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Supporting Females in STEM: Evidence on Student-Instructor Gender-Matching in 4-Year Research Universities in Texas

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Abstract

Despite progress in overall educational attainment, female students remain underrepresented in STEM fields. One proposed mechanism for improving female students' outcomes is exposure to same-gender faculty, yet evidence on both the prevalence and impacts of student–instructor gender matching in higher education remains limited. Using administrative data from ten public research universities in Texas spanning 2011–2021, we document patterns of gender matching in STEM courses and estimate its causal effects on female students' academic outcomes. Female students are substantially less likely than male students to be taught by same-gender instructors in STEM, particularly in engineering, economics, and computer science, and, even when same-gender matching does occur, are more often matched with non-tenure-track faculty. Leveraging student and classroom fixed effects, we find that same-gender matching improves female students' course performance and reduces course withdrawals. Early exposure to female instructors modestly increases short-term persistence and subsequent STEM course-taking, though effects on long-term degree outcomes are limited. We discuss these implications for gender diversity in STEM.

The research reported here was conducted using administrative data from Texas state agencies made available by the UT Dallas Education Research Center. The conclusions of this research do not necessarily reflect the opinion or official position of the Texas Education Agency, Texas Higher Education Coordinating Board, Texas Workforce Commission, or state of Texas.

1 Introduction

Despite decades of effort to close the gender gap in science, technology, engineering, and mathematics (STEM) careers, females [1] still remain significantly underrepresented. Female graduates make up a majority (58%) of all college graduates in the United States and are over 10 percentage points more likely to hold a bachelor's degree or higher than their male counterparts (Nietzel, 2024; Hurst, 2024). However, only 35% of females hold a degree in STEM (Montoya, 2024), and only 18% work in a STEM or STEM-related occupation (compared to 30% among males; National Science Board, 2024). Females' persistent underrepresentation flows from a variety of mechanisms, including (in part), stereotyping, unconscious bias, uneven work-life balance, and other systemic and social barriers that begin early in life and persist through postsecondary education and transitions into the workforce (Piloto, 2023). One additional barrier—a lack of female representation for mentorship and role-modeling—has been of particular interest by researchers and policymakers alike. Female students who have a female instructor or mentor experience "same-gender matching," and prior works have suggested this phenomenon can raise females' aspirations and outcomes in STEM specifically (e.g., Dee, 2005; Dee, 2007; Winters et al., 2013). However, little is known about the full incidence and impacts of same-gender matching.

Same-gender matching, whether in the context of mentorship, research collaboration, or instructional settings, has been hypothesized to enhance belonging, boost self-efficacy, and counteract the effects of stereotype threat (Freeman et al., 2024; Gottfried et al., 2023). For female students and early-career researchers in male-dominated STEM fields, interactions with female peers, mentors, or faculty members may offer unique psychosocial and academic benefits (Price, 2010; Hoffmann and Oreopoulos, 2009). However, empirical evidence on the effectiveness and specific

[1] We adopt "female" terminology to remain consistent with how data are reported by the Texas Higher Education Coordinating Board. However, it is important to acknowledge that sex and gender are distinct biological and socio-cultural constructs, and that individuals identified as female in our data may or may not individually identify as such. Our findings are thus generalizable to individuals coded as female in Texas's administrative data.

impacts of same-gender matching in STEM remains mixed and context-dependent (Carrell et al., 2010; Bettinger and Long, 2005; Rask and Bailey, 2002; Kofoed and McGovney, 2019). While some studies report increased persistence, higher academic performance, and greater satisfaction among female students exposed to same-gender environments, others find limited or no measurable effects. Yet, even if we had full information on the impacts of same-gender matching for females in STEM, we have virtually no information on the *incidence* of this phenomenon (Odle et al., 2025). That is, even if same-gender matching is effective, how likely are female students to have same-gender instructors in college—and how does that exposure vary across courses, institutions, and time? Our work extends both of these lines of inquiry.

Our work provides a comprehensive assessment of the incidence and impacts of same-gender matching in STEM on female students' short- and long-term outcomes. We first descriptively document the incidence of female student-instructor same-gender matching across one of the largest postsecondary sectors in the United States: research universities in Texas from fall 2011 to fall 2021. Leveraging data on nearly 740,000 unique student-instructor pairs, we estimate the overall rate of same-gender matching while also exploring how matching varies across course types, instructor profiles, and time. We show that, while same-gender matching has marginally increasing over the past decade, female students are still significantly less likely to be taught by an instructor of the same gender when compared to their male counterparts, especially in STEM disciplines. Moreover, when female students do experience same-gender matching, they are more likely to match with instructors in non-tenured and non-tenure-track positions, potentially limiting the opportunity for sustained mentorship and role modeling. Following this investigation, we then leverage within- and across-student variation in female students' exposure to same-gender instructors in their first year of college to estimate causal impacts of gender-matching in STEM on their short- and long-term outcomes. Results suggest that same-gender matching raises female students' course performance and reduces dropout rates. Additionally, though the effect is marginal, exposure to female instructors in first-semester courses increases female students' persistence and engagement in STEM-related coursework.

This work not only provides an empirical expansion of the existing body of work examining the impacts of same-gender matching but also underscores a focus on the incidence of these impacts. If same-gender matching "works," then policymakers and practitioners alike should equally be focused on ensuring that female students can and do experience same-gender matching at higher (and more equal) rates. Such considerations demand attention across the entire female-in-STEM pipeline, including in how female students in college engage with female role models or instructors and persist *to and through* graduate education at research universities. Moreover, our work builds a foundation for additional inquiry into the incidence and impacts of same-gender matching for female students in STEM (and beyond) by extending prior works into newer, larger, and more diverse settings while also documenting inequalities in same-gender matching across groups, institutional contexts, and over time.

In addition to longstanding structural barriers in STEM fields, the broader policy environment surrounding equity initiatives in higher education is undergoing rapid change. In Texas and several other states, legislative actions have curtailed or eliminated formal diversity, equity, and inclusion (DEI) offices and programming at public universities. Nationally, legal and political pressures have further narrowed the range of institutional strategies available to address disparities in access and persistence. While these policy shifts vary across states and institutions, they collectively signal a transition away from centralized equity programming toward alternative approaches for supporting historically underrepresented students. In this evolving context, it becomes increasingly important to understand how structural features of universities—independent of formal DEI initiatives—shape females' engagement and persistence in STEM pathways. Faculty composition, instructional assignments, and early academic experiences are not ancillary programs but core elements of the institutional environment. If exposure to female faculty meaningfully influences females' academic trajectories in STEM, then student–instructor gender matching represents a mechanism embedded within the ordinary functioning of universities rather than a standalone intervention.

In all, our study examines both the incidence and impacts of same-gender matching in STEM at public research universities. By documenting who has access to gender-matched instruction and estimating its effects on short- and long-term outcomes, we provide evidence relevant to policymakers and institutional leaders seeking to strengthen the STEM workforce under shifting policy constraints.

In what follows, we provide an overview of the existing body of work on gender-matching for females in STEM and preview the insights and implications of our study in Section 2. We then discuss our setting and data in detail in Section 3, before describing our complementary descriptive in Section 4 and our causal inference strategies in Section 5. Results are presented in Sections 6 and 7, and we conclude in Section 8 with a summary of our work and its implications for policy, practice, and future research.

2 Gender-Matching for females in STEM

A growing body of work has explored the impacts of same-gender matching for female students in STEM at both the K-12 and college levels. Dee (2005, 2007) and Winters et al. (2013) find that female middle school math and science teachers are significantly more effective than their male counterparts at fostering female students' engagement and improving their performance in these subjects. Both Nixon and Robinson (1999) and Bottia et al. (2015) extend this same-gender impact on STEM development into high school. Nixon and Robinson (1999) find that female students in high schools with a higher percentage of female faculty and professional staff are more likely to graduate and enroll in college, while Bottia et al. (2015) argue that a higher proportion of high-quality female math and science teachers increases the likelihood that female students who enroll in college subsequently choose a STEM major and graduate. However, research on the impacts of same-gender matching in college remains limited—particularly for females.

In the short term, female students in STEM who have a same-gender instructor, on average, earn higher course grades (Carrell et al., 2010) and report more interest in STEM fields (Bettinger and Long, 2005; Rask and Bailey, 2002; Kofoed and McGovney, 2019). In perhaps the most comprehensive study to date on same-gender matching, Carrell et al. (2010) leverage the random assignment of students to courses and instructors at the U.S. Air Force Academy and find that female students who are matched with female instructors in first-year math and science classes score, on average, 5 percent of a standard deviation higher than those who are not. Furthermore, when estimating the gender-match effect by students' initial math ability (i.e., SAT math scores at admission), they find that students with higher initial math ability are more sensitive to an instructor's gender in math and science classes. On average, female students with SAT math scores above 700 earn grades 14% of a standard deviation higher, while those with scores below 660 score only 4% of a standard deviation higher than their unmatched peers—albeit still a statistically significant effect. When considering the entire body of evidence on same-gender matching for female students in college, however, evidence remains mixed, and estimates can vary widely across different individual and institutional contexts.

Other work in this area includes an investigation by Bettinger and Long (2005) that exploits data from two cohorts of student at more than 10 public universities in Ohio. Their findings suggest that a higher proportion of female instructors in introductory STEM courses is associated with higher interest in STEM among female students. Furthermore, female students are twice likely to enroll in a math course in their second semester if their first math class is taught by a female instructor. Female students who experience same-gender matching also take, on average, 5.2 more credits in math than those who never experience a same-gender match. However, the benefits of same-gender matching are not consistent across disciplines. In fact, female students with a female faculty in physics, biology, and political science enroll in fewer credit hours after experiencing this match (compared to their peers with an opposite-gender instructor). Using a similar population and setting as Bettinger and Long (2005), Price (2010) asserts that female instructors in STEM courses have negligible effects on female students' ultimate persistence in STEM—and may, in fact, have a subtle adverse impact on male students. Indeed, both Price (2010) and Hoffmann and Oreopoulos (2009) show that the perceived benefits of gender matching for female students may come at the expense of male students' course performance in classes taught by female instructors. However, there is no consistent evidence of an opposite-gender penalty—either generally or in STEM—in the long run.

Beyond student-instructor pairs, several studies have also investigated whether a female academic advisor or mentor can also influence female students' outcomes. Kofoed and McGovney (2019) find the evidence that female cadets at West Point are increasingly likely to choose the same branch as their mentors when gender-matched. Similarly, Canaan and Mouganie (2023) argue that female students at the American University of Beirut are more likely to declare a STEM major after freshman year and earn a degree in STEM conditioned on being matched with a female science advisor in their first year.

While each of these studies is instructive, the mechanisms through which gender matching might influence female students' academic trajectories remain only partially understood. First, each is necessarily limited in scope in some way, often focusing exclusively on immediate course grades or short-term outcomes (like next-semester persistence in STEM). Furthermore, among these studies that do exist, most also draw samples of students attending a few highly selective four-year universities (e.g., Hoffmann and Oreopoulos, 2009; Carrell et al., 2010; Kofoed and McGovney, 2019; Solanki and Xu, 2018) or those with little racial and socioeconomic diversity (Bettinger and Long, 2005; Price, 2010). We extend our inquiry into a large and broadly diverse setting and additional focus on students' longer-run outcomes, including persistence in STEM and STEM degree receipt. Our work also uniquely focuses on the *incidence* of STEM same-gender matching for female students. That is, how often does same-gender matching occur for female students? Does the rate of gender-matching vary across courses, disciplines, or institutional contexts—and how has it evolved over time?

Beyond role-model effects narrowly defined, a growing interdisciplinary literature suggests that exposure to same-gender faculty may influence students' academic trajectories through identity formation, motivational beliefs, and perceptions of belonging. Identity-based frameworks argue that persistence in STEM is shaped not only by academic preparation but also by whether students come to see themselves—and are recognized by others—as legitimate participants in scientific fields (Carlone and Johnson, 2007; Stets et al., 2017). For female students in male-dominated disciplines, the presence of female faculty may provide symbolic and relational cues that STEM identities are attainable and socially validated. Such exposure can counteract stereotype threat and shift expectations about who "fits" in a given field (Cheryan et al., 2017), potentially reinforcing students' academic self-concept and commitment.

Motivational theories similarly emphasize the role of perceived competence, task value, and expectations for success in shaping academic decisions (Eccles and Wigfield, 2002; Wang and Degol, 2013). From an expectancy-value perspective, interactions with female instructors may increase female students' beliefs about their likelihood of succeeding in STEM courses and the long-term value of remaining in STEM pathways. Even small shifts in early academic performance or perceived belonging may alter course-taking decisions, particularly during the first year of college when students are forming academic identities and evaluating major options. Prior work has shown that institutional climate and faculty interactions play a central role in shaping these early experiences (Hurtado and Carter, 1997; Hurtado et al., 2012).

At the same time, organizational research highlights that representation alone does not automatically translate into inclusive climates or durable structural change. Faculty diversity interacts with institutional norms, mentoring structures, and workload allocation in shaping students' experiences (Guarino and Borden, 2017; Misra et al., 2012). Thus, while same-gender matching may operate as a mechanism of identity affirmation and motivational reinforcement, its effects are likely to depend on the broader academic environment in which those interactions occur. Understanding both the prevalence and impact of gender matching within research universities therefore contributes not only to role-model theory but also to broader debates about how institutional structures shape female students' engagement and persistence in STEM.

Our work extends this body of evidence to consider the incidence and impacts of same-gender matching for female students in STEM within one of the largest and most diverse postsecondary sectors in the United States: research universities in Texas. Research universities are unique settings where highly diversified cohorts engage with specialized and competitive academic environments. These are also the very settings that generate a large quantity of STEM degrees—and especially graduate degrees in STEM. Research universities differ fundamentally from community colleges or K-12 environments due to their emphasis on research output, faculty tenure processes, and competitive course structures. These institutions are also, on average, better resourced (Altbach, 2011). Early exposure to gender-matched faculty could be especially impactful in research universities (Reason et al., 2006), as these institutions often serve as key gateways to graduate studies and STEM career pipelines. Our study focuses on the incidence and impacts of same-gender matching in STEM across 10 research universities.

3 Data

We base our gender-match analysis in higher education on data from the state of Texas, which provides an ideal context for studying the incidence and impact of student-instructor gender matching for female STEM students at research universities. The state's diverse student body and varied institutional landscape enable a comprehensive analysis of how gender matching influences female STEM students across different types of institutions. Texas is home to a range of public research universities, including two flagship institutions with a strong emphasis on research, as well as numerous emerging research universities focused on basic and applied research in selected fields.[2] This variation allows us to explore gender-matching patterns across different institutional

[2] The University Peer Group Criteria in Texas can be found in Texas Higher Education Coordinating Board official website: University Peer Group Categories.

settings, as well as student and faculty demographics. Additionally, Texas has been a leader in postsecondary education policy reforms, particularly in STEM education initiatives, providing a unique context for evaluating how gender matching interacts with broader institutional and policy changes. As a result, the state's emphasis on STEM education offers a rich dataset on female students in STEM fields, enabling precise estimates of gender-matching effects.

We leverage data from the Texas Higher Education Coordinating Board (THECB), which collects comprehensive administrative records on all students enrolled in and faculty employed at public universities across the state. The dataset includes transcript-level data beginning in 2011. Our primary dataset is derived from THECB's student enrollment reports, covering all students enrolled at 10 research universities in Texas between fall 2011 and fall 2021. This allows us to identify students' first-time-in-college (FTIC) status and their demographic characteristics, including gender, race, and age. We focus on FTIC students and retain only their initial enrollment record, ensuring that each cohort contains a single record per unique student in the student-level dataset. We then merge this student-level dataset with course registration data to incorporate detailed course records, including course level, credit hours, and instruction type, as well as students' academic performance indicators such as dropout behavior, course grades, and credits earned. To ensure meaningful student-instructor interaction, we retain only lecture-based courses, excluding laboratory and practicum courses.

Our sample includes students with any positive-credit-hour enrollment in their first semester. Since our study focuses on STEM course-taking patterns, we exclude students who did not take any STEM courses in their first semester. As a final step, we merge faculty course assignment reports with student-course data, creating a student-course-instructor dataset. Each course record is linked to an instructor, incorporating key instructor demographics such as race, gender, rank, tenure status, and employment status. In total, our dataset comprises 737,594 student-course-instructor observations, representing 380,147 unique students and 4,645 unique instructors. This comprehensive dataset allows us to analyze students' course-taking patterns and academic performance during their first fall semester, assess the prevalence of student-instructor gender matching across disciplines overall and over time, and evaluate its impact on early academic outcomes in research university settings.

We are not only concerned with students' short-term outcomes but also their long-term development. Therefore, we also examine whether female students who experience gender matching in their first semester derive any lasting benefits in terms of persistence, interest in STEM fields, and degree completion. The ongoing data collection by THECB on student enrollment and course registration enables longitudinal tracking of students who initially enroll at any university within the state. This allows us to assess long-term outcomes such as persistence and subsequent STEM-related course registration as an indicator of sustained interest in STEM fields. Additionally, THECB reports students' degree completion, providing details on the timing of degree awards and the majors earned. We merge the student enrollment and course registration dataset with the degree completion records to create the final long-term outcome dataset. Since long-term outcomes are measured at the student level, each student has a unique record in this dataset.

4 Descriptive Study

Table 1 presents summary statistics for students, instructors, and courses. Panel A provides individual-level summaries, including gender composition among students and instructors, major distribution among students, and tenure status among instructors. Among students who took at least one STEM course in their first fall semester, 51.22% are female. Additionally, 44.34% of all students declared a STEM major in their first semester, with female students comprising 41.51% of this group. Meanwhile, 10.99% of students in the sample had not declared a major, with female students accounting for 44.37% of them. Regarding faculty composition, out of 4,645 instructors, 32.96% are female. In terms of tenure status, 58.41% of instructors hold non-tenure positions, with female faculty representing 41.95% of this group. Tenured and tenure-

Table 1: Summary Statistics

Panel A

	Student			Instructor	
	Freq.	Percent		Freq.	Percent
Total	380,147	100%	Total	4,645	100%
Female	194,694	51.22%	Female	1,531	32.96%
Male	185,453	48.78%	Male	3,114	67.04%
STEM Major	169,800	44.34%	Non-Tenure	2,713	58.41%
Female	69,972	41.51%	Female	1,138	41.95%
Non-STEM Major	169,800	44.67%	Tenured	1,400	30.14%
Female	106,179	62.53%	Female	211	15.07%
Major Undecided	41,791	10.99%	On-Track	532	11.45%
Female	18,543	44.37%	Female	182	34.21%

Panel B *N=737,594*

Student			**Instructor**		
Age	18.06		Female	37.92%	
Female	48.73%		Male	62.08%	
Male	51.27%				
			Category	Share	Female Share
Course			*Rank*		
Modality	Share		Full	14.24%	7.53%
Face-to-Face	90.10%		Associate	8.47%	20.81%
Internet	8.70%		Assistant	3.28%	33.51%
Hybrid	0.84%		Other	74.01%	45.92%
Course Subject	Share	Female Share	*Part-time Status*		
CS	4.90%	24.31%	Full-time	86.52%	37.65%
Engineering	9.39%	24.31%	Part-time	13.48%	39.61%
Math	35.77%	49.04%			
Chemistry	18.51%	51.43%	*Tenure Status*		
Biology	13.81%	68.06%	Non-Tenure	73.69%	45.82%
Psychology	0.49%	68.52%	Tenured	22.53%	12.44%
Economics	3.77%	42.79%	On Track	3.78%	35.60%

Note: Data include the universe of STEM courses for first-year FTIC students who enrolled from fall 2011 to fall 2021.

track faculty account for 30.14% and 11.45% of all instructors, respectively, with female representation at 15.07% and 34.21%. These figures indicate that while female instructors constitute a significant portion of non-tenured positions, their presence is notably lower in tenured and tenure-track roles, highlighting potential disparities in career progression and faculty retention.

Panel B of Table 1 summarizes course-level data, detailing student enrollments and instructor characteristics across subjects and teaching modalities. Mathematics courses account for 35.77% of total course records, with female students making up 49.04% of enrollments. Computer science and engineering courses represent 4.90% and 9.39% of course records, respectively, both with female enrollment shares of 24.31%. Similarly, chemistry, biology, and economics courses constitute 18.51%, 13.81%, and 3.77% of total course records, with female students comprising 51.43%, 68.06%, and 42.79% of enrollments, respectively. In terms of course delivery, 90.1% of courses are conducted face-to-face, 8.7% are internet-based, and 0.84% follow a hybrid model. Regarding instructor representation, female instructors teach 37.92% of all course records, and full-time instructors are responsible for 86.52% of courses. Faculty rank and tenure status distribution show that professors, associate professors, and assistant professors teach 14.24%, 8.47%, and 3.28% of courses, respectively. Additionally, 73.69% of course records are taught by non-tenured faculty, with female faculty accounting for 45.82% of them, while tenured and tenure-track instructors account for 22.53% and 3.78%, respectively, with female representation at 12.44% and 35.60%.

With these basic statistics, we can address our first key question: What does the pattern of gender matching between instructors and FTIC students look like in Texas? Table 2 presents same-gender match rates by gender across different course major types, including both STEM and non-STEM courses. To highlight the gender disparity in STEM fields, we also report match rates for non-STEM courses to contrast the lower match rate for female students in STEM. Overall, 52.76% of course records involve a student being taught by an instructor of the same gender. However, significant differences exist between male and female students in their likelihood of having a same-gender instructor, particularly in STEM disciplines. Among all courses, the same-gender match rate for female students is 46.19%, whereas for male students, it is notably higher at 60.09%. This discrepancy persists across both STEM and non-STEM courses. In STEM courses, male students experience the highest same-gender match rate at 65.45%, while female students are significantly less likely to have a same-gender instructor, with a match rate of just 41.46%. In non-STEM courses, the overall same-gender match rate is slightly lower (51.98%), with female and male match rates at 49.38% and 55.27%, respectively. These figures indicate that female students are consistently less likely to be taught by an instructor of the same gender across all course types, particularly in STEM fields.

When breaking down gender match rates across STEM disciplines, significant variation emerges and appears to reflect disparities in faculty gender composition across different departments. Fields such as engineering and economics exhibit substantial gender imbalances, with female match rates as low as 21.71% in engineering and 24.55% in economics, compared to 76.96% and 74.83% for male students, respectively. In contrast, disciplines like biology and psychology show more balanced gender distributions. Mathematics and chemistry exhibit a less pronounced gender imbalance, with 42.00% and 42.53% of female students, respectively, being matched with a female instructor, compared to 65.05% and 59.88% of male students in these fields.

Table 3 provides further insight into the tenure status of faculty when students and instructors are gender-matched across all courses and STEM courses. Non-tenured faculty dominate gender-matched course records, particularly in STEM, while tenured and tenure-track faculty play a limited role. Overall, 71.98% of gender-matched course records involve non-tenured faculty, with this proportion increasing to 74.13% in STEM courses. This trend is more pronounced for female students, who are matched with non-tenured faculty 82.36% of the time across all courses and 89.54% in STEM courses. In contrast, male students are more likely to be matched with tenured faculty, with 31.79% of their gender-matched records taught by tenured faculty across all subjects and 31.02% in STEM courses. By comparison, female students are matched with tenured faculty in only 11.96% of cases across all courses and just 6.76% in STEM. This disparity suggests that male students have greater exposure to tenured faculty, who typically possess more research experience and institutional stability, particularly in STEM fields.

In Table 4, we present the trend of same-gender matching rates in STEM courses by gender from 2012 to 2022. The overall same-gender matching rate has remained relatively stable, fluctuating between 52.6% and 54.5%, with a slight annual decline of 0.35 percentage points. This suggests that, on average, over half of students are

Table 2: Same-Gender Matching Rate

	All Courses	STEM	Non-STEM	CS	Engineering	Math	Chemistry	Biology	Psychology	Economics
Overall	52.76%	53.76%	51.98%	55.33%	63.53%	53.75%	50.96%	51.57%	48.87%	53.32%
Female	46.19%	41.46%	49.38%	45.98%	21.71%	42.00%	42.53%	52.17%	50.34%	24.55%
Male	60.09%	65.45%	55.27%	58.33%	76.96%	65.05%	59.88%	50.30%	45.66%	74.83%

Note: Table reports the same-gender matching rates.

Table 3: Faculty Tenure Status When Matched

	All Courses	STEM Courses
Overall		
Non-Tenure	71.98%	74.13%
Tenured	22.63%	21.90%
Tenure-Track	5.39%	3.97%
Female students		
Non-Tenure	82.36%	89.54%
Tenured	11.96%	6.76%
Tenure-Track	5.68%	3.70%
Male students		
Non-Tenure	63.07%	64.85%
Tenured	31.79%	31.02%
Tenure-Track	5.15%	4.13%

Note: Table reports the tenure status distribution of faculty when matched

matched with an instructor of the same gender, with minimal change over time. However, the same-gender matching rate for female students has shown a modest yet inconsistent upward trend, increasing by 1.66% per year on average, whereas male students have experienced a decline in gender matching. Despite this improvement, female students remain less likely than male students to be taught by an instructor of the same gender.

We now turn to an analysis of student educational outcomes to assess whether gender matching is associated with differences in those outcomes. Table 5 presents a descriptive summary of students' course-level and long-term outcomes, with Panel B highlighting a comparison of course-level outcomes between matched and unmatched cases. This allows us to explore whether gender matching correlates with key indicators such as course completion and grades. According to Panel A, compared to male students, female students are more likely to pass the course, earn a grade of B or higher, and score higher on average. However, female students are slightly more likely to withdraw from the class. Panel B compares the matched and unmatched cases, showing that female students do not exhibit significant differences in course grades or failure rates, but they have a higher likelihood of withdrawing from the class

Table 4: Same-Gender Matching Rate Over Time

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Overall	54.49%	53.85%	54.72%	54.61%	53.29%	53.93%	54.31%	53.44%	53.09%	53.16%	52.61%
Female	38.09%	41.17%	41.78%	36.58%	38.41%	40.68%	41.75%	41.07%	44.42%	46.08%	44.96%
Male	68.92%	65.42%	66.82%	71.14%	67.32%	65.89%	66.17%	65.64%	61.73%	60.36%	60.37%

Note: Table reports the same-gender matching rate over time.

when matched with a same-gender instructor. For male students, their overall course performance appears better when matched with a male instructor. As reported in Panel C, female students are more likely to persist to their second year and complete a degree. However, when it comes to STEM-related outcomes, they tend to enroll in fewer STEM courses in the second semester and have a lower likelihood of completing a STEM degree. While we observe that female students' course-level outcomes seem to be negatively impacted by gender matching, it is necessary to further examine the causal effect of gender matching on female students.

5 Methodology

Our econometric model examines the effect of student-instructor gender matching on academic outcomes for FTIC students at research universities. Specifically, we estimate whether female students perform differently in courses when taught by female instructors compared to male instructors. Following Fairlie et al. (2014), we employ a difference-in-differences approach, where female students matched with female instructors in a class form the treatment group, and those matched with male instructors form the control group. Therefore, we specify the following baseline model at the course level:

$$\begin{aligned} Y_{ijskt} = \alpha_0 + \alpha_1 femInst_j + \alpha_2 femStu_i + \alpha_3 femInst_j \times femStu_i \\ + \phi_s + \phi_t + \beta X_{ijskt} + \epsilon_{ijskt}, \end{aligned} \tag{1}$$

where Y_{ijskt} represents the course-level outcomes of student i taught by instructor j at institution s in course k for cohort t. The variables $femStu_i$ and $femInstr_j$ are binary indicators that take the value of 1 if student i and instructor j are female, respectively. ϕ_s and ϕ_t are the school and cohort fixed effects. The vector X_{ijskt} includes observable control variables capturing student characteristics (e.g., SAT/ACT scores), instructor characteristics (e.g., tenure status and part-time status), and course characteristics (e.g., class size and course level) that may influence student outcomes.

Table 5: Descriptive Summary of Student Outcomes

Panel A Course Performance

	Overall	**Female**	**Male**
Dropped Course	0.055	0.056	0.054
	(0.228)	(0.230)	(0.227)
Passed Course	0.933	0.941	0.926
	(0.25)	(0.24)	(0.26)
Good Grade	0.676	0.678	0.674
	(0.468)	(0.467)	(0.469)
Grade Points	2.850	2.866	2.834
	(1.19)	(1.17)	(1.21)

Panel B Course Performance Comparison Between Matched and Matched Cases

	Overall		**Female**		**Male**	
	Matched	Unmatched	Matched	Unmatched	Matched	Unmatched
Dropped Course	0.055	0.056	0.058	0.054	0.053	0.058
	(0.227)	(0.229)	(0.234)	(0.227)	(0.223)	(0.233)
Passed Course	0.933	0.934	0.940	0.942	0.929	0.921
	(0.250)	(0.249)	(0.238)	(0.235)	(0.256)	(0.270)
Good Grade (above B)	0.678	0.673	0.675	0.680	0.680	0.661
	(0.467)	(0.469)	(0.468)	(0.467)	(0.466)	(0.473)
Grade Points	2.86	2.84	2.86	2.87	2.86	2.79
	(1.19)	(1.19)	(1.18)	(1.16)	(1.20)	(1.23)

Panel C Long-Term Outcomes

	Overall	**Female**	**Male**
Persist to 2nd Yr	0.730	0.740	0.720
	(0.443)	(0.437)	(0.449)
STEM Courses	2.230	2.080	2.382
	(1.04)	(0.99)	(1.06)
Degree Completion	0.437	0.464	0.408
	(0.50)	(0.50)	(0.49)
STEM Degree Completion	0.176	0.136	0.217
	(0.38)	(0.34)	(0.41)

Note: Table reports the descriptive summary of student outcomes.

The error term ϵ_{ijskt} captures unobservable factors affecting course outcomes. α_3, our parameter of interest, captures the average outcome difference in female students' course performance between their gender-matched and unmatched courses.

We include student fixed effects φ_i and classroom fixed effects φ_c to modify this model. A classroom is defined jointly by the course identifier, institution, and the academic year in which it is offered. Therefore, we replace the combination of indices j, s, k, and t with a classroom index c, and simplify the female-instructor index by c. We then drop any student- and course-related variables from Equation (1) that are multicollinear with either the student or classroom fixed effects. This results in our preferred model:

$$Y_{ic} = \alpha_0 + \alpha_3 femInst_c \times femStu_i + \varphi_i + \varphi_c + \epsilon_{ic}, \quad (2)$$

The inclusion of student and classroom fixed effects helps address potential threats to internal validity in several ways. Incorporating classroom fixed effects implicitly controls for instructor and course fixed effects, capturing various unobservable factors that may vary across classrooms and influence students' course performance. For example, if female students enroll in courses taught by instructors with systematically different grading policies or instructional styles, this difference is accounted for through instructor-course fixed effects. Moreover, female-dominated subjects, such as biological sciences and social sciences, may naturally attract more female students, leading to a selection issue driven by comparative advantage. This concern is addressed through the course fixed effects embedded within classroom fixed effects. Course fixed effects also account for factors such as course difficulty. Additionally, classroom fixed effects ensure the standardization of classroom- level characteristics, including course content, assessment methods, testing arrangements, and grading criteria. As a result, students within the same classroom experience identical class-level shocks and instructional quality. Furthermore, student fixed effects account for unobservable individual characteristics, such as academic ability, family background, and study motivation, which may influence academic performance. The inclusion of student fixed effects safeguards our estimates from bias arising from systematic differences between students who enroll in courses taught by female instructors and those who do not, regardless of gender.

Our model specification is not without bias concerns; we acknowledge that differential sorting based on instructor gender remains a potential issue. For instance, highly motivated female students may be drawn to classes taught by female instructors, while highly motivated male students may prefer courses taught by male instructors. This type of bias is mitigated by our sample selection and minimized through our modeling approach. Our sample restriction inherently reduces this bias: the dataset is limited to FTIC students, who have minimal discretion in course enrollment. Furthermore, if gender disparities in academic outcomes persist across all courses regardless of instructor characteristics, they are implicitly accounted for through the inclusion of student fixed effects.

We examine four student course outcomes using our econometric model (2): a dummy variable indicating whether the student drops the class after the census date, a dummy variable for passing the course, a standardized course grade with a mean of zero and a unit standard deviation within each classroom, and a dummy variable indicating whether the student earns a grade of B or higher [3] , conditional on passing the class.

6 Results

Table 6 reports the estimates of the interaction between female students and instructors across four model specifications: the baseline model, the preferred model, and two additional specifications used for robustness checks. Column 1 presents results from the baseline model, which includes school and cohort fixed effects. Column

[3] Colleges in Texas have discretion over whether to award students +/- grades. Since many colleges do not award +/- grades, while others leave that decision to instructors, we defined earning a good grade as receiving a grade of B- or higher.

2 introduces student fixed effects but omits school and cohort fixed effects due to multicollinearity. Column 3 incorporates both course and student fixed effects, while Column 4 reports results from the preferred model, which includes student and classroom fixed effects. A key distinction between course fixed effects and classroom fixed effects is that the latter additionally accounts for class section and the assigned instructor, factors not captured by course fixed effects (e.g., Biology 100 versus Biology 100 taught by Professor X at University Y in Spring 2026).

Results indicate that the interaction between female students and female instructors has a significant effect on students' dropout behavior and course performance, except for the pass rate. The estimates from the preferred model in Column 4 show that female students matched with female instructors are 0.6 percentage points less likely to withdraw from a course, 1.3 percentage points more likely to earn a good grade (B or higher), and score 3.6% of a standard deviation higher. However, the effect of same-gender matching on passing the course is not statistically significant. Our findings are robust, as all other specifications also show significant evidence.

7 Long-Term Impact of Gender Matching

To what extent do course-level interactions between female students and female instructors shape long-term academic trajectories? While our analysis confirms the influence of gender matching on STEM course performance, the impact on critical educational milestones—such as students' subsequent interest in STEM disciplines, persistence in STEM fields, and degree attainment in STEM majors, all of which are strongly tied to labor market success—remains an open question. In this study, we also examine these long-term outcomes.

In the regression estimating the long-term gender match effect, we have only one observation per student for aggregated outcomes, so we do not include either classroom or student fixed effects. To ensure the accuracy of the estimates, we control for a range of student characteristics and aggregated instructor features. We also include

Table 6: Effects on Course-Level Outcomes

	(1)	(2)	(3)	(4)
Student Dropped Course				
	-0.003**	0.000	-0.005***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.002)
Observations	735,427	586,298	582,814	579,963
R^2	0.014	0.512	0.563	0.582
Student Passed Course				
	0.004***	0.001	0.002	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	686,404	533,736	530,081	527,206
R^2	0.058	0.681	0.713	0.727
Good Grade (above B-)				
	0.011***	0.007***	0.015***	0.013***
	(0.002)	(0.003)	(0.0030)	(0.003)
Observations	640,257	493,482	489,764	486,884
R^2	0.080	0.609	0.685	0.707
Standardized course grade				
	0.024***	0.011**	0.037***	0.036***
	(0.004)	(0.005)	(0.005)	(0.005)
Observations	632,631	485,212	481,574	478,746
R^2	0.077	0.694	0.744	0.760
Fixed effect				
School	X			
Cohort	X			
Student		X	X	X
Course			X	
Classroom				X
Controls				
Student	X			
Instructor	X	X		

Note: The table reports the main results for course-level outcomes. Only the coefficient on the interaction term is reported here.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

students' initial major, as well as institution and cohort fixed effects, to address potential endogeneity concerns arising from the aggregation. Below, we present our model that explores the long-term effect:

$$\begin{aligned} Y_{ist} = \alpha_0 + \alpha_1 femStu_i + \alpha_2 femInstShr_{ist} + \alpha_3 femInstShr_{ist} \times femStu_i \\ + \beta X_{ist} + \phi_i + \phi_s + \phi_t + \epsilon_{ist} \end{aligned} \tag{3}$$

The variable $femInstrShr_{ist}$ represents the percentage of credit hours taught by female instructors out of all credit hours taken during student i's first semester. ϕ_i, ϕ_s, and ϕ_t denote the student's initial major, institution, and cohort fixed effects, respectively. The coefficient α_3 captures how female students' long-term outcomes vary with the share of first-semester credit hours taught by female instructors.

The long-term outcomes we examine include persistence in the second semester and second year (the second fall semester), STEM major declaration, the number of STEM courses enrolled in during the second semester, and degree completion. Persistence is defined as whether students register for any credit hours in the second semester or second year. Similarly, STEM major declaration refers to whether students declare a major in any STEM field in a given semester. This indicator captures whether exposure to female instructors affects students' movement into STEM fields among initially non-STEM students (including initially undeclared students) or persistence among those who initially declared a STEM major. The number of STEM courses taken in the second semester provides further insight into students' continued engagement with STEM disciplines. Lastly, degree attainment, a key milestone linked to labor market success, serves as another measure of the long-term impact of gender matching. Degree completion is defined as graduating within six years of first enrolling in college. We analyze both overall graduation, regardless of major, and STEM-specific graduation. Since some students earn multiple degrees at different times within this period, we retain only their first degree in our dataset. Additionally, if a student graduates with both STEM and non-STEM majors in the same year, we classify them as a STEM graduate.

Table 7 presents estimates of gender-matching effects on long-term outcomes. Columns 1 and 2 display the effects on students' persistence to the second semester and second year, where we find significant evidence of gender-matching effects. Specifically, female students' probability of persisting into the second semester increases by 0.6 percentage points when their first-semester learning experience shifts from being fully male-taught to fully female-taught. A similar effect (0.7 percentage points) is observed on second-year persistence when female students take all their credit hours with female instructors instead of male instructors. These results suggest that greater exposure to female instructors encourages female students to persist in university, thereby improving their retention at research universities.

Columns 3 and 4 present the effects on female students' STEM declaration in the second semester and second year, where we do not find statistically significant evidence. However, our results on STEM course enrollment, reported in Column 5, indicate that having all first-semester courses taught exclusively by female instructors rather than male instructors leads female students to enroll in slightly more (0.05 additional) STEM courses in the following spring semester. This finding suggests that, while female students do not exhibit a greater likelihood of declaring a STEM major, their interest in STEM fields appears to be marginally influenced by same-gender matching. However, since we examine STEM major declaration only in the second semester and the second fall semester (typically the third semester of university attendance), which is still early in a students' college journey, the lack of effects may be due to students delaying major decisions or institutional requirements that mandate completing prerequisite courses before committing to a STEM major. Finally, the results on degree attainment—a key stepping stone to labor market success—are reported in Columns 6 and 7. We do not find statistically significant effects of female students' intensive interaction with female instructors on either overall degree completion or STEM degree attainment.

In sum, although we find some positive impacts of gender matching among female students on a few outcome measures immediately following the first semester, these

Table 7: Effects on Long-Term Outcomes

	(1) Persist Fall-Spring	(2) Persist Fall-2nd Fall	(3) STEM Major Spring	(4) STEM Major 2nd Fall	(5) STEM Course Count	(6) Complete Degree	(7) Complete a STEM Degree
Interaction term	0.006***	0.007**	-0.005	0.001	0.050***	0.006	-0.002
	(0.0020)	(0.003)	(0.003)	(0.002)	(0.008)	(0.005)	(0.004)
Observations	341,780	341,780	281,009	320,058	287,399	235,856	235,856
R^2	0.031	0.087	0.635	0.701	0.341	0.168	0.298
Fixed effects							
School	X	X	X	X	X	X	X
Cohort	X	X	X	X	X	X	X
Initial Major	X	X	X	X	X	X	X

Note: Table reports the results for long-term outcomes. Only the coefficient on the interaction term is reported here.
$^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

effects are marginal and unlikely to yield a meaningful impact on students' overall academic trajectories. While exposure to female instructors may slightly increase female students' persistence and engagement in STEM-related coursework in the short run, its impact does not extend beyond the early stages of college. The lack of effects on longer-term outcomes—such as degree completion—suggests that same-gender matching alone may be insufficient to create lasting academic advantages. This does not mean that increasing (or equalizing) female students' incidence of same-gender matching is not worthwhile—but rather that same-gender matching should likely be considered as one of many complementary strategies to increase enrollment, persistence, and completion in STEM rather than a silver bullet on its own.

8 Conclusion and Discussion

Despite decades of effort to close the gender gap in STEM careers, females still remain significantly underrepresented. A key leak in the STEM pipeline for female students occurs at the postsecondary level, where there is an insufficient number of female faculty members in STEM disciplines to serve as mentors and role models for qualified femaless considering STEM careers. Indeed, a broad literature documents a myriad of benefits—such as improved course success, persistence, and degree completion both overall and within STEM disciplines—when female students are matched with female faculty in STEM classes, particularly early in their college careers.

This study contributes to the literature by documenting descriptive patterns in the incidence and impacts of same gender matching for female students at public research universities in Texas. Our findings are broadly consistent with the current research base, but our estimates are less pronounced than what has been reported in most previous studies. In particular, we find that female students are less likely to be taught by an instructor of the same gender, especially in STEM disciplines. Moreover, when matched with a same-gender instructor, female students are more likely to be taught by faculty in non-tenured positions. However, the matching rate for female students has gradually increased over time. One important consideration for these meaningful differences between our study and earlier works is the fact that prior studies often focused on international or single-institution samples (Canaan and Mouganie, 2023), highly-specialized campuses (e.g., West Point; (Kofoed and McGovney, 2019), and in much less diverse contexts (Bettinger and Long, 2005; Price, 2010).

Causal estimates that compare how being assigned to a female instructor in the first term differentially affects outcomes for female and male students in the same classroom indicate that interactions with female instructors positively influence female students' course performance and reduce dropout rates. In particular, female students who experience a same-gender match, on average, have course grades that are 0.04 standard deviations higher than unmatched peers and are 1.3 percentage points more likely to earn a B- or higher in the course. Female students also have a slightly lower likelihood of withdrawing from the course but no difference in passing. Additionally, although the effect is marginal, exposure to female instructors in first-semester courses increases female students' persistence and engagement in STEM-related coursework.

Despite great efforts to attract and retain female STEM faculty in Texas and across the nation, the gender diversity of the STEM professoriate has largely not kept pace with the increasing diversity of students. This suggests that states and institutions may want to consider strategies to increase the incidence of same-gender matching that do not rely exclusively on increasing the diversity of the professoriate. For example, colleges could encourage female STEM faculty to teach more lower division courses and prioritize seats in those sections for female students—or offer course releases for female STEM faculty to stand up mentoring programs and support affinity groups for female students with interests in STEM. In doing so, colleges should be mindful of the burden placed on female STEM faculty to take on these efforts and offer course releases or other supports for those in these roles, so that their research is not hampered. Any efforts of female STEM faculty to serve as mentors to female students should be considered in tenure decisions.

These findings take on particular significance in light of recent policy shifts affecting equity initiatives in public higher education. As formal DEI infrastructures are reduced or restructured in some states, institutions face greater constraints in deploying targeted programming to address gender disparities in STEM. In such an environment, attention may shift toward structural mechanisms embedded within the academic organization itself—such as faculty hiring patterns, course assignments, and mentoring structures—as potential levers for promoting engagement and persistence.

Our results suggest that student–instructor gender matching operates as one such structural mechanism. Female students are substantially less likely than male students to encounter same-gender instructors in STEM, particularly in fields with pronounced gender imbalances among faculty. Moreover, when gender matching occurs, it disproportionately involves non-tenure-track faculty, raising questions about the sustainability and depth of mentorship opportunities available to female students in STEM. While our causal estimates indicate that same-gender matching modestly improves course performance and short-term persistence, the magnitude of these effects is limited and does not translate into substantial gains in STEM degree attainment.

These findings underscore both the promise and the limits of representation-based approaches. Increasing female students' exposure to female faculty may yield incremental improvements in early academic outcomes, but representation alone is unlikely to eliminate persistent gender gaps in STEM fields. If policymakers and institutional leaders aim to expand females' participation in the STEM workforce, efforts to diversify the professoriate may need to be coupled with broader supports—such as advising, academic assistance, and financial resources—that address multiple dimensions of persistence. At the same time, institutions should remain mindful of the service and mentoring burdens often placed on female STEM faculty, particularly those in contingent or non-tenure roles, and ensure that such contributions are appropriately recognized and supported within promotion and evaluation systems.

In sum, as universities navigate evolving policy landscapes, understanding how core institutional structures influence females' STEM trajectories remains essential. Faculty composition is not merely symbolic; it is embedded in the human capital production process that shapes who persists in STEM and ultimately enters the STEM workforce. Unfortunately, given the relatively modest impacts of same-gender matching on outcomes of female STEM students we estimate for public research universities in Texas and the structural challenges colleges face in expanding the gender diversity of their faculty, even when coupled with efforts to increase the incidence of same-gender matching and mentoring opportunities for female STEM faculty, same-gender matching is unlikely to close gender gaps in STEM degree production. Colleges should couple a thoughtful approach to same-gender matching with other research-based strategies to improve student success such as robust advising, tutoring, wraparound supports, and financial aid.

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