

# Longitudinal Study of FUTURE STEM SCHOLARS

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## Key Points

In this brief, we report findings from our Year 1 survey, which asked respondents why they chose to participate in teaching development (TD) and what discouraged their participation. First, we provide summary statistics and break down our findings according to gender and discipline. Second, we discuss three important implications of our work: (1) expand mandatory TD, (2) assess and address doctoral students' needs for TD, and (3) more closely examine gendered patterns in TD participation.

## LSFSS Study

*The Longitudinal Study of  
Future STEM Scholars*

explored the short- and long-term impact of teaching-focused professional development on STEM doctoral students and early-career academics. The study used repeated surveys and interviews to follow an initial cohort of 3,060 late-stage doctoral students.

## Why STEM Doctoral Students Participate in Teaching Development Programs

One way to improve undergraduate science, technology, engineering, and mathematics (STEM) education is to provide teaching development (TD) to doctoral students with academic career aspirations. TD helps prepare doctoral students for their roles as future faculty members and in a variety of academic careers that involve undergraduate teaching and mentoring.

Yet, TD is often not a formal component of doctoral training, especially in research-intensive institutions. Although STEM doctoral students who work as teaching assistants (TAs) are usually required to attend training for their TA duties, those activities tend to be relatively brief and focus more on policies and procedures than pedagogy. As such, TA training often does not sufficiently prepare future academics for the full range of instructional responsibilities they will face as faculty members.

Feeling underprepared for faculty work, many doctoral students seek out additional opportunities to develop teaching expertise. However, others with faculty career aspirations do not pursue additional TD, perhaps because they are uninterested in TD or have found that engaging in TD is not always easy or convenient.

Why do some future faculty members seek out TD while others do not? Knowing which factors promote or prevent participation in doctoral TD programs would help TD facilitators and others involved in future-faculty development improve TD impact.

In this brief, we present findings from a survey that asked late-stage doctoral students in STEM fields to report (1) what motivated their participation in TD, and (2) what factors discouraged their participation. After examining differences among subgroups, we discuss the implications of our research for shaping the next generation of STEM academics.

## Method

In 2009, we surveyed 3,060 late-stage doctoral students at three research universities; 73% ( $n = 2,163$ ) responded. For a list of reasons to participate in TD and not participate, see **Table 1**. Our primary independent variables included gender and broad field of study (e.g., engineering, physical science, mathematical science, and biological science). The study also controlled for other variables such as race, citizenship, and amount of teaching experience.

We first performed descriptive analyses of the reasons for participation and non-participation for all participants, and then conducted the same analyses by gender and broad field of study. We

then performed logistic regression analyses for each reason to participate or not participate in TD, across all respondents and by gender and broad field of study.

## Findings

### Why Participate in TD?

Survey respondents reported most often that they engaged in TD because it was required (71.5%). This is no surprise since 78.3% of respondents held at least one TA position, which often requires training sessions that orient TAs to campus policies, resources, technology, and basic teaching skills.<sup>1</sup>

TABLE 1: DOCTORAL STUDENTS' REASONS TO PARTICIPATE AND NOT PARTICIPATE IN TD

Reasons to Participate in TD	%	Reasons to Not Participate in TD	%
Participation was required (e.g., by advisor, department, graduate school)	71.5	Not enough time	71.0
To learn more about teaching and learning	57.0	Not a high priority	45.9
To improve my work as a teaching assistant	53.5	Not aware of programs or offerings	39.1
To improve my knowledge and skills regarding teaching and learning	53.2	The programs/activities conflicted with my schedule	27.0
To prepare for a career as a faculty member	39.0	I didn't find the programs/activities to be useful	16.0
To gain practical teaching experience	29.1	Little or no interest in teaching	13.7
To be more competitive on the job market	25.0	I was discouraged from participating (e.g., by advisor, department)	8.6
To improve my ability to explain my research to non-experts/laypersons	15.5	The people running the programs/activities were not helpful	4.8
To obtain academic leadership and management skills	13.1	I didn't feel like I fit in	4.0
To interact with people from different disciplines	12.0	I didn't enjoy the experience	3.6
To increase my chances of obtaining research grants	4.5		

<sup>1</sup> Robinson, S. S. (2011). An introductory classification of graduate teaching assistant orientations. In L. L. B. Border (Ed.), *Mapping the range of graduate student professional development: Studies in graduate and professional student development* (Vol. 14, pp. 19-33). Stillwater, OK: New Forums Press.

Survey respondents also said they wanted to learn more about teaching and learning (57.0%), improve their knowledge and skills with respect to teaching (53.2%), prepare for a career as a faculty member (39.0%), and be more competitive on the job market (25.0%). See **Table 1**.

We found that men were more likely than women to participate in TD because it was required (75.2% versus 67.7%). Women were more likely than men to participate in TD programs to learn more about teaching and learning (61.1% vs. 52.2%), improve their knowledge and skills regarding teaching and learning (57.3% vs. 49.6%), gain practical teaching experience (31.3% vs. 27.3%), prepare for a career as a faculty member (41.9% vs. 36.4%), and be more competitive on the job market (30.6% vs. 19.9%). See **Figure 1**.

Doctoral students in biological science and health fields were more likely than students in engineering and physical science to participate in TD to learn about teaching and learning (65.5%, 63.6% vs. 46.5%, 42.3% respectively). The same is true for improving one's teaching knowledge and skills (60.5%, 63.6% vs. 39%, 39.2%) and preparing for a

faculty career (42.4%, 48.5% vs. 28.5%, 25.9%). These differences may be partially explained by the fact that biological sciences and health fields are often women-dominated fields, whereas physical sciences and engineering are male-dominated, which further supports the gender differences noted above. See **Figure 2**.

### What Prevents Participation?

Lack of time was the most significant barrier for 71.0% of respondents, which was followed by participants' perception that TD was not a high priority (45.9%), participants' lack of awareness of TD programs (39.1%), and scheduling conflicts (27.0%). Many respondents (78%) reported that two or more factors discouraged their participation in TD. See **Table 1**.

More women than men reported that TD programs conflicted with their schedules (30.7% vs. 23.9%) and that advisors discouraged their participation (12.4% vs. 5.7%), whereas more men felt that TD was not a high priority (52.4% vs. 38.4%).

Survey respondents in biological sciences and health fields were less likely to consider TD as a low

**FIGURE 1: REASONS TO PARTICIPATE IN TD BY GENDER**

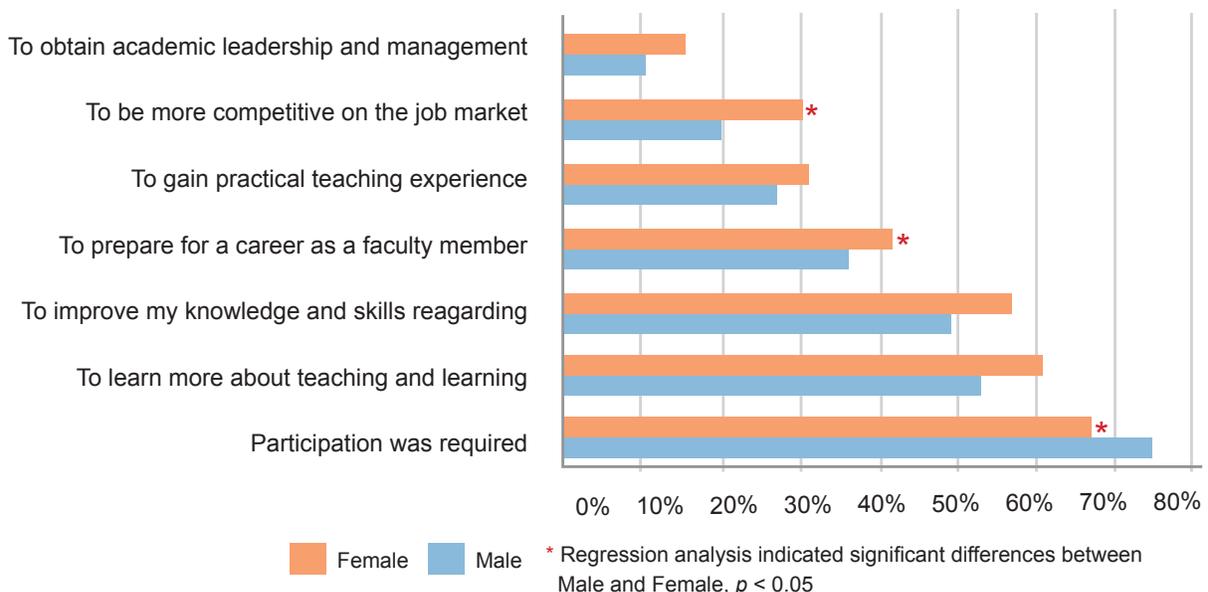
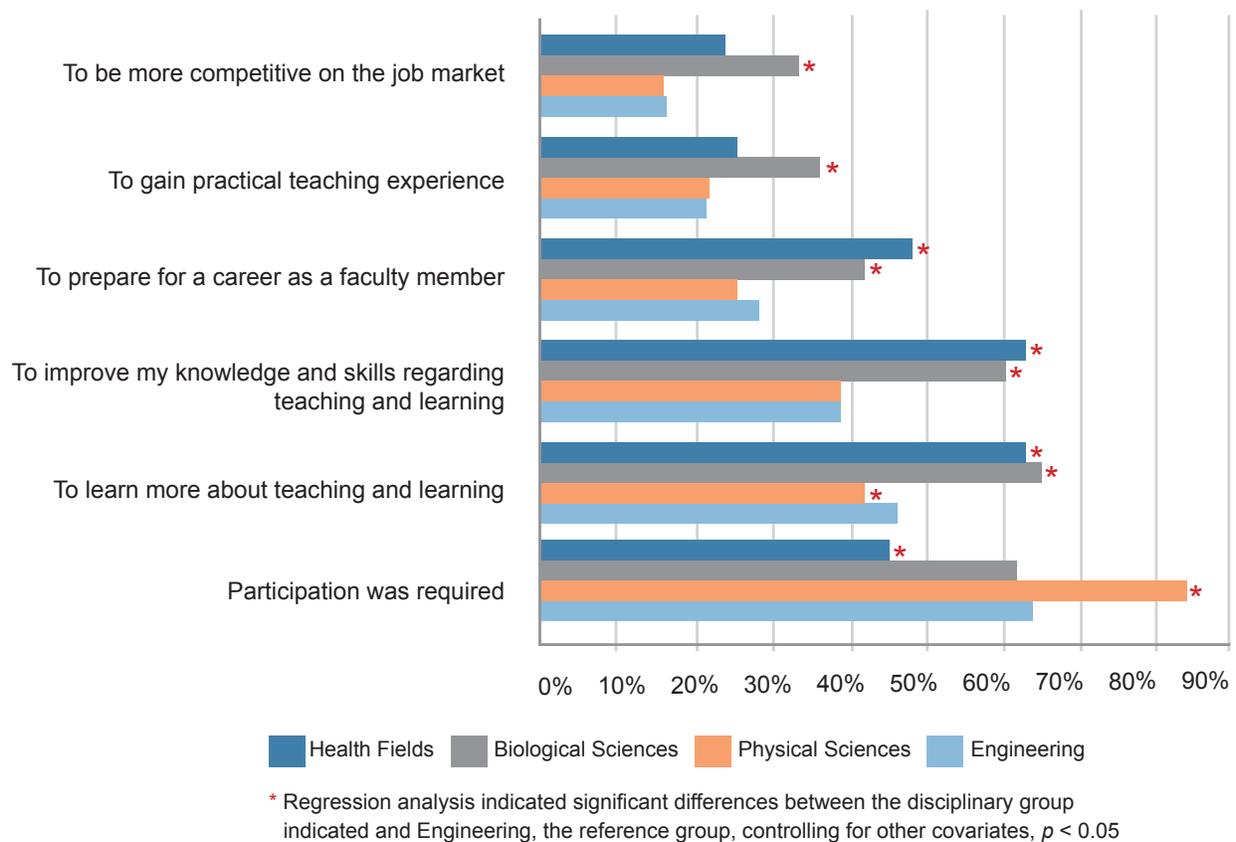


FIGURE 2: REASONS TO PARTICIPATE IN TD BY DISCIPLINE



priority as compared to engineering and physical science students (42.9%, 41% vs. 51.3%, 53.6%), and more likely to report that TD conflicted with their schedules (29.3%, 31.4% vs. 23%, 22.6%). Biological sciences students were also more likely to indicate they were discouraged to participate than engineering and physical science students (14.1% vs. 6.6%, 6.2%). Thus, even though biological science students considered TD to be a higher priority than other disciplines, these students may encounter more obstacles in the form of unsupportive advisors and scheduling conflicts, which may demonstrate that interest in TD, support of advisors, and ability to engage in TD are misaligned.

## Implications

Our study's results have three major implications.

### 1. Expand Mandatory Teaching Development Offerings.

Most doctoral students in our study (71.5%) indicated that they participated in TD because it was required, which is most likely a result of mandatory TA orientation and training. For the past few decades, scholars have advocated that TA training should focus more on effective teaching practices.<sup>2</sup>

<sup>2</sup> See, for example, (a) Border, L. L. B. (Ed.) (2011). *Mapping the range of graduate student professional development: Studies in graduate and professional student development*. Studies in Graduate & Professional Student Development (Vol.14). Stillwater, OK: New Forums Press. (b) Border, L. L. B., & von Hoene, L. M. (2010). Graduate and professional student development programs. In K. H. Gillespie & D. L. Robertson (Eds.), *A guide to faculty development* (2nd ed.). San Francisco, CA: Jossey-Bass. (c) Marincovich, M., Prostko, J., & Stout, F. (Eds.) (1998). *The professional development of graduate teaching assistants*. Bolton, MA: Anker.

*While our results encouragingly demonstrate female doctoral students' interest in developing as effective teachers, why are male doctoral students seemingly less interested in TD?*

Thus, one straightforward way to increase doctoral students' access to TD would be to include more pedagogical professional development in current TA training efforts.

However, TA training is often limited and brief. To address this, departments and colleges could add required TD for students with teaching duties, partnering with other campus units to provide TD programs.<sup>3</sup> Departments and colleges could include TD the formal graduate curriculum. Even students who take non-faculty positions (i.e., administrators, government, private sector) could benefit from TD because effective teaching engenders strong planning, communication, and collaborative learning skills. Such skills which could have many practical applications (e.g., training and mentoring fellow employees).

Although "mandatory" can seem pejorative, required training can positively promote TD participation among graduate students. Required participation could address some common barriers (e.g., advisor support, scheduling, awareness and importance of TD). Mandatory TD could also promote institutional and departmental culture change, since it would give doctoral students and supporters of TD official top-down institutional credibility that can be combined with grassroots efforts to improve teaching.

Yet, requiring TD is not enough to address participation barriers. Intrinsic motivation is often

a stronger incentive than extrinsic motivators, suggesting that carrots and not just sticks be used to promote TD participation. TD providers and campus leaders should find ways to make participation easier without overusing compulsory programming. Required TD could discourage interest in TD if it is not aligned with intrinsic motivators such as feeling competent to handle one's work responsibilities.

## 2. Help Doctoral Students Pursue TD Experiences

Our findings suggest that TD programs fill a particular niche for students wanting to gain teaching and learning skills and prepare for academic careers. Graduate deans, department chairs, faculty, and other important campus stakeholders should take note that doctoral students want TD experiences. However, doctoral students need their advisor's support, enough time to participate, sufficient awareness of TD offerings on campus, and help in selecting TD activities.

Colleges and departments need to listen to what their students want in terms of TD, why they want it, and what prevents participation. Such knowledge could be used to develop a good mix of mandatory and optional TD programming and identify steps to reduce TD participation barriers.

To meet student needs and interests in TD, campus units will likely need to cooperate, especially since most colleges or departments will not have all of the resources and expertise to help their students develop as teachers.

## 3. Address the Gender Gap

Lastly, we found the reasons to participate in TD were different for men and women, which is related to another LSFSS finding where women were more

<sup>3</sup> Schussler, E.E., Quentin, R., Marbach-Ad, G., Miller, K., & Ferzli, M. (2015). Preparing biology graduate teaching assistants for their roles as instructors: An assessment of institutional approaches. *CBE-Life Science Education*, 14, 1-11.

<sup>4</sup> Connolly, M.R., Lee, Y.G., Hill, L., & Associates (2015). STEM college teaching: Building confidence through teaching development. *LSFSS Brief Series, No.3*, Madison, WI: Wisconsin Center for Education Research, University of Wisconsin-Madison.

likely to engage in TD than their male classmates.<sup>4</sup> We also found participants from disciplines with higher proportions of women (e.g., biological sciences and health fields) were more interested in TD than fields traditionally associated with men (e.g., physical sciences and engineering). Our findings are consistent with prior research which demonstrates gendered differences in teaching, such as women teaching more than men in tenure-track and non-tenure-track faculty positions.<sup>5</sup> Taken together, our findings suggest a gender gap in TD participation, which warrants further study.

For instance, while our results encouragingly demonstrate female doctoral students' interest in developing as effective teachers, why are male doctoral students seemingly less interested in TD? We may not be able to answer this question from this study, but our findings do reflect deeper cultural-gender challenges inherent in STEM departments and colleges related to teaching and learning. We suggest that future studies investigate and explain the gender disparities of TD participation.

<sup>5</sup> For example, see: (a) Perna, L. W. (2001). Sex and race differences in faculty tenure and promotion. *Research in Higher Education*, 42(5), 541-567. doi: 10.1023/A:1011050226672 (b) Harper, E. P., Baldwin, R. G., Gansneder, B. G., & Chronister, J. L. (2001). Full-time women faculty off the tenure track: Profile and practice. *The Review of Higher Education*, 24(3), 237-257. doi: 10.1353/rhe.2001.0003

*Important campus stakeholders should take note that doctoral students want TD experiences but they need support from their advisors, enough time to participate, sufficient awareness of TD offerings on campus, and guidance in selecting TD activities.*

## Conclusion

To increase TD participation, campus leaders should consider: expanding mandatory TD, assessing and addressing doctoral students' needs for TD, and closely examining gendered patterns in TD participation. While these strategies are not the only ways to increase TD participation, all three have a strong potential to elevate the importance of TD for career development, reduce participation barriers, and encourage institutional culture change.



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