes.

We further classify classes into three gender categories based on the proportion of female students in each of the 27 degree programs: male-dominated (less than 33% female students, primarily STEM fields), gender-balanced (33% to 67% female students, e.g., Philosophy, Law, Communication, and Business), and female-dominated (more than 67% female students, e.g., Nursing, Pedagogy, and Odontology). Figure 1 presents the proportion of female students and the number of students enrolled in each program, illustrating the distribution across gender categories. Appendix A provides a full list of degree program names and codes by gender category. We use the 33% and 67% thresholds to ensure an even distribution of classes across gender categories, allowing us to examine how teacher gender effects vary across different gender contexts in higher education.

Figure 1: Female proportion and Student enrollment by program

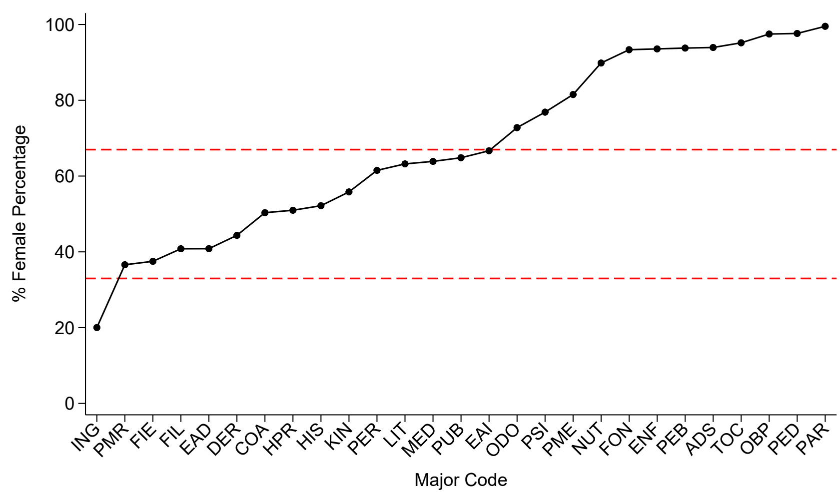


Table 1 presents summary statistics by gender category. In terms of academic performance, using the Chilean grading system (1.0 to 7.0, where 1.0 is the lowest and 7.0 is the highest, with a passing threshold of 4.0), male-dominated programs exhibit the lowest grade point average (4.84) and approval rates (81%), while female-dominated programs show the highest grades (5.63) and approval rates (96%). Additionally, female-dominated programs display the lowest variability in grades and approval rates compared to other gender categories.

Table 1: Descriptive Statistics by Gender Composition

	Male-Dominated		Female-Dominated		Gender-Balanced	
	Mean	SD	Mean	SD	Mean	SD
Classes and teachers						
Grade	4.844	0.892	5.626	0.722	5.043	0.804
Pass/Fail	0.809	0.229	0.960	0.085	0.892	0.167
Female Teacher	0.277	0.448	0.687	0.464	0.418	0.494
Female Student Prop.	0.205	0.079	0.886	0.172	0.495	0.159
Class size	51.798	12.792	34.187	21.087	41.912	23.970
Teacher Age	40.560	13.146	47.689	11.001	46.357	11.207
Teacher Education						
Professional	0.348	0.477	0.339	0.474	0.207	0.405
Masters	0.311	0.464	0.484	0.500	0.406	0.491
Doctoral	0.341	0.475	0.177	0.382	0.388	0.487
Chilean Teacher	0.901	0.299	0.954	0.209	0.934	0.249
Full Time Contract	0.227	0.420	0.418	0.493	0.431	0.495
Students						
Female Student	0.206	0.404	0.902	0.298	0.506	0.500
Student Age	18.948	1.165	19.897	4.122	19.028	1.330
Chilean Student	0.971	0.169	0.980	0.138	0.974	0.160
School Type						
Private	0.839	0.368	0.823	0.381	0.865	0.341
Public	0.058	0.234	0.050	0.218	0.039	0.193
Voucher	0.103	0.304	0.127	0.333	0.096	0.295
PSU Average	662.351	42.532	632.232	48.323	658.163	64.003
Standard Admission	0.812	0.391	0.787	0.410	0.844	0.363
Municipality						
Las Condes	0.332	0.471	0.261	0.439	0.287	0.452
Lo Barnechea	0.185	0.389	0.169	0.375	0.216	0.412
Vitacura	0.095	0.294	0.093	0.290	0.099	0.299
Other	0.388	0.487	0.477	0.500	0.398	0.490

Notes: Notes: SD corresponds to Standard Deviation. The dataset comprises information about the gender category male-dominated, female-dominated, and gender-balanced. These categories include 1,993; 4,541, and 5,012 students respectively; 101; 245 and 267 teachers respectively; and 267; 1,167 and 1,122 classes respectively.

Regarding class characteristics, male-dominated programs have the lowest proportion of female students (21%), while female-dominated programs, as expected, have the highest (89%). Gender-balanced programs maintain a more equal distribution of male and female students. Additionally, male-dominated programs tend to have the largest class sizes (51.80 students on average), followed by gender-balanced (41.91) and female-dominated programs (34.19).

On average, female teachers represent 28% of faculty in male-dominated programs, 42% in gender-balanced programs, and 69% in female-dominated programs. This distribution aligns with the proportion of female students, as female teachers are more prevalent in programs with higher female enrollment and less so in male-dominated fields.

Figure 2: Grades and Female Teacher Proportion by Gender Category

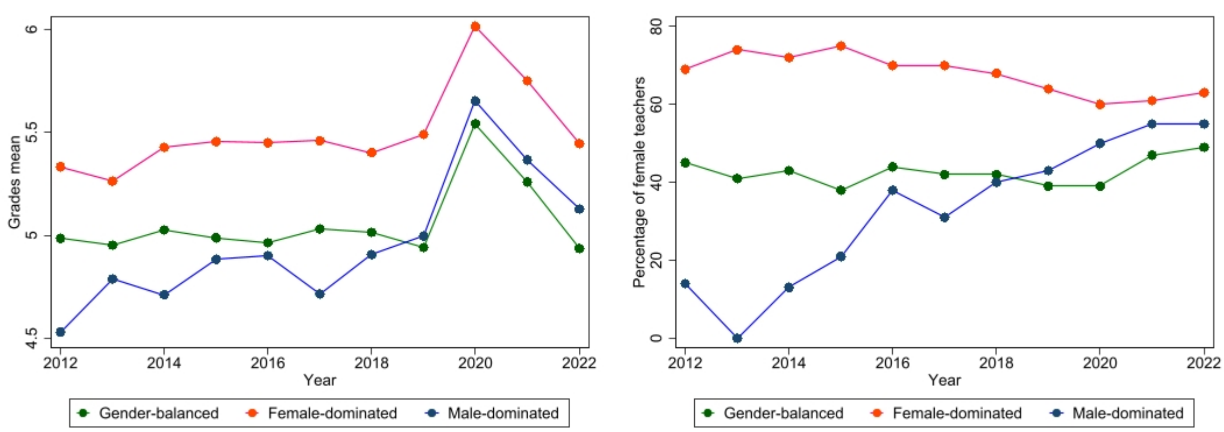
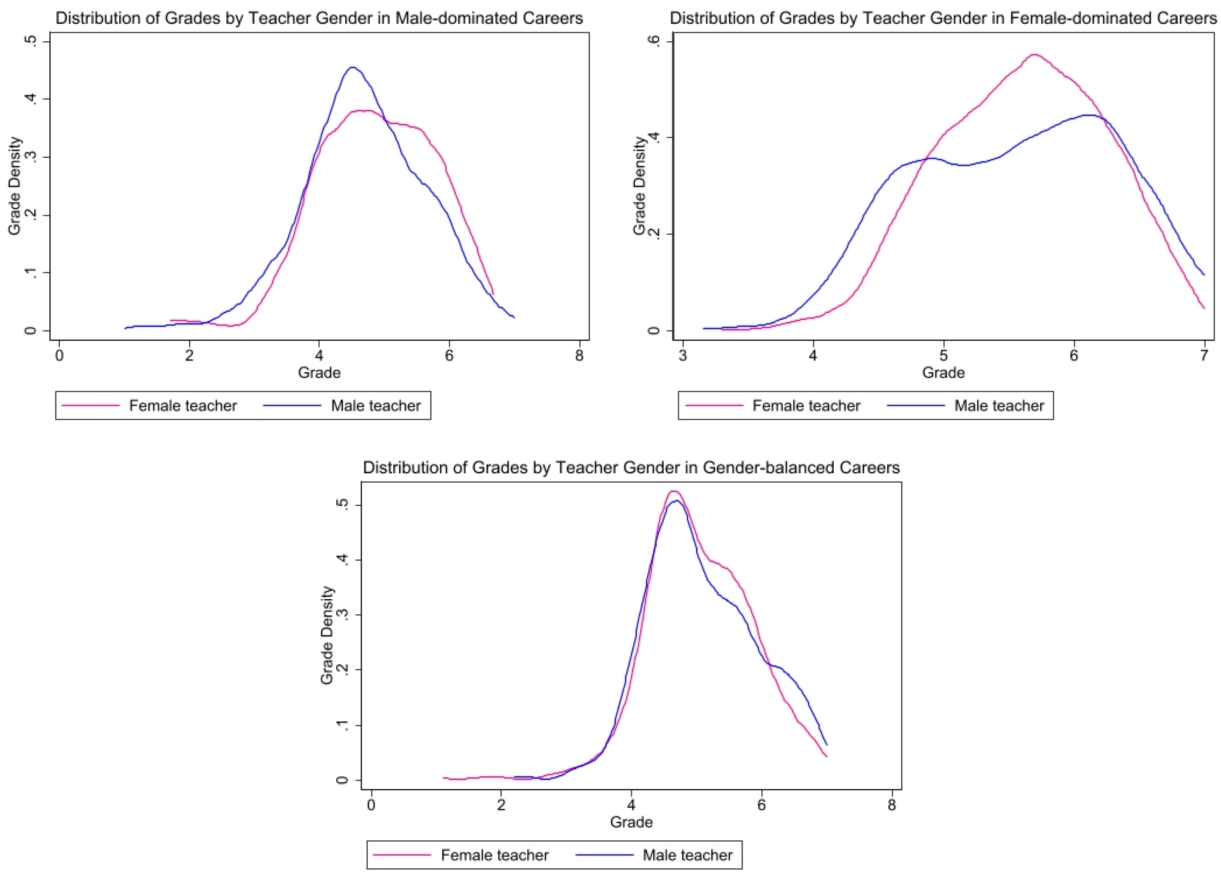


Figure 2 presents the evolution of grades and the proportion of female teachers from 2012 to 2022, categorized by gender composition. The left panel shows that female-dominated programs consistently achieve the highest grades, while male-dominated programs exhibit the lowest, until 2019, when gender-balanced programs began recording the lowest average grades. Interestingly, the right panel, which depicts trends in the proportion of female teachers, exhibits similar patterns. Female-dominated programs have the highest share of female teachers, while male-dominated programs have the lowest. However, the proportion of female teachers in male-dominated programs shows an upward trend over time, gradually surpassing gender-balanced programs from 2019 onward. This trend may reflect broader societal and institutional changes aimed at addressing gender disparities in STEM fields.

Figure 3: Students Grades by Gender Category and Gender Teacher



To further analyze these trends, Figure 3 illustrates grade distributions by teacher gender across gender categories. In male-dominated programs (top left panel), students in classes taught by female professors achieve higher grades than those taught by male professors, with an average of 5.06 vs. 4.88, a difference of 0.18 points (significant at 1%). In female-dominated programs (top right panel), female professors also achieve slightly higher student grades compared to male professors (5.54 vs. 5.41, difference: 0.13 points, significant at 1%). Lastly, in gender-balanced programs (bottom panel), grade distributions are similar between male and female professors, with averages of 5.07 vs. 5.04, a difference of 0.03

points (significant at 5%). These results underscore the potential influence of teacher gender on academic performance and highlight the importance of considering gender dynamics in educational settings, particularly in fields with significant gender imbalances.

3 Methods

This section outlines the econometric models used to assess the causal effect of teacher gender on student performance. We describe our identification strategy and present empirical evidence supporting its validity.

As explained in section 2, the dataset consists of repeated cross-sectional data, where each first-year student i enrolls in approximately six classes during their first semester. Each class $k \in \{F, M, B\}$ is taught by teacher j, where F, M, B represent female-dominated, male-dominated, and gender-balanced categories, respectively. Note that a class is taught by a single teacher, although they may teach multiple classes over time and even within a given semester.

To identify the effect of teacher gender on academic performance, our base model is:

$$Y_{ijk} = \beta_0 + \beta_1 FT_j + \beta_2 FP_k + \beta_3 FP_k^2 + \beta_4 FT_j \times FP_k + \beta_5 FT_j \times FP_k^2 + \gamma X_i + \delta Z_{jk} + u_{ijk} \quad (1)$$

The outcome variables Y_{ijk} include (i) the final grade, standarized at the gender category level to account for differences in grading standards across programs, and (ii) a binary variable indicating whether the student passed the class, defined as achieving a grade of 4.0 or higher on the Chilean grading scale. FT_j is an indicator for whether teacher j is female, while FP_k denotes the proportion of female students in class k, included in the model as a second-degree polynomial. The interaction terms $FT_j \times FP_k$ and $FT_j \times FP_k^2$ allow us to examine whether the effect of teacher gender varies nonlinearly with the proportion of female students in the class.

To ensure robust results to different specifications, we include various control variables. X_i is a vector of student characteristics (e.g., cohort, age, nationality, school type, PSU admission score, municipality of residence and admission type), while Z_{jk} includes teacher (e.g., age, educational level, nationality and contract type) and class characteristics (e.g., size).

Additionally, we incorporate student fixed effects in alternative specifications to account for both observed (X_i) and unobserved individual heterogeneity. By including student fixed effects, we control for class-invariant unobservable characteristics, such as innate ability or motivation, that could otherwise bias our estimates of the effect of teacher gender on student performance. This approach strengthens the exogeneity of teacher gender, as causal identification relies on the assumption that, conditional on student fixed effects and class-teacher control variables, teacher gender is orthogonal to idiosyncratic errors.

After estimating the effect of teacher gender on student performance and its variation by class gender composition, we extend our analysis by estimating separate models for each gender category:

$$Y_{ijk} = \beta_0 + \beta_1 FS_i + \beta_2 FT_j + \beta_3 FT_j \times FS_i + \vec{\gamma} X_i + \vec{\delta} Z_{jk} + u_{ijk} \quad \forall k \in \{F, M, B\} \tag{2}$$

Here, FS_i is an indicator for whether student i is female, which is removed along with X_i when incorporating fixed effects in the alternative specification. In this case, parameter β_3 captures the differential effect of teacher gender based on student gender.

To establish a causal relationship between teacher gender and student performance, it is essential to ensure the independence of the treatment variable (FT_j) from unobservables (u_{ijk}). To achieve identification, we restrict the sample to first-semester students enrolled in first-semester classes, addressing potential self-selection biases that arise as students progress in their academic programs and gain autonomy in selecting subjects, teachers, and schedules. During this initial stage, students are automatically assigned to classes, eliminating the possibility that their individual preferences regarding professor gender influence the treatment received. Additionally, in subjects with multiple classes, student assignment is randomized, further mitigating selection concerns.

To empirically validate our identification strategy, we follow Paredes (2014) and Carrell et al. (2010) by regressing teacher gender FT_j on student characteristics X_i to test for correlations between treatment and observable confounders. If teacher gender is not significantly correlated with observed student characteristics, it suggests that teacher assignment is as good as random, supporting the plausibility of independence between teacher gender and unobservables u_{ijk} in the causal models.

Table 2: Balancing Test Male-dominated Programs

	Coefficient	Std. err.
PSU Average	-4.974**	2.178
Student Age	-0.069	0.470
Standard Admission	0.022	0.029
Chilean Student	-0.002	0.009
School Type		
Private	-0.014	0.011
Public	0.005	0.006
Voucher	0.009	0.008
Municipality		
Las Condes	0.038**	0.019
Lo Barnechea	-0.034*	0.017
Vitacura	-0.015	0.014
Other	0.011	0.009

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. A simple regression is estimated for each student characteristic. Clustered Standard errors at the class level.

Table 2 presents the regression results for male-dominated programs. Variables such as age, admission type, nationality, and school type are not significantly correlated with teacher gender. While admission scores and residential municipality show statistically significant coefficients, their economic magnitude is negligible. For instance, the PSU admission score differs by less than 5 points, which is inconsequential given its 150–850 point scale. Similarly, differences in municipality proportions are below 4 percentage points, a minimal variation. Regression tables for female-dominated and gender-balanced programs, presented in Appendix B, yield similar results, with no strong evidence of correlation between teacher gender and student characteristics. These findings support the independence assumption, reinforcing the validity of our identification strategy.

4 Results

This section presents the main results by gender category. Our findings reveal the influence of teacher gender on academic performance, measured by final grade and approval condition. In addition, heterogeneity analysis is conducted to better understand if these effects vary according to class and/or teacher characteristics.

4.1 Main Results

Tables 3, 4, and 5 present estimation results for models as described in Equation 2, separately analyzing both grades and approval rates in male-dominated, female-dominated, and gender-balanced programs, respectively. In columns (1) and (5), regression models consider student performance solely in relation to the variables of interest: Female Teacher (FT_j), Female Student (FS_i), and their interaction ($FT_j \times FS_i$). Columns (2) and (6) include controls for student characteristics. Transitioning to columns (3) and (7), teacher and class characteristics are further added. Finally, columns (4) and (8) additionally account for student fixed effects. Linear probability models are estimated for the pass/fail outcome. Clustering of errors is performed at the class level, accounting for any correlation in outcomes for students in the same class as done by Gong et al. (2018) and Hoffmann and Oreopoulos (2009).

Table 3 presents the results regarding the effect in male-dominated programs. Concerning the effect on grades when male students have a female teacher in comparison to a male teacher, we find that as we incorporate student-, teacher-, and class-control variables, the coefficient remains around 0.127 standard deviations (SD). In particular, with the inclusion of student fixed effects, the effect becomes significant at 10%, indicating that male students increase, on average, their grades by 0.185 SD.

Table 3: Main Results for Male-Dominated Careers

	Grade				Approved			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female Teacher (FT)	0.127	0.014	0.136	0.185*	0.051*	0.017	0.033	0.047
	(0.100)	(0.097)	(0.095)	(0.103)	(0.027)	(0.026)	(0.027)	(0.030)
Female Student (FS)	0.165***	0.041	0.032	-	0.042***	0.003	-0.000	-
	(0.034)	(0.031)	(0.026)	-	(0.012)	(0.012)	(0.012)	-
FT × FS	0.088*	0.100**	0.106**	0.102**	-0.000	0.006	0.008	-0.007
	(0.053)	(0.048)	(0.046)	(0.050)	(0.018)	(0.019)	(0.019)	(0.019)
Student Characteristics	No	Yes	Yes	No	No	Yes	Yes	No
Teacher/Class Characteristics	No	No	Yes	Yes	No	No	Yes	Yes
Student Fixed Effects	No	No	No	Yes	No	No	No	Yes
Observations	10,691	9,299	9,276	10,620	10,691	9,299	9,276	10,620

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

The interaction coefficient consistently exhibits statistical significance, underscoring a notable distinction in the effects observed for male and female students. As a result, Table 3 reveals that female students derive significant benefits from having a female teacher in all four models, showing a positive and significant coefficient. Upon examination of column (4), we find that, on average, the benefit amounts to (0.185+0.102) 0.286 SD, significant at 5%. Furthermore, the results show no discernible effect of teacher gender on the approval probability for both genders.

Table 4 presents the results in female-dominated programs. For male students we find that, in general, there is no discernible effect on grades nor approval rates when taught by a female teacher in comparison to a male teacher. Regarding female students we find that, when including teacher and class characteristics and then student fixed effects, the interaction becomes positive and significant. Therefore, female students having a female teacher exhibit a positive and significant (at the 5% level) increase in grades of 0.112 SD on average. In addition, female students have a probability of passing 3.3 pp higher when taught by a female teacher, which can be considered rather small given a passing rate of 96% in average.

Table 4: Main Results for Female-Dominated Careers

	Grade				Approved			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female Teacher (FT)	0.067	0.252***	0.031	-0.001	0.003	0.018	0.008	0.013
	(0.079)	(0.080)	(0.069)	(0.062)	(0.012)	(0.014)	(0.014)	(0.011)
Female Student (FS)	0.177***	0.285***	0.121***	-	0.012	0.018*	0.011	-
	(0.049)	(0.045)	(0.034)	-	(0.009)	(0.010)	(0.010)	-
FT × FS	0.068	0.060	0.107*	0.113**	0.022*	0.025*	0.025*	0.020*
	(0.064)	(0.063)	(0.056)	(0.053)	(0.012)	(0.014)	(0.014)	(0.012)
Student Characteristics	No	Yes	Yes	No	No	Yes	Yes	No
Teacher/Class Characteristics	No	No	Yes	Yes	No	No	Yes	Yes
Student Fixed Effects	No	No	No	Yes	No	No	No	Yes
Observations	28,692	23,539	23,507	28,653	28,737	23,583	23,551	28,698

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

Lastly, Table 5 presents the results in gender-balanced programs. We find that, as control variables are incorporated, the effect does not change drastically. For male students, the effect of having a female teacher on grades and approval condition is mostly nonsignificant. On the other hand, as control variables are included, the interaction terms become significant at the 1% level, suggesting a difference between male and female students. However, we find that the effect of having a female teacher on grades for female students is of -0.001 SD nonsignificant, while the effect on approval condition is of 1.5 pp (significant at the 5% level), but once again a rather small effect considering a mean passing rate of 89%.

Table 5: Main Results for Gender-Balanced Careers

	Grade				Approved			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Female Teacher (FT)	-0.059	0.005	-0.063	-0.065*	-0.008	0.001	-0.009	-0.009
	(0.051)	(0.044)	(0.039)	(0.037)	(0.011)	(0.010)	(0.010)	(0.010)
Female Student (FS)	0.321***	0.202***	0.069***	-	0.050***	0.024***	0.010*	-
	(0.019)	(0.019)	(0.015)	-	(0.005)	(0.005)	(0.005)	-
FT × FS	0.038	0.079***	0.085***	0.064***	0.021**	0.024***	0.024***	0.025***
	(0.028)	(0.027)	(0.025)	(0.023)	(0.008)	(0.009)	(0.009)	(0.008)
Student Characteristics	No	Yes	Yes	No	No	Yes	Yes	No
Teacher/Class Characteristics	No	No	Yes	Yes	No	No	Yes	Yes
Student Fixed Effects	No	No	No	Yes	No	No	No	Yes
Observations	28,712	25,306	25,306	28,668	28,712	25,306	25,306	28,668

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

4.2 Heterogeneity by Class Characteristics

We now conduct a heterogeneity analysis to gain a deeper understanding of the interplay between different class characteristics and the effect of teacher gender on academic performance. Results are presented for each gender category, and comparisons are drawn between the findings obtained for the entire dataset as in subsection 4.1, where student fixed effects are used, and those observed when the dataset is divided into subsets. Heterogenous effects are analyzed in terms of grades distribution (terciles), the median proportion of female students and median class size.

Table 6 presents the results for heterogeneity in male-dominated programs. In these fields, grades are distributed as follows: the 1^{st} tercile shows an average grade of 4.22, the 2^{nd} tercile of 4.97, and 3^{rd} tercile of 5.60. The median proportion of female students is approximately 21%, and the median class size is around 56 students.

First, in terms of grade distribution, we find that students in the 3^{rd} tercile are the ones that experience the benefits of having a female teacher. This positive effect of 0.181 SD (significant at 5%) for both male and female students, suggest that high-performing students gain more from female instructors regardless of their own gender.

Secondly, in classes where the proportion of female students exceeds 21%, the presence of a female teacher also leads to an improvement in performance regardless of student gender. For both male and female students the effect is 0.309 SD (significant at 5%). This indicates that a higher representation of female students in a class amplifies the positive impact of female teachers, potentially due to a more supportive and relatable classroom environment.

Lastly, we find that larger classes generally have a positive effect on student performance for both male and female students when taught by a female teacher in comparison to a male teacher. However, the magnitude of this benefit differs between genders. Female students benefit significantly more, with an increase of 0.525 SD, compared to a 0.415 SD improvement for male students. This suggests that female teachers are particularly more effective than male teachers in managing and delivering quality education in larger classes, especially for female students.

Table 6: Heterogeneity of Classes Characteristics on Male-Dominated Career Grades

		Terciles			Female Percentage		Class size	
	Full Sample	1^{st}	2^{nd}	3^{rd}	< 0.21	≥ 0.21	< 56	≥ 56
Female Teacher	0.185*	0.156	0.143	0.181**	0.031	0.309**	0.045	0.415**
	(0.103)	(0.125)	(0.106)	(0.090)	(0.167)	(0.144)	(0.147)	(0.163)
FT × FS	0.102**	-0.058	0.147	0.091	0.049	0.064	0.084	0.110*
	(0.050)	(0.109)	(0.108)	(0.067)	(0.087)	(0.053)	(0.068)	(0.064)
Student Characteristics	No	No	No	No	No	No	No	No
Teacher/Class Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,620	3,656	2,899	2,522	5,005	5,081	5,001	5,106

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

Table 7 presents the results for heterogeneity in female-dominated programs. The average grades for students are 4.81 in the 1^{st} tercile, 5.54 in the 2^{nd} tercile, and 6.15 in the 3^{rd} tercile. In this case, female students in the 2^{nd} tercile benefit the most from having a female teacher, with a significant effect of 0.137 SD (at the 10% level). Additionally, both male and female students in the 3^{rd} tercile experience a positive and significant effect of 0.122 SD from having a female teacher. Regarding students in the first tercile, although the interaction is significant, the effect for female students is 0.106 SD with a p-value of 0.109, implying no significant effect.

In terms of female proportion in class, where the median corresponds to 94%, we find that female students benefit from having female teachers, with an increase in performance of 0.184 SD, although this effect seems to be nonsignificant due to the sample size reduction. Lastly, concerning class size, no effect of having a female teacher for male students is observed in any case. However, in classes with fewer than 45 students, female students benefit from having a female teacher, exhibiting an average effect of 0.138 SD with a significance level of 10%.

Table 7: Heterogeneity of Classes Characteristics on Female-Dominated Career Grades

		Terciles			Female Percentage		Class size	
	Full Sample	1^{st}	2^{nd}	3^{rd}	< 0.94	≥ 0.94	< 45	≥ 45
Female Teacher	-0.001	-0.051	0.006	0.122*	-0.021	0.008	-0.083	-0.147
	(0.062)	(0.085)	(0.081)	(0.064)	(0.072)	(0.133)	(0.087)	(0.093)
FT × FS	0.113**	0.157*	0.131*	-0.075	0.049	0.175	0.221**	0.105
	(0.053)	(0.081)	(0.075)	(0.062)	(0.045)	(0.113)	(0.089)	(0.076)
Student Characteristics	No	No	No	No	No	No	No	No
Teacher/Class Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,653	10,374	8,428	6,855	13,904	13,863	12,530	14,275

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

Lastly, Table 8 presents the results for grades in gender-balanced programs. The average grades for students are 4.40 in the 1^{st} tercile, 5.18 in the 2^{nd} tercile, and 5.78 in the 3^{rd} tercile. As expected, the median proportion of women corresponds to 50%, and finally, the median class size is 53 students.

In the results corresponding to grades distribution, we find that for male students in the first tercile, there is a negative effect of having a female teacher, with a coefficient of -0.080 SD, at 10% significance. However, it can be argued that this effect is quite minimal. Additionally, the interaction for the first tercile is shown to be significant and even higher than when estimating the full sample, indicating a difference in performance between male and female students. Yet, when estimating the marginal effect for female students, there is no statistically significant effect (-0.005 SD with a p-value of 0.918).

Table 8: Heterogeneity of Classes Characteristics on Gender-Balanced Career Grades

		Terciles			Female Percentage		Class size	
	Full Sample	1^{st}	2^{nd}	3^{rd}	< 0.5	≥ 0.5	< 53	≥ 53
Female Teacher	-0.065*	-0.080*	-0.041	-0.002	-0.044	-0.084	-0.008	-0.059
	(0.037)	(0.048)	(0.038)	(0.031)	(0.052)	(0.053)	(0.050)	(0.058)
FT × FS	0.064***	0.075*	0.004	0.004	0.082***	0.055**	0.083***	0.062*
	(0.023)	(0.042)	(0.028)	(0.031)	(0.027)	(0.027)	(0.032)	(0.035)
Student Characteristics	No	No	No	No	No	No	No	No
Teacher/Class Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	28,668	9,952	8,338	7,015	13,306	14,735	13,753	13,215

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

The observed pattern recurs when examining the outcomes associated with the proportion of female students and class size. In both cases, all interactions are significant and even larger than when estimating for the full sample. However, there is no significant effect on female students. Specifically, concerning the proportion of females per class, the effect on female students is 0.038 SD below the median and -0.029 above the median, with corresponding p-values of 0.591 and 0.505, respectively. Similarly, for class size, the effect is 0.076 SD below the median and 0.003 SD above the median, with p-values of 0.150 and 0.955, respectively.

Finally, the analysis of heterogeneity for the approval rate by class characteristics can be found in Appendix C with similar results to those discussed for grades in this section.

4.3 Heterogeneity by Teacher Characteristics

In addition to the above analysis based on class characteristics, it is also important to examine if the observed effects vary by certain teacher characteristics. Specifically, the study focuses on determining whether the effect is attributed to younger or older female teachers, or if it is related to the possession of a doctoral degree.

Table 9 presents the results for teacher heterogeneity in male-dominated programs. The findings reveal intriguing variations in the effect of having a female professor based on specific attributes.

Table 9: Heterogeneity of Teacher Characteristics on Male-Dominated Career Grades

		Teacher Age		Doctoral Degree	
	Full Sample	< 36	≥ 36	No	Yes
Female Teacher	0.185*	0.122	0.391***	0.327***	0.048
	(0.103)	(0.173)	(0.148)	(0.117)	(0.262)
FT × FS	0.102**	0.068	0.050	0.127**	-0.052
	(0.050)	(0.084)	(0.075)	(0.057)	(0.090)
Student Characteristics	No	No	No	No	No
Teacher/Class Characteristics	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	10,620	5,069	5,115	6,739	3,061

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

We find that for both male and female students, the effect of having a female professor is 0.391 SD at the 1% significance level, when she is above the median age of 36 years.

This suggests a substantial positive influence on student performance attributable to older female professors within male-dominated programs. Furthermore, the analysis reveals that both male and female students benefit when the female professor lacks a Ph.D., with the effect size being more pronounced for female students. Specifically, the effect size for female students is significantly higher at 0.453 SD, compared to 0.327 SD for male students, both significant at the 1% level. This indicates that female students derive greater academic advantages from female professors without doctoral degrees within male-dominated program contexts, compared to their male counterparts.

Table 10 presents the results for heterogeneity in female-dominated programs, highlighting variations in the effect of female teachers based on certain characteristics. For younger female teachers, those below the median age of 46, male students perform worse by an average of 0.220 SD at a 5% significance level, while there is no significant effect observed for female students (0.038 SD and p-value of 0.652). Conversely, for female teachers above the median age, although the interaction is significant, there is no discernible effect on female students (0.121 SD p-value of 0.150). Furthermore, if a female teacher does not hold a Ph.D., female students benefit by 0.276 SD and male students by 0.130 SD on average, significant at the 1% and 10% level respectively. However, if the female teacher holds a Ph.D., the effect becomes negative and significant, with female students experiencing a decrease in grades of 0.521 SD and male students 0.675 SD on average, significant at the 1% level.

Table 10: Heterogeneity of Teacher Characteristics on Female-Dominated Career Grades

		Teacher Age		Doctoral Degree	
	Full Sample	< 46	≥ 46	No	Yes
Female Teacher	-0.001	-0.220**	-0.001	0.130*	-0.675***
	(0.062)	(0.093)	(0.094)	(0.075)	(0.115)
FT $\times$ FS	0.113**	0.258***	0.122*	0.146**	0.154**
	(0.053)	(0.075)	(0.073)	(0.061)	(0.072)
Student Characteristics	No	No	No	No	No
Teacher/Class Characteristics	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	28,653	13,584	14,043	22,951	4,079

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

Table 11 presents the results for heterogeneity in gender-balanced programs. In this case, female professors over the age of 46 have an impact on students. Specifically, male students exhibit a negative effect of 0.088 SD at 10% significance, which is a minimal effect. Furthermore, while the interaction is significant and positive, the analysis shows that the result is not significant for female students (-0.009 SD).

Additionally, an interesting finding emerges concerning the possession of a Ph.D. degree by female professors. Both male and female students experience a decline in their grades, with the effect being statistically significant at the 5% level. On average, students' grades decrease by 0.138 SD when taught by female professors with Ph.D. degrees. This indicates that the presence of female professors with Ph.D. degrees may have a negative impact on student performance in gender-balanced program contexts, irrespective of the student gender.

Table 11: Heterogeneity of Teacher Characteristics on Gender-Balanced Career Grades

		Teacher Age		Doctoral Degree	
	Full Sample	< 46	≥ 46	No	Yes
Female Teacher	-0.065*	-0.081	-0.088*	-0.018	-0.138**
	(0.037)	(0.057)	(0.053)	(0.051)	(0.069)
FT × FS	0.064***	-0.005	0.079**	0.092***	-0.039
	(0.023)	(0.036)	(0.032)	(0.029)	(0.046)
Student Characteristics	No	No	No	No	No
Teacher/Class Characteristics	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	29,668	13,400	13,577	17,421	10,074

Notes: Clustered standard errors at class level presented in parenthesis. *** p<0.01, ** p<0.05, * p<0.1. Student level control variables include age, nationality, school type, PSU average, NEM scores, admission, and municipality. Teacher level control variables include age, educational level, nationality and contract. Classes level control variables include class size and female percentage.

Finally, the analysis of the heterogeneity in the approval rate by teacher characteristics can be found in the Appendix C, with similar findings.

5 Analysis and Discussion

In the previous section, the results of the effect of teacher gender were shown in three contexts: an environment perceived as hostile to women, characterized by male dominance among both students and teachers represented by STEM fields; the opposite scenario, examining the impact on students' academic performance in settings where women predominate among both faculty and students, such as in Education and Health; and a gender-balanced environment among teachers and students, such as in Law and Business. This section analyzes all findings and discusses implications.

5.1 Male-dominated programs

The influence of female teachers on student performance within male-dominated programs is positive and statistically significant. Male students, on average, increase their grades by 0.185 SD when taught by a female teacher, while female students see an increase of 0.286 SD. This suggests that the presence of a female teacher is associated with improved overall student performance in comparison with a male teacher, particularly benefiting female students.

According to the analysis of heterogeneity by class characteristics, both male and female students in the 3^{rd} tercile, those with higher academic performance, are the ones who benefit from having a female teacher. Their grades improve by an average of 0.181 SD. When the proportion of female students in a class is above the median and they have a female teacher, both male and female students increase their grades by an average of 0.309 SD. Lastly, the effect is more pronounced in larger classes, with average increases of 0.415 and 0.525 SD for male and female students respectively.

As previously mentioned, women studying in traditionally male-dominated programs tend to obtain better grades. This trend suggests that an increase in the proportion of women in these programs could have a positive effect on student performance, as more female students may be motivated by the example and impact of having a female teacher as a role model, which in turn could contribute to an overall improvement in grades.

Our findings are in line with Carrell et al. (2010). They document a gender gap in various dimensions of STEM success, which diminishes significantly when female students are taught by female professors, though this effect is not observed in the humanities. The positive impact of female teachers is more pronounced among female students with strong math abilities, particularly those in the upper quartile of SAT math scores. For these students, having a female teacher eliminates the gender gap in introductory course grades and increases enrollment in science programs. Conversely, teacher gender has minimal influence on male students' academic outcomes. Carrell et al. (2010) suggest that the pronounced effect among high-achieving students may be due to role modelling.

In turn, Paredes (2014) provides further support for this theory, suggesting that the substantial impact of female professors on female students in male-dominated fields aligns with the role model hypothesis. This effect appears particularly pronounced in students with fewer female teachers. However, her study also reveals no discernible effect for male students. The discrepancy with our results may be attributed to her study's focus on schools, as well as the consideration of mothers' educational levels.

Other similar results are found in Gong et al. (2018), whom suggest that female teachers significantly improve female students' test scores compared to male students. In their study, the absolute improvement for female students by having a female teacher is about 0.104 SD, whereas in this study it is 0.285 SD. The difference can be explained by the fact that their study focuses in schools and does not separate between gender categories.

Regarding the heterogeneity of teacher characteristics, female teachers above the median age of 36 in engineering have a positive effect on student performance, with an average increase of 0.391 SD for both male and female students. Additionally, both genders benefit when their female teachers do not hold a doctoral degree. However, the improvement is even greater for female students, with an average increase of 0.454 SD for females and 0.327 SD for males.

In this regard, it might be that older female teachers demonstrate softer skills, such as empathy, organization, and understanding, in comparison to their male counterparts, which positively contribute to student performance. Conversely, the possession of a doctorate by female teachers may potentially diminish these soft skills, giving rise to two plausible explanations. The first suggests that women pursuing doctoral degrees are less likely to have children earlier, as they devote their time to advancing their programs, potentially leading to a decline in these skills. The second explanation posits that women in STEM fields seeking doctoral degrees face heightened pressure to excel in male-dominated environments, potentially resulting in more stringent teaching approaches and, consequently, students perform better with teachers who do not have a doctorate. However, these explanations remain speculative, lacking empirical validation with the current available data.

It is possible to assert that the low presence of female faculty in traditionally male-dominated fields accentuates the impact of their distinctive characteristics compared to their male colleagues. These characteristics are particularly evident in larger classes, where classroom management and reducing disruptions are more challenging. In contrast, smaller classes tend to have a more controlled and calm environment, facilitating effective teaching regardless of the instructor's gender, which may explain why the effect is particularly noticeable in large classes.

5.2 Female-dominated programs

The impact of female teachers on student performance in female-dominated environments is positive and significant. Specifically, female students experience a positive and significant effect of 0.112 SD. Conversely, for male students, the teacher's gender does not appear to influence their performance. This finding is initially surprising, as it might be expected that in a predominantly female environment, the gender of the teacher would not have a differential impact. This suggests that the interaction between teacher and student gender is important for the academic performance of female students, potentially due to factors such as the role model effect or the presence of teacher bias.

Nevertheless, the role model theory is discounted in this context, as female students do not seem to find a role model in an environment where they are already well represented. Instead, teacher bias channel could explain these results, suggesting that female professors might teach female students more effectively and treat male students differently due to stereotypes. Given that men represent on average less than 10% of the enrollment in female-dominated fields, it is reasonable to think that female professors might not be accustomed to their presence and behave differently towards them.

Heterogeneity analysis reveals that female students in the 2^{nd} tercile of performance benefit the most from having a female teacher, with a positive effect of 0.137 SD. In addition, both male and female students in the top performing tercile also benefit from having a female teacher of 0.122 SD. We also found that female students in the middle tercile significantly benefit from having a female teacher, with an improvement of 0.137 SD in their grades. These findings suggest that female teachers may be providing additional support or adapting their teaching methods to help these students, who are striving to improve their grades to reach average levels. Female teachers may recognize the challenges these students face and focus on guiding them more effectively, perhaps using more empathetic and understanding pedagogical strategies.

Furthermore, we found that both male and female students in the 3^{rd} tercile also improve their grades, with an increase of 0.122 SD when they have a female teacher. This result could be related to the softer skills that female teachers possess in comparison with male-teachers, such as empathy, effective communication, and the ability to inspire and motivate their students. These skills can create a more positive and supportive learning environment, benefiting all students regardless of their gender, but especially those who are already high achievers.

It is important to consider that, in general, grades in female-dominated fields are high in comparison with male-dominated fields, with an average of 5.54 in the 2^{nd} tercile and 6.15 in the 3^{rd} tercile. This context of generally high performance could make differences in the impact of teacher gender more noticeable among students at the extremes of academic performance, whether striving to reach the average or maintaining outstanding performance. Female teachers, being possibly more attuned to the emotional and academic needs of their students, may provide the type of support that fosters continuous improvement, especially in an environment where performance expectations are already high.

On the other hand, students in the 1^{st} tercile do not show a significant effect of having a female professor. One possible explanation for this lack of effect is that these students, having lower performance, might be facing deeper academic and personal challenges that cannot be overcome solely through the support and soft skills that female professors provide. These students may need more intensive and specific interventions to improve their performance, which are not captured by the mere presence of a female professor in the classroom. Additionally, these students may be less motivated or less receptive to the teaching style of female professors, thereby limiting the potential impact.

The proportion of female students per class does not show a significant difference in relation to having a female professor, indicating that the number of women in the class does not influence the positive impact of having a female professor. Although the result is not statistically significant, the positive coefficient of 0.175 SD suggests a favorable trend. Given that the median percentage of women in a course is 94%, this implies that the courses are predominantly composed of women, and suggests that in these female-dominated environments, female professors can further enhance the academic performance of female students due to the previously mentioned stereotypes.

Additionally, class size does not show a significant difference in this relationship, suggesting that the number of students does not affect the positive impact of having a female teacher.

Regarding teacher characteristics, younger female teachers have a negative effect on male students, possibly due to the previously mentioned gender stereotypes. On the other hand, female teachers without a Ph.D. present a positive and significant effect for both genders: an increase of 0.130 SD for men and 0.276 SD for women. In contrast, female professors with a Ph.D. show a negative and significant effect, with a decrease of 0.675 SD for men and 0.521 SD for women, suggesting that students perform worse with more academically qualified female professors.

This negative effect is less pronounced for female students, which could be attributed to a role model effect. Although female teachers with Ph.D. may present a greater academic challenge, female students may feel inspired and motivated by the presence of a highly qualified female figure, partially mitigating the negative effect observed on performance.

Then, while the proportion of female students and class size do not significantly influence the impact of having a female professor, the specific characteristics of the female professors do. Younger female professors negatively affect male students, possibly because they replicate the behavior of their own female teachers, thereby normalizing stereotypes against men. Conversely, female teachers without a doctorate have a positive effect on both genders. Female professors with a doctorate, although generally having a negative effect, affect women less negatively due to a possible role model effect.

In contrast to this paper, Bettinger and Long (2005) investigate the effect of male teachers on male students in under-represented fields. Their analysis aimed to determine whether having a male teacher in a female-dominated discipline positively impacted male students' interests. While no effect was found in most disciplines except business, significant effects were observed in education. Male students with male teachers in initial education courses enrolled in more subsequent credit hours and were more likely to major in the subject. These findings support the idea that same-gender faculty can positively influence student interest in a subject. The study recommends further research to explore the impact of faculty on student interests and performance.

5.3 Gender-balanced programs

Teacher gender does not have a significant effect on student performance. This suggests that in environments where both genders are equally represented among students and faculty, the influence of teacher gender is minimized, reflecting an ideal model for educational equity across all fields.

Upon further examination of heterogeneity, it becomes evident that the presence of a doctoral degree among female teachers correlates with a decrease in grades for both male and female students, averaging 0.138 SD. This finding aligns with the theory observed across all gender categories, indicating that female professors with Ph.D. may adopt stricter teaching approaches. However, in this context, there is no discernible effect of role model or bias, as the negative impact is consistent across both genders. This neutrality in impact suggests a balanced classroom dynamic in terms of gender representation among students and teachers.

In comparison to male-dominated fields, both male and female students benefit positively from female teachers in gender-balanced programs. This positive effect may be attributed in part to the scarcity of female faculty members, which accentuates their unique contributions and role model influence, particularly for female students, leading to enhanced academic performance relative to their male counterparts. However, in female-dominated fields, the significant positive impact of female teachers is primarily observed among female students. This discrepancy suggests a nuanced interplay of bias and role model, with female professors potentially favoring female students and serving as aspirational figures for girls. While the influence of teacher gender is more discernible in gender-balanced fields, its impact is predominantly observed among female students.

Furthermore, across all analyzed categories, the presence of a Ph.D. among female professors generally negatively impacts students' grades. This trend may arise from the heightened expectations and academic rigor associated with female professors holding advanced degrees. Consequently, students may encounter greater academic challenges under their instruction, potentially leading to lower overall academic performance. Additionally, female professors with doctoral degrees often focus intensely on their academic research and scholarly pursuits. This strong emphasis on academic excellence and research can sometimes come at the expense of developing effective teaching skills and pedagogical techniques. As a result, these professors might not possess the same level of talent in educational methods as their counterparts without Ph.D.. The combination of rigorous academic standards and potentially less refined teaching strategies could further contribute to the observed decline in student grades.

Following the approach proposed by Paredes (2014), the inquiry revolves around whether the effect of female teachers on female students stems from role model or stereotype threat theory. According to the author, a stronger effect would be anticipated for girls in traditionally male-dominated subjects, such as mathematics, and a less pronounced effect in language subjects if the positive impact of female teachers on girls is attributed to teacher behavior. Conversely, if the effect is linked to teacher bias, a greater impact would be expected in mixed-gender classrooms. While Paredes (2014) does not segregate students by gender composition in her analysis, she draws a common conclusion regarding the role model theory, but does not find support for the stereotype threat theory.

Finally, fostering a gender-neutral academic environment is imperative for promoting diversity and equality in education. Striving for a balance between male and female representation among both teachers and students across all disciplines is crucial. Ideally, the influence of a teacher's gender on student performance should be minimized, ensuring that academic success is determined solely by merit and effort rather than gender dynamics. Despite existing research by authors like Zafar (2013), Gong et al. (2018) and Aguirre et al. (2020), indicating variations in program preferences between men and women, it is essential to acknowledge that these differences may be perpetuated by societal stereotypes and a lack of gender-diverse role models in certain fields. Addressing these stereotypes and increasing the visibility of diverse role models can pave the way for a more inclusive and supportive educational landscape, benefiting students and educators alike. Through concerted efforts to challenge biases and promote gender equality, it can create an environment where all individuals have equal opportunities to thrive and succeed in their academic pursuits.

6 Conclusions

This paper examines the effect of teacher gender on students' academic performance in higher education, focusing on male-dominated, female-dominated, and gender-balanced programs. Given the persistent gender wage gap, particularly in STEM fields, our findings highlight the importance of female role models in shaping academic outcomes and program trajectories.

Using data from a Chilean university over a 10-year period, we estimate fixed-effects regression models to assess whether faculty gender has a causal impact on the immediate academic performance of female and male students. Additionally, we conduct a heterogeneity analysis to examine whether the effect of teacher gender vary by class and teacher characteristics. We address potential self-selection biases by restricting the sample to first-year students with automatic and randomized class assignments, and incorporating student fixed effects. Our balance tests confirm that teacher gender is not systematically correlated with student characteristics, reinforcing the validity of our causal estimates.

Across gender-dominated fields, our findings reveal distinct patterns. In male-dominated fields, female teachers significantly enhance student performance, particularly among high-achieving students and in classes with a higher proportion of female students. This effect is amplified in larger classes and is most pronounced for female professors without a Ph.D. or those with more experience. These results align with the role model hypothesis, suggesting that the presence of female professors in male-dominated fields motivates female students and improves overall academic outcomes. Moreover, these findings are consistent with previous research showing that the gender gap in academic achievement in STEM fields narrows when students are taught by female teachers.

In female-dominated fields, only female students, on average, benefit from having female professors, showing a moderate grade increase, while male students' performance remains unaffected. This finding aligns with a teacher bias channel, rather than the role model channel, as female professors may interact differently with male and female students due to stereotypes. However, high-achieving students of both genders benefit from female professors. Additionally, younger female teachers negatively affect male students, while non-Ph.D. professors have a positive impact.

In gender-balanced fields, we find no significant effect of teacher gender on student performance, suggesting that when gender representation is more equal, faculty gender plays a minimal role in shaping academic outcomes. These results highlight the complex interplay between teacher bias and role model effects in gender-dominated contexts.

Our findings underscore the importance of gender diversity in faculty hiring decisions. Male-dominated fields are largely staffed by male professors, while female-dominated fields exhibit the opposite trend. Universities should actively increase female representation in male-dominated fields, as their presence not only benefits female students but improves academic performance for all. Similarly, greater gender diversity in female-dominated fields could help foster more balanced learning environments and help dismantle stereotypes.

This study sheds light on the relationship between teacher gender and student performance in higher education. As students navigate post-secondary education, the gender composition of faculty emerges as an important factor in gender-dominated fields. Understanding gender dynamics is essential for developing strategies to promote gender parity, narrow gaps, and ensure equitable opportunities for women in lucrative, male-dominated fields. Increasing female representation in male-dominated disciplines can help bridge gender gaps in STEM and encourage more women to pursue high-paying programs.

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