



Longitudinal Study of FUTURE STEM SCHOLARS

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Summary

The purpose of this brief is twofold. First, the brief familiarizes the reader with the Longitudinal Study of Future STEM Scholars (LSFSS) by providing details regarding the background of the study, research questions, a description of research methods, key findings, and implications. Second, the brief introduces the reader to the new *LSFSS Brief Series*, which will share major LSFSS findings that have practical significance for a wide range of audiences.

LSFSS Study

The Longitudinal Study of Future STEM Scholars explores the short- and long-term impact of teaching development on STEM doctoral students and early-career academics. The study uses repeated surveys and interviews to follow a 2009 cohort of 3,060 late-stage doctoral students.

The Longitudinal Study of Future STEM Scholars: An Overview

In the United States, improving undergraduate science, technology, engineering, and mathematics (STEM) education has become a national priority. One strategy for improving STEM education at the college level is to better prepare future STEM faculty during their doctoral programs as effective undergraduate teachers and mentors.

According to data from the *Survey of Doctorate Recipients*, one of every three STEM Ph.D.'s will be teaching undergraduates within six years of completing their doctorate. However, doctoral training in STEM fields tends to emphasize doctoral students' formation as researchers and scholars. As a result, STEM Ph.D.'s who enter faculty positions often receive insufficient pedagogical training, which can negatively affect undergraduate STEM learning. **Thus, preparing doctoral students who aspire to academic careers to be effective undergraduate educators has become a key strategy for advancing the national STEM agenda.**

Over the past two decades, significant resources have been invested in developing programs that help graduate students gain teaching knowledge and skills. These teaching development programs (e.g., seminars, workshops, courses) are intended to both enhance and compliment their training as researchers. However, little is actually known about these programs and whether they are effective at preparing future faculty for their teaching responsibilities.

To address this lack of information about doctoral teaching development programs, the Longitudinal Study of Future STEM Scholars (LSFSS) examines the preparation of future faculty for their pivotal role as teachers and mentors of undergraduates. Building on several years of research supported by the NSF-funded Center for the Integration of Research, Teaching, and Learning (CIRTL), this seven-year, multi-institutional study seeks to identify the short- and long-term effects of teaching development (abbreviated in this brief as TD) programs on STEM doctoral students who intend to become postsecondary faculty and educators.

Survey and Interview Data

Since 2009, the LSFSS has followed a single panel of late-stage STEM doctoral students (initial N= 3,060) at Arizona State University, the University of Washington-Seattle, and the University of Wisconsin–Madison. We selected these three research universities because they not only produce a large number of STEM Ph.D.'s, but they also have a large number of TD programs intended for doctoral students. Study participants included both doctoral students who participated in TD and those who never participated in TD. See Table 1 for the study's primary and secondary research questions.

We surveyed all STEM doctoral students at the three participating universities in 2009, asking about them about their TD participation and experiences. As Table 2 shows, researchers also surveyed this group in 2011 and 2013.

TD programs affect participants' confidence in their ability to teach undergraduates, positively influence the development of certain teaching competencies relative to non-participants, and provide opportunities to learn high-impact instructional practices that they can apply in their early careers.

In 2010 and 2011, we interviewed select survey respondents—75 TD participants who had completed their doctorate and were presently working at a postsecondary institution—in order to explore their TD experiences and career transition, with special emphasis on the values, expectations, and priorities that had influenced them since beginning their doctoral studies.

TABLE 1: PROJECT RESEARCH QUESTIONS

Primary Research Question	
How does participation in teaching development (TD) affect STEM doctoral students' teaching preparation, career pathways, and early-career performance?	
TD Program Description & Design	
1.	What are the variations of TD programs for STEM doctoral students?
2.	What elements should be considered in designing and evaluating TD programs?
TD Program Participation	
3.	Who participates in TD programs, and why?
TD Program Impacts	
4.	What influence does participation in TD programs have on the kinds of careers that STEM Ph.D.'s pursue and ultimately choose?
5.	What skills and knowledge do STEM doctoral students gain from TD programs that help prepare them for a diverse range of academic careers?
6.	What influence, if any, does participation in TD have on indicators of early-career performance (e.g., satisfaction, peer and student feedback, use of research-based instructional approaches) as academics?

TABLE 2: SURVEY SUMMARY

Survey	N	Responses	Rate	Primary Focus
Year 1 (2009)	3,060	2,163	73%	TD participation and experiences
Year 2 (2011)	2,146	1,445	67%	TD impact on teaching self-efficacy beliefs; current employment
Year 3 (2013)	2,146	1,414	66%	TD impact on teaching self-efficacy and behaviors as early-career professionals; career trajectories

Key Findings

Why do doctoral students participate in TD?

From our 2009 survey, we found that:

- The factors that most encourage TD participation are departmental requirements, the student's interest in teaching and learning, and his or her career goals.
- The factors that most discourage doctoral students' participation are lack of awareness of the programs, scheduling conflicts with TD events, and seeing TD participation as a lower priority.
- Women report engaging in TD programs at higher levels than men.

What effects does TD have on doctoral students?

- TD programs positively affect participants' beliefs about their ability to teach undergraduates; moreover, TD has a greater influence on women's beliefs than on men's.
- Compared with non-participants, TD participation also positively influences certain teaching competencies, such as course design and assessment of student learning.
- Doctoral students who participate in TD programs learn high-impact instructional practices that they apply in their early careers.
- Through TD participation, some women develop an identity as teacher-scholars and make connections beyond their departments.
- Participating in TD programs and having actual teaching experience play equally important and complimentary roles in shaping early-career academics beliefs and skills.

How does TD influence doctoral students' career trajectories?

- While proceeding through their doctoral programs, doctoral students often experience a mismatch among (1) what they expected of graduate school, (2) their actual training experiences, and (3) their career interests and opportunities. We found that some doctoral students use teaching development to realign this three-way mismatch.
- Teaching development activities help participants clarify their career interests and successfully compete for a wider variety of academic jobs.

Implications

Through the LSFSS, we know that TD programs promote teaching self-confidence and competencies. TD programs also help doctoral students explore and align career goals to match the current academic job market, including the wide array of faculty positions available outside of research universities.

Because of their impact on the professional development of future STEM faculty, TD programs may play a key role in national efforts to improve undergraduate STEM education. Given the benefits of TD programs, university departments, colleges, and graduate schools should consider:

- Expanding their support of TD programs
- Encouraging STEM doctoral student participation
- Lowering barriers to doctoral student participation
- Coordinating TD program offerings on campus

Introduction to the LSFSS Brief Series

This is the first in a series of research briefs describing this study's contributions to the scholarly literature on STEM doctoral education and postsecondary STEM faculty.

Findings from the LSFSS address topics such as the characteristics of TD programs, factors that influence participation, benefits of TD program participation, and career paths of STEM Ph.D.s.

We have reported initial findings at the meetings of the Association for the Study of Higher Education (ASHE) and the American Education Research Association (AERA). Furthermore, several manuscripts are under review or in development.

Because faculty, administrators, and doctoral students may not have the time to read full-length manuscripts, the *LSFSS Brief Series* is a way to disseminate our research findings in an accessible format. This is the first in a series of research briefs describing this project's contributions to

the scholarly literature on STEM doctoral education and postsecondary STEM faculty. Future issues will elaborate on key findings described above and highlight elements of the study that have practical significance for a wide range of audiences:

- Departments, units, and organizations that deliver teaching development programs for STEM doctoral students and postdoctoral scholars
- Deans, directors, and chairs of STEM departments and colleges
- Graduate school deans and administrators
- Current and prospective STEM doctoral students
- STEM faculty, especially those who advise graduate students
- Funding agencies investing in STEM reform
- Education researchers

Resources Cited

The Survey of Doctorate Recipients, 2010 data set <http://www.nsf.gov/statistics/srvydoctoratework/>



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CONTRIBUTORS

Mark R. Connolly (Principal Investigator), Associate Research Scientist, Wisconsin Center for Education Research (WCER) at the University of Wisconsin–Madison

You-Geon Lee, Assistant Researcher, WCER, UW–Madison

Julia N. Savoy, Assistant Researcher, WCER, UW–Madison

Lucas Hill, Assistant Researcher, Michigan State University

Jessica Grettie, Project Manager, WCER, UW–Madison

Jennifer Vandenberg, Undergraduate Assistant, WCER, UW–Madison

Ann E. Austin, Professor of Higher Education, Michigan State University (2008-2014)

FOR MORE INFORMATION ABOUT THIS STUDY

Dr. Mark R. Connolly

Wisconsin Center for Education Research

University of Wisconsin–Madison

570A Education Sciences Building

1025 W. Johnson St., Madison, WI 53706-1706

mrconnolly@wisc.edu ~ (608) 263-4233

Project Website: lsfss.wceruw.org



**Wisconsin Center for
Education Research**

SCHOOL OF EDUCATION
UNIVERSITY OF WISCONSIN–MADISON