

# A 10 Year Cross-Section of STEM Faculty Teaching Practices

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## Overview

With millennials now entering their mid-20s and Generation Z entering as new, traditional-age college students it is pertinent to examine the evolution of teaching practices to engage new students in the classroom. Old structures of learning environments are obsolete and do not serve the current generational needs or expectations (Strange & Banning, 2015). STEM faculty are known to be more likely than faculty in other disciplines to rely on lecturing and occasional examinations than to use learning strategies and assignments that require more active involvement of students (e.g., group work and applied projects) (Stains et al., 2018). Freeman and colleagues (2014) found in a metaanalysis of 225 studies that students' exam scores increased by 6% in active learning classrooms compared to traditional lecture style in STEM courses.

In 2011, women earned less than one-third of doctorates in hard sciences, math, computer science, and engineering fields (National Science Board, 2014). Collectively, degree attainment in computer science and mathematics has declined since 2000 (National Science Board, 2014, 2016). Considering that epistemology regarding teaching and learning has been closely related to disciplinary affiliations, it is important to hone research on specific areas such as STEM to improve practices (Nelson Laird, Shoup, Kuh, & Schwarz, 2008; Stark & Morstain, 1978). Bourner (1997) echoes this sentiment stating, teaching methods should be considered based on the goals faculty are attempting to achieve. It is important to examine women's practices to see how they are performing in a male dominated field.

Women's voices are critical to perpetuate future students entering scientific fields. Studies on the gender gap within STEM has been occurring since the 1970s focusing on structural barriers, psychological factors, and individuals' characteristics (Kann, Sax & Riggers-Pieh, 2014). However, research has focused on differences with faculty satisfaction and experiences in their roles few studies focus on teaching practices (Ropers-Huilman, 2000).

## Purpose & Research Question

Studies have shown faculty in STEM are slow to adopt pedagogies that improve learning outcomes. This study aimed to center female faculty as they have been, and are currently, marginalized in these disciplines. It was found female faculty are using active teaching practices more than their male counterparts.

Specifically, this study is guided by the following question:

- How have STEM faculty teaching practices changed over 10 years at Master's granting institutions by sex?

## Methods & Sample

Data from the Faculty Survey of Student Engagement (FSSE) was used to help explore faculty teaching practices. The instrument collects data on the way faculty engage students at 4-year colleges and universities. A cross-sectional approach used three years of data spanning 10 years to uncover differences in pedagogical approaches among female and male faculty. The Basic 2005, 2010, and 2015 Carnegie Classifications were used to identify institutional type. Smaller, medium, and larger Master's colleges and universities were collapsed into one group for analyzing data. Each year there were between 48-71 institutions represented in the sample. Of the total 62,000 respondents represented in 2007, 2012, and 2017 there were 1521, 917, and 1300 respectively, who met the criterion of working at a Master's institution and in a STEM field.

Table 1  
Master's Colleges & Universities

	2007	2012	2017
Small	12	8	12
Medium	18	12	19
Large	41	28	39
<b>Total</b>	<b>71</b>	<b>48</b>	<b>70</b>

Table 2  
STEM Faculty at Master's Institutions

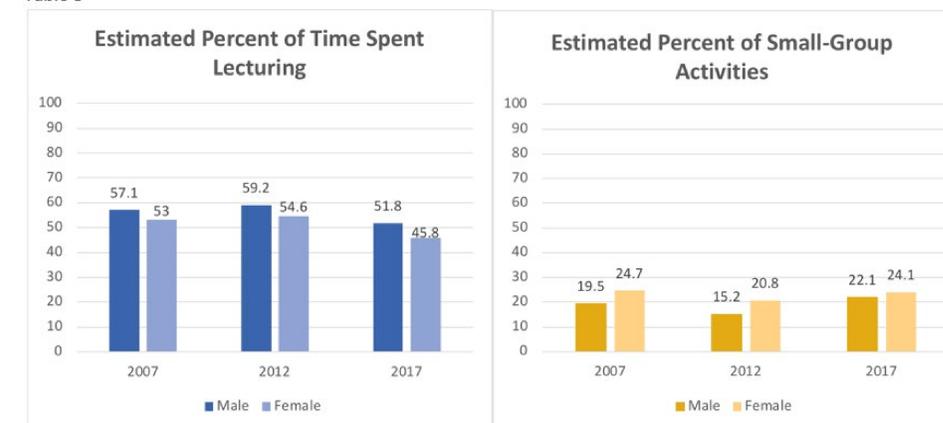
Sex	2007	2012	2017
Male	1042	568	836
	68%	62%	63%
Female	479	349	464
	32%	38%	37%
<b>Total</b>	<b>1521</b>	<b>917</b>	<b>1300</b>

Faculty were instructed to respond to items based on "one particular undergraduate course section you are teaching or have taught during the current school year" (FSSE, n.d.). **They indicated the percent of class time spent on various teaching practices e.g., lecturing, discussion, small group activities, tests, independent work, media use, and experiential activities.** Respondents could select the categories 0%, 1-9%, 10-19%, 20-29%, 30-39%, 40-49%, 50-74%, and 75% or more. **Response category midpoints were used to estimate the average use of teaching strategies: 0%, 5%, 14.5%, 24.5%, 34.5%, 44.5%, 62%, and 87.5%.**

## Results

The table below used descriptive statistics to provide an overview of the data. On average, female STEM faculty used lecturing four percentage points less than male faculty except in 2017 where there was six points difference. Both female and male faculty decreased their use of lecturing by eight and five percentage points respectively over 10 years. When looking at use of small-group activities, female faculty on average used this method five percentage points more than their male counterparts in 2007 and 2012. Both female and male faculty increased over 10 years in their use of small-group activities.

Table 3



## Results

Analysis of variance (ANOVA) was conducted to compare male and female's estimated percent of lecturing in 2007, 2012, and 2017. There were significant differences at the  $p < .001$  level [ $F(5, 3664) = 22.55, p = 0.00$ ] (Table 5). An ANOVA was repeated for small-group activities finding significant differences as well [ $F(5, 3608) = 21.98, p = 0.00$ ] (Table 6).

Table 5  
Results of ANOVA Estimated Percent of Class Time Lecturing Over 2007, 2012, and 2017 by Sex

Source	df	SS	MS	F	p
Between Groups	5	70,486.12	14,097.23	22.55	0.00
Within Groups	3,664	2,290,139.36	625.04		
Total	3,669	2,360,625.498			

Table 6  
Results of ANOVA Estimated Percent of Class Time Small-Group Activities Over 2007, 2012, and 2017 by Sex

Source	df	SS	MS	F	p
Between Groups	5	34,772.65	6,954.53	21.98	0.00
Within Groups	3,603	1,139,777.53	316.34		
Total	3,608	1,174,550.17			

## Summary of Findings

Male and female STEM faculty continue to take different approaches to teaching in their disciplines. While continued assessment is needed to understand non-dominant populations and the implications on student learning outcomes here are some highlights from the study:

- Female faculty were more likely to use small-group activities as a teaching practice than their male faculty counterparts.
- Both males and females used small-group activities more over time.
- Lecturing has decreased as a teaching practice for both females and males over time.

## Discussion

Male and female STEM faculty continue to take different approaches to teaching in their disciplines. Social desirability in responses, social connectedness of faculty, or knowledge about pedagogy could be possible explanations for differences. The findings could be used to begin conversations in departments about time allocation based on teaching performance, adjusting the weight of teaching for tenure based on using effective teaching practices, and implications for the student experience in STEM. Continued assessment is needed to understand non-dominant populations and the implications on student learning outcomes.

## Comments?

Please leave us any feedback. Also, feel free to request references or direct questions to Kyle Fassett at [kfassett@iu.edu](mailto:kfassett@iu.edu). This poster and more FSSE research can be found at [fsse.indiana.edu/html/publications\\_presentations.cfm](http://fsse.indiana.edu/html/publications_presentations.cfm)