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Center for the Integration of  
Research, Teaching, and Learning

**Delta Participation and the Attitudes, Beliefs, and  
Professional Development Experiences of  
Doctoral Students and Postdoctoral Researchers in  
Science, Technology, Engineering, and Mathematics (STEM)  
at the University of Wisconsin–Madison**

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## **EXECUTIVE SUMMARY**

This report presents the findings of a cross-sectional study on STEM doctoral students and postdoctoral researchers at the University of Wisconsin–Madison. The purpose of this study is to understand their perceptions of teaching, their interest in various academic roles, and how their perceptions and interests are related to academic status, demographics, and professional development experience. The results of the study are based on 464 doctoral students and 185 postdoctoral researchers who were randomly selected respondents to a survey, conducted between April and June 2005, with 42% and 45% response rates, respectively. Of the respondents, 95 had participated in one or more of the activities of the Delta Program in Research, Teaching, and Learning (“Delta”).

The findings of this research suggest that attitudes and beliefs about teaching were more positive for Delta participants than for doctoral students and postdoctoral researchers who had not participated in Delta. In addition, Delta participants were more interested in undergraduate teaching and in working as an educator. Specifically, 1) 92% of Delta participants planned to work in education, whereas only 74% of non-participants planned to work in education; 2) Delta participants were more interested in undergraduate teaching (76%) than non-participants (58%); 3) Delta participants were more interested in university administration (24%) and serving on department or institution-wide committees (41%) compared to non-participants (9% and 29%, respectively); and 4) among individuals who had high interest in teaching, Delta participants had more positive attitudes and beliefs about teaching than non-participants.

An analysis of the survey responses based on academic status, gender, and citizenship revealed the following additional findings:

- 1) STEM doctoral students had more positive attitudes and beliefs about teaching than postdoctoral researchers. However, only 73% of doctoral students planned to work in education, compared to 85% of postdoctoral researchers.
- 2) STEM female doctoral students and postdoctoral researchers had more positive attitudes and beliefs about teaching than their male counterparts. Women (69%) were more interested in teaching undergraduate students than were men (55%). Women were less interested in teaching graduate students (only 54% of women compared to 69% of men) and conducting research (only 72% of women compared to 83% of men).
- 3) Doctoral students and postdoctoral researchers in STEM who were U.S. citizens had more favorable attitudes and beliefs about teaching than non-U.S. citizens. Of U.S. citizens (both doctoral students and postdoctoral researchers), 70% were interested in teaching at a research university and 71% were interested in teaching undergraduate students. Of non-U.S. citizens (both doctoral students and postdoctoral researchers), 83% were interested in teaching at a research university, whereas only 42% were interested in teaching undergraduate students.

Based on the findings of this study, we recommend the following:

- 1) Since STEM doctoral students and postdoctoral researchers who participate in teaching-related professional development demonstrate more positive attitudes and beliefs about teaching, institutions of higher education should provide students with these types of programs and encourage students to participate.
- 2) The professional development programs that emphasize teaching preparation appear to differentiate more among students who have high interest in teaching than among students who have low interest in teaching. This suggests that interest is a factor in gaining the most from the such professional development programs.
- 3) Since more postdoctoral researchers than doctoral students plan to work in education—yet the attitudes and beliefs about teaching among postdoctoral researchers are significantly lower than those among doctoral students—institutions of higher education should actively recruit postdoctoral researchers to teaching-related professional development programs.
- 4) Since the attitudes and beliefs about teaching among men are generally less favorable than the attitudes and beliefs among women, male doctoral students and postdoctoral researchers should be targeted by teaching-related professional development programs.
- 5) Since the attitudes and beliefs about teaching among non-U.S. citizens are less favorable than the attitudes and beliefs among U.S. citizens and 83% of non-U.S. citizens plan to teach at a research university, institutions of higher education should reach out to non-U.S. citizens in their teaching-related professional development programs.

The cross-sectional study conducted for this report has some limitations. Since the study was descriptive in nature, seeking to obtain an accurate description of the attitudes, beliefs, and professional development experiences of STEM doctoral students and postdoctoral researchers, the findings are descriptive rather than causal. That is, even though the findings suggest a relationship between positive attitudes and beliefs about teaching and participating in teaching-related professional development programs such as Delta, additional research needs to be conducted to demonstrate any causality. This is the focus of the longitudinal study on the impact of Delta that is being conducted by the CIRTLE Evaluation and Research Team.

# 1. INTRODUCTION

## 1.1 Context of the Research

Over the past decade, national interest in improving the quality of undergraduate teaching and learning has increased dramatically. In particular, the need to prepare doctoral students and postdoctoral fellows for teaching, especially in the sciences (Fagen and Wells, 2004; Golde and Dore, 2004), has caught the attention of U.S. institutions of higher education. Pedagogical training is underemphasized in doctoral programs of many disciplines (Committee on Science Engineering and Public Policy, 2000; Davis and Fiske, 2001; Golde and Dore, 2001), although such training is well received by doctoral students and postdocs when it is offered (DeNeef, 2002; Pruitt-Logan, Gaff, and Jentoft, 2003). Indeed, there is a strong demand for programs that develop teaching abilities and enable future instructors to teach students from diverse backgrounds (Wulff, 2004).

The Center for the Integration of Research, Teaching, and Learning (CIRTL) is a multi-year, multi-university initiative and research project, funded by the National Science Foundation, aimed at implementing and advancing effective teaching practices for diverse student audiences in science, technology, engineering, and mathematics (STEM) at U.S. colleges and universities. To further CIRTL's mission of advancing teaching in STEM, in Fall 2003 the leaders of CIRTL created the Delta Program in Research, Teaching, and Learning ("Delta") at the University of Wisconsin-Madison. Delta is a learning community that offers courses, seminars, workshops, presentations, internships, and certificate programs to graduate students and postdocs to enhance their knowledge and practice of teaching.

Delta is founded on the three core concepts of CIRTL: 1) Teaching-as-Research, 2) Learning Community, and 3) Learning-through-Diversity. Teaching-as-Research refers to the application of a research-oriented approach to teaching. A Learning Community is a collaborative, interdisciplinary, and inclusive community of students and teachers with shared knowledge and objectives. Learning-through-Diversity encourages teachers to build on the perspectives of the increasingly diverse constituents of STEM.

Delta participants embracing these concepts should be able to use research methods to reflect on teaching and learning, create a community of shared learning and discovery, and capitalize on the diverse experiences, backgrounds, and skills of students to enhance learning. By focusing on these three "pillars," Delta aims to help current and future faculty become more effective teachers and ultimately improve undergraduate education.

## 1.2 Purpose of the Research

As part of its investigation into the impact of Delta<sup>1</sup>, the CIRTl Evaluation and Research Team conducted a cross-sectional study on doctoral students and postdoctoral fellows. The purpose of this study is to understand their perceptions of teaching, their interest in various academic roles, and how their perceptions and interests are related to academic status, demographics, and professional development experience (e.g., Delta). Thus, this research was designed around two guiding questions:

- 1) What are the prevailing attitudes and beliefs about teaching, career choice, and academic roles among STEM doctoral students and postdoctoral fellows?
- 2) How do STEM doctoral students and postdoctoral fellows' attitudes and beliefs about teaching, career path, and academic roles relate to their professional development experiences?

The data and findings from this cross-sectional study serves as a baseline for the longitudinal study, which will explore over a course of five to eight years how perceptions change over the course of the doctoral and postdoctoral experience and the factors that influence and contribute to understanding of teaching.

## 2. METHOD

To address the research questions, a web survey was developed and administered to a random sample of doctoral students and postdoctoral fellows at UW–Madison. In this section, we describe the survey population, the sampling plan, the design of the survey, the data collection, and the data analysis procedures. We also define six measured dimensions utilized in the analysis.

### 2.1 Survey Population

The research population consisted of all STEM doctoral students who were enrolled at UW–Madison during the Spring 2004-05 semester and all STEM postdoctoral researchers (including postdoctoral fellows, postdoctoral trainees, and research associates) who were employed by UW–Madison during the Spring 2004-05 semester. The sampling frame consisted of 2,477 STEM doctoral students and 453 STEM postdoctoral employees who could be reached by e-mail.

The disciplinary and demographic distributions of the survey population provides an indication of how representative the sample is with respect to the population. Ideally, we would compare our sample against data from the same time period as when the survey was conducted (i.e.,

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<sup>1</sup> The Evaluation and Research Team is also conducting a qualitative longitudinal study on the impact of Delta. See Susan Millar and Jana Bouwma-Gearhart (2005), *Longitudinal Study of the Impact of the UW-Madison Delta Program in Research, Teaching, and Learning: Findings from Spring 2005 Data*.

Spring 2004-05). However, since the disciplinary and demographic distributions of UW–Madison STEM doctoral students and postdocs had previously been compiled for the Census Surveys of April 2004, we decided to use the Spring 2003-04 data from the Census Surveys for comparison.

Our profile of the doctoral student population is based on UW–Madison September 2004 enrollment records (Spring 2003-04, Office of the Registrar) as reported in *A Report on Attitudes and Aspirations Related to College Teaching Held by Doctoral Students in STEM at the UW-Madison* (Dillenburg and Connolly, 2005). The population is comprised primarily of students in the biological sciences (26.9%), engineering (25.1%), and physical sciences (17.3%) (see Table 1). The majority are male (62.4%), U.S. citizens (59.5%), and Caucasian (84.7%) (see Table 2).

The profile of the postdoctoral employee population is based on UW–Madison March 2004 employment records (Spring 2003-04, Office of Budget Planning and Analysis) as reported in *A Report on Attitudes and Aspirations Related to College Teaching Held by Post-Doctoral Employees in STEM at the UW-Madison* (Dillenburg, 2005). The postdoctoral population is comprised primarily of postdocs working for the College of Agricultural and Life Sciences (36.8%), College of Letters and Science (22.1%), School of Medicine and Public Health (20.4%), and College of Engineering (19.3%). The majority are male (70%), U.S. Citizens (53.3%), and Caucasian (80.1%).

*Table 1: Disciplinary Distribution of STEM Doctoral Students for the Spring 2003-04 Semester*

Field of Study	Number	Percent
Biological Sciences	741	26.9
Engineering	693	25.1
Physical Sciences	478	17.3
Math and Statistics	215	7.8
Computer Science	163	5.9
Possible STEM fields/Health Fields	158	5.7
Social Sciences	148	5.4
Agricultural Sciences	129	4.7
Earth, Atmospheric, Ocean Sciences	34	1.2
Total	2759	100.0

Table 2: Demographic Distribution of STEM Doctoral Students for the Spring 2003-04 Semester

Demographic Characteristic		Number	Percent
Gender	Male	1721	62.4
	Female	1038	37.6
	Total	2759	100.0
Citizenship	U.S. Citizen	1642	59.5
	Non U.S. Citizen	1117	40.5
	Total	2759	100.0
Race/Ethnicity <sup>2</sup>	White	1390	84.7
	Other	91	5.5
	Latino or Hispanic	62	3.8
	Asian or Pacific Islander	57	3.5
	African American/Black	33	2.0
	American Indian or Alaskan Native	9	0.5
	Total	1642	100.0

Table 3: Disciplinary Distribution<sup>3</sup> of STEM Postdoctoral Employees, Spring 2003-04

School / College	Number	Percent
Agricultural and Life Sciences	128	36.8
Letters and Science	77	22.1
Medical School	71	20.4
Engineering	67	19.3
Veterinary Medicine	4	1.2
Education	1	0.2
Total	348	100.0

Table 4: Demographic Distribution of the STEM Postdoctoral Employees, Spring 2003-04

Demographic Characteristic		Number	Percent
Gender	Male	244	70
	Female	104	30
	Total	348	100.0
Citizenship	U.S. Citizen	186	53.3
	Non U.S. Citizen	163	46.7
	Total	348	100.0
Race/Ethnicity	White	149	80.1
	Asian or Pacific Islander	22	11.8
	Other	11	5.9
	Latino/Hispanic	3	1.6
	African American/Black	1	0.6
	American Indian or Alaskan Native	0	0
Total	186	100.0	

<sup>2</sup> Race/Ethnicity is reported for U.S. citizens only.

<sup>3</sup> Classification by school and college was derived from the department where the postdoctoral researcher was employed.

## **2.2 Sampling Plan and Procedures**

A repeated-sampling design was used to select the STEM doctoral students included in the sample. This design provides one check in the consistency of responses received. A random sample of 770 (31.1%) was randomly selected from the sampling frame of 2,477 STEM doctoral students. Those students in the first random sample were sent an email requesting their participation in the electronic survey accessed on the internet in March 2005. After two weeks, a follow-up email was sent to those who had not responded. In April, a second random sample of 340 (19.9% of the 1,707) was selected from students who had not been selected in the first sample. The non-responders from this sample were sent a follow-up request two weeks later. A total of 44% of the first sample of 770 and 37% of the second sample of 340 returned completed surveys. The responses for the two samples, A and B, were almost identical. Although this procedure does not increase the representativeness of the responses to the full sampling frame, the consistency in responses for the two samples, does indicate that about 41.8% of those surveyed are likely to reply and that the responses of those who do reply do not vary over a short time frame of one or two months. Because the responses for each sample were nearly identical, the two samples were combined and not analyzed separately. Nearly all of the 453 postdoctoral researchers were sent a survey to complete. A random sample of 89.8%, 407 of 453, were sent a survey.

## **2.3 Design of the Survey**

The survey (see Appendix A) was designed to provide comparable information from the sampling frame population as the information being collected on those who have been chosen as a participant for the CIRTTL longitudinal study. All of the questions on the survey are the same as the interview questions used to gather information in the interview part of the study. Of the 34 questions included on the doctoral graduate student survey, six of the questions ask students about their field of study, nine questions ask about their professional development experiences in teaching and research including Delta, 12 questions ask about their beliefs towards the three pillars of CIRTTL (teaching as research, teaching-through-diversity, and learning communities), three questions ask about future aspirations, and four are demographic questions. The survey was modified slightly for the postdoctoral researchers. The six questions regarding field of study were modified and reduced to four questions about the researchers' Ph.D. program. Otherwise the questions were the same. The 12 questions on beliefs about the three pillars of CIRTTL came from the census survey administered to all STEM faculty, graduate students, and postdoctoral researchers in spring 2004.

## **2.4 Data Collection Procedures**

Data collection occurred between April 2005 and June 2005. On April 14, e-mail messages were sent to a random sample of 770 doctoral students and 407 postdocs. Each student and postdoc received a personalized e-mail message (see Appendix B) explaining the purpose of the study and requesting his or her participation.

Within the body of the e-mail message was a link to start the web questionnaire. A unique identifier in the link allowed the web server to track which students completed the survey and prevented participants from completing multiple questionnaires. Two follow-up reminder messages (see Appendix C) were sent on April 25 and May 20. On May 24, the initial invitation e-mail message was sent to an additional 340 doctoral students. One follow-up e-mail message was sent to these doctoral students on June 14.

In the web questionnaire, a screen-by-screen construction format was employed. Respondents were asked to answer each of the questions, but were permitted to skip questions if they wished. The survey application utilized was SurveySolutions XP. Personally identifiable information was stored separately from survey responses, and only the responses were exported for analysis.

## 2.5 Data Analysis Procedures

Analysis of the cross-sectional data was performed in two stages: a qualitative analysis on the written comments provided by the survey respondents and a quantitative analysis on the survey responses. For more information on the qualitative analysis, please refer to *Professional Development Needs and Recommendations Reports by the Doctoral and Postdoctoral Respondents of the CIRTL Longitudinal Survey* (Barger, 2005).

Upon completion of the data collection, survey responses were exported from SurveySolutions XP in Excel format. The data was then imported into SPSS for quantitative analysis.

The survey consisted of three categories of questions: 1) questions related to the respondent’s attitudes and beliefs about teaching, 2) questions related to the respondent’s interest in academic roles, and 3) general demographic questions.

Factor analysis was used to reduce the number of variables by grouping those that correlated highly with each other. This was done to validate the constructs used in this analysis. Factor analysis of the questions in the first two categories yielded six dimensions of measurement. The first category, “Attitudes & Beliefs about Teaching,” was decomposed into two dimensions—Teaching-as-Research/Learning Community and Learning-through-Diversity—reflecting Delta’s core concepts. (See Table 5.) The second category, “Interest in Academic Roles,” was decomposed into four dimensions—Undergraduate Teaching, Graduate Teaching, Research, and Service—reflecting faculty responsibilities. The alpha values, which measure the internal consistency of the dimensions, are moderately high.

Table 5: The Six Dimensions of Measurement

Category	Dimension	Alpha
Attitudes & Beliefs about Teaching	Teaching-as-Research/Learning Community	0.6853
	Learning-through-Diversity	0.7178
Interest in Academic Roles	Undergraduate Teaching	0.7288
	Graduate Teaching	0.6606
	Research	0.6182
	Service	0.5369

To facilitate analysis, each question was assigned a label within SPSS. Labels were selected to convey the meaning of the question in a succinct manner and are used in the tables in this report. The survey questions, as identified by their SPSS labels, for each dimension are as follows:

*Dimension 1: Teaching-as-Research/Learning Community*

Teaching requires input from others<sup>4</sup>  
Would study effects of instructional practices<sup>5</sup>  
Would seek teaching advice outside department<sup>6</sup>  
Teachers need not collect data on teaching effectiveness<sup>7</sup>  
Not important to discuss teaching with others<sup>8</sup>

*Dimension 2: Learning-through-Diversity*

Teachers need to study students' learning styles<sup>9</sup>  
Important to facilitate learning for all students<sup>10</sup>  
Would vary how to teach based on knowledge of students<sup>11</sup>  
Would use teaching activities that reflect students' backgrounds<sup>12</sup>  
Covering content is more important than student needs<sup>13</sup>

*Dimension 3: Undergraduate Teaching*

Interested in teaching at a teaching university  
Interested in teaching not at a university  
Most interested in teaching lectures  
Most interested in teaching discussions  
Most interested in teaching labs  
Most interested in teaching undergraduates  
Most interested in advising undergraduates

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<sup>4</sup> Survey question: "Effective teaching requires input from others"

<sup>5</sup> Survey question: "As a teacher, I would study the effects of different instructional practices in my own classroom."

<sup>6</sup> Survey question: "As a teacher, I would seek pedagogical advice from those outside my department."

<sup>7</sup> Survey question: "A teacher does not need to collect data on the effectiveness of his/her teaching."

<sup>8</sup> Survey question: "It is not important for me to discuss my teaching with others."

<sup>9</sup> Survey question: "An effective teacher studies his/her students' learning in order to teach students of all types effectively."

<sup>10</sup> Survey question: "I believe it is important to try to facilitate learning among all the students in my class."

<sup>11</sup> Survey question: "As a teacher, I would vary how I teach my courses, based on my own knowledge about my students and their learning issues."

<sup>12</sup> Survey question: "As a teacher, I would use teaching activities that take into account the different backgrounds of my students."

<sup>13</sup> Survey question: "As a teacher, it would be more important for me to cover the course content than to attend to the different needs of the students in the course."

#### *Dimension 4: Graduate Teaching*

Interested in teaching at a research university  
Most interested in teaching graduates  
Most interested in advising graduates

#### *Dimension 5: Research*

Interested in doing research at a university  
Interested in doing research outside a university  
Most interested in conducting research

#### *Dimension 6: Service*

Interested in university administration  
Most interested in serving on disciplinary committees  
Most interested in serving on dept/institution committees

Two questions from the “Attitudes & Beliefs about Teaching” category designed to describe aspects of learning community did not relate close enough to other items to be assigned by the factor analysis and thus are reported separately:

Rarely talk to colleagues about teaching<sup>14</sup>  
Know how to facilitate discussing teaching and learning<sup>15</sup>

### **3. DATA RETURN AND SURVEY PARTICIPANTS**

In this section we report the survey response rates and describe the disciplinary and demographic distributions of the respondents. By comparing the distributions of the samples to the populations, we can determine whether the samples are representative of the populations. In addition, the results of a small-scale telephone survey conducted to assess non-response bias are reported.

#### **3.1 Data Return**

Of the 1,110 surveys distributed to doctoral students, 464 were completed, for a response rate of 42%. Of the 407 surveys distributed to postdoctoral employees, 185 were completed, for a response rate of 45%. (See Table 6.) This rate of return is comparable to the census survey administered in 2004.

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<sup>14</sup> Survey question: “I rarely talk to my colleagues about teaching.”

<sup>15</sup> Survey question: “I know how to organize others for the purpose of discussing teaching and learning.”

*Table 6: Sample Sizes and Response Rates by Stratum*

	Doctoral Students	Postdoctoral Employees	Total
Population (April 2004)	2759	348	3107
Sampling frame (April 2005)	2477	453	2930
Survey sample sent (April-June 2005)	1110	407	1517
Completed cases	464	185	649
Response rate	42%	45%	43%

### 3.2 Profile of the Doctoral Survey Respondents

Of the doctoral survey respondents, 29.7% were in the biological sciences, 22.6% were in engineering, and 19.2% were in the physical sciences. Compared to the disciplinary distribution of the STEM doctoral student population, the sample is highly representative. (See Tables 1 and 7.)

The demographic distribution of the doctoral student respondents was also representative of the population (see Tables 2 and 8), although there were slightly fewer males (52.8% compared to 62.4%) and more U.S. citizens (71.1% compared to 59.5%) who returned a completed survey than in the population. Thus, a greater proportion of female graduate students and U.S. citizens responded to the survey than who are in the total population.

*Table 7: Disciplinary Distribution of the Doctoral Survey Respondents*

Field of Study	Number	Percent
Biological Sciences	138	29.7
Engineering	105	22.6
Physical Sciences	89	19.2
Social Sciences	37	8.0
Math and Statistics	30	6.5
Agricultural Sciences	26	5.6
Computer Science	23	5.0
Earth, Atmospheric, Ocean Sciences	16	3.4
Total	464	100.0

*Table 8: Demographic Distribution of the Doctoral Survey Respondents*

Demographic Characteristics		Number	Percent
Gender	Male	245	52.8
	Female	219	47.2
	Total	464	100.0
Citizenship	U.S. Citizen	330	71.1
	Non U.S. Citizen	134	28.9
	Total	464	100.0
Race	White	294	89.1
	Asian or Pacific Islander	16	4.8
	Other	8	2.4
	African American/Black	6	1.8
	Missing	5	1.5
	American Indian or Alaskan Native	1	0.4
	Total	330	100.0
Ethnicity	Not Hispanic or Latino	317	96.1
	Hispanic or Latino	13	3.9
	Total	330	100.0

### 3.3 Profile of the Postdoctoral Survey Respondents

Of the postdoctoral survey respondents, 28.6% were employed by the College of Agricultural and Life Sciences, 24.3% by the College of Engineering, and 23.2% by the College of Letters and Science (see Table 9). Compared to the disciplinary distribution of the STEM postdoctoral population (see Table 3), we find that the sample is fairly representative of the population.

Field of study for the postdoctoral survey respondents is reported in Table 10. Field of study data on the population was unavailable for comparison.

The demographic distribution of the postdoctoral survey respondents was strikingly similar to the distribution in the population (see Tables 4 and 11). Thus, the postdoctoral sample was highly representative of the population.

*Table 9: Disciplinary Distribution of the Postdoctoral Survey Respondents by School / College*

School / College	Frequency	Percent
Agricultural and Life Sciences	53	28.6
Engineering	45	24.3
Letters and Science	43	23.2
Medical School	33	17.8
Pharmacy	10	5.4
Veterinary Medicine	1	0.5
Total	185	100.0

Table 10: Disciplinary Distribution of the Postdoctoral Survey Respondents by Field of Study

Field of Study	Number	Percent
Biological Sciences	87	47.0
Engineering	39	21.1
Physical Sciences	32	17.3
Agricultural Sciences	14	7.6
Social Sciences	8	4.3
Earth, Atmospheric, Ocean Sciences	2	1.1
Math and Statistics	2	1.1
Computer Science	1	0.5
Total	185	100.0

Table 11: Demographic Distribution of the Postdoctoral Survey Respondents

Demographic Characteristics		Number	Percent
Gender	Male	128	69.2
	Female	57	30.8
	Total	185	100.0
Citizenship	U.S. Citizen	93	50.3
	Non U.S. Citizen	92	49.7
	Total	185	100.0
Race	White	82	88.2
	Asian or Pacific Islander	5	5.4
	Missing	3	3.2
	Other	2	2.1
	American Indian or Alaskan Native	1	1.1
	African American/Black	0	0
	Total	93	100.0
Ethnicity	Not Hispanic or Latino	92	98.9
	Hispanic or Latino	1	1.1
	Total	93	100.0

In summary, the disciplinary and demographic distributions of the survey respondents are highly representative of their respective populations. Thus, our ability to generalize from the results of the research to the population should not be negatively impacted by sampling bias.

### 3.4 Profile of the Delta Participant Survey Respondents

Of the 649 survey respondents, 95 (14.6%) indicated that they had participated in one or more Delta events or courses (see Table 12). To assess the representativeness of the sample, the profile of the Delta respondents was compared to the profile of the Delta population.

*Table 12: Delta Participation of the Survey Respondents*

	Participated in Delta				Total
	Yes		No		
	N	%	N	%	
Doctoral Respondents	59	12.7	405	87.3	464
Postdoctoral Respondents	36	19.5	149	80.5	185
Total	95	14.6	554	85.4	649

Prior to the distribution of the survey for this study, 317 graduate students (approximately 11.5% of the total population of 2,759 STEM graduate students) and 105 postdocs (approximately 30.2% of the total population of 348 STEM postdocs) had participated in Delta. Data on field of study (Table 13) and gender (Table 14) for the Delta doctoral population was obtained from the Delta Participant Database.<sup>16</sup> Data on field of study (Table 15) and gender (Table 16) for the Delta postdoctoral population was also obtained from the Delta Participant Database.

*Table 13: Disciplinary Distribution of Delta Doctoral Participants (through April 2005)*

Field of Study	Number	Percent
Biological Sciences	39	28.5
Possible STEM fields/Health Fields	23	16.8
Physical Sciences	21	15.3
Engineering	20	14.6
Agricultural Sciences	14	10.2
Computer Science	8	5.8
Social Sciences	5	3.7
Math and Statistics	4	2.9
Earth, Atmospheric, Ocean Sciences	3	2.2
Total	137	100.0

*Table 14: Gender of Delta Doctoral Participants (through April 2005)*

Gender	Number	Percent
Female	75	54.7
Male	62	45.3
Total	137	100.0

<sup>16</sup> Delta doctoral population data is based on the 137 identifiable doctoral participants.

Table 15: *Disciplinary Distribution of Delta Postdoctoral Participants (through April 2005)*

Field of Study	Number	Percent
Biological Sciences	76	72.4
Engineering	12	11.4
Physical Sciences	5	4.8
Social Sciences	2	1.9
Other	10	9.5
Total	105	100.0

Table 16: *Gender of Delta Postdoctoral Participants (through April 2005)*

Gender	Number	Percent
Female	51	48.6
Male	46	43.8
Missing	8	7.6
Total	105	100.0

Of the 59 Delta doctoral respondents, 35.6% were in the biological sciences, 23.7% were in engineering, and 18.6% were in the physical sciences (see Table 17). Within the Delta doctoral student population, 28.5% were in the biological sciences, 15.3% were in the physical sciences, and 14.6% were in engineering (see Table 13). Similarly, females represented 66.1% of the Delta doctoral respondents (see Table 18) and 54.7% of the population (see Table 14). Thus the Delta doctoral student sample is reasonably representative of the Delta doctoral student population considering field of study and gender.

Table 17: *Disciplinary Distribution of the Doctoral Respondents Who Participated in Delta*

Field of Study	Number	Percent
Biological Sciences	21	35.6
Engineering	14	23.7
Physical Sciences	11	18.6
Agricultural Sciences	4	6.8
Earth, Atmospheric, Ocean Sciences	4	6.8
Computer Science	2	3.4
Math and Statistics	2	3.4
Social Sciences	1	1.7
Total	59	100.0

*Table 18: Demographic Distribution of the Doctoral Respondents Who Participated in Delta*

Demographic Characteristics		Number	Percent
Gender	Female	39	66.1
	Male	20	33.9
	Total	59	100.0
Citizenship	U.S. Citizen	50	84.7
	Non U.S. Citizen	9	15.3
	Total	59	100.0
Race	White	43	87.8
	Asian or Pacific Islander	4	8.2
	African American/Black	1	2.0
	Other	1	2.0
	American Indian or Alaskan Native	0	0
	Total	49	100.0
Ethnicity	Not Hispanic or Latino	45	91.8
	Hispanic or Latino	4	8.2
	Total	49	100.0

Of the 36 Delta postdoctoral respondents, 77.8% were in the biological sciences and 11.1% were in engineering (see Table 19). Within the Delta postdoctoral population, 72.4% were in the biological sciences and 11.4% were in engineering (see Table 15). Similarly, females represented 58.3% of the Delta postdoctoral respondents (see Table 20) and 48.6% of the population (see Table 16). Thus the Delta postdoctoral respondent sample is quite representative of the Delta postdoctoral population considering field of study and gender.

*Table 19: Disciplinary Distribution of the Postdoctoral Respondents Who Participated in Delta*

Field of Study	Number	Percent
Biological Sciences	28	77.8
Engineering	4	11.1
Agricultural Sciences	3	8.3
Physical Sciences	1	2.8
Total	36	100.0

Table 20: Demographic Distribution of the Postdoctoral Respondents Who Participated in Delta

Demographic Characteristics		Number	Percent
Gender	Female	21	58.3
	Male	15	41.7
	Total	36	100.0
Citizenship	U.S. Citizen	28	77.8
	Non U.S. Citizen	8	22.2
	Total	36	100.0
Race	White	25	92.6
	Asian or Pacific Islander	2	7.4
	African American/Black	0	0
	American Indian or Alaskan Native	0	0
	Total	27	100.0
Ethnicity	Not Hispanic or Latino	26	96.3
	Hispanic or Latino	1	3.7
	Total	27	100.0

### 3.5 Non-Response Bias

Non-response bias is a concern when not everyone in the sample responds to the survey. To see whether the responses of those who participated in the web survey may have differed from those who did not, we conducted telephone interviews (see Appendix D) during the second week of October 2005. A random sample of the 42 doctoral students and 28 postdoctoral researchers who did not respond to the original web survey was selected. In total, 28 (17 doctoral students and 11 postdoctoral researchers) agreed to participate in the phone interview; eighteen of those interviewed were male and ten were female. (See Tables 21 and 22.)

Table 21: Sample Sizes and Response Rates of Non-Respondents by Stratum

Non-Respondents	Contacted	Participated	Response Rate
Doctoral Students	42	17	40%
Postdoctoral Researchers	28	11	39%
Total	70	28	40%

Table 22: Non-Respondents and Survey Respondents by Gender

Gender	Non-Respondent		Survey Respondent	
	Number	Percent	Number	Percent
Male	18	64.0	373	57.0
Female	10	36.0	276	43.0
Total	28	100.0	649	100.0

The interviewees were asked why they did not respond to the web survey. (See Table 23.) Two claimed they did not receive the survey and 18 said they did not remember receiving the survey.

Only eight recalled receiving the e-mail message inviting them to participate in the web survey. Of these, six did not respond because they were too busy and two because they forgot. Of the 28 interviewees, only one had participated in the Delta program; his reason for not responding was that he was too busy.

*Table 23: Reasons for Not Responding to the Survey*

Reason for not responding	Number of non-respondents
Don't remember receiving it	18
Too busy	6
Forgot to do it	2
Didn't receive it	2
Total	28

Non-response bias was assessed by comparing the responses of respondents and non-respondents on three questions from the survey<sup>17</sup> (see Table 24). Twenty-five of the interviewees agreed to answer these questions. The difference between responses of the web survey respondents and non-respondents on the first two questions was not statistically significant. While the difference on the third question was statistically significant, with a higher mean for non-respondents than respondents, this question was not included in the six measured dimensions and thus not of great consequence to our analysis. This question asked about the respondent's confidence in organizing people for discussing teaching and research, one attempt to gather information related to organizing learning communities.

*Table 24: Mean Comparison of the Survey Respondents and Non-Respondents on Three Questions*

Question	Group	N	Mean	SD	P-Value (Sig. at 0.05)
As a teacher, I would study the effects of different instructional practices in my own classroom.	Respondents	649	3.99	0.727	0.659
	Non-Respondents	25	3.92	0.909	
	Total	674	3.98	0.734	
I would use teaching activities that take into account the different backgrounds of my students.	Respondents	649	3.83	0.786	0.299
	Non-Respondents	25	4.00	0.957	
	Total	674	3.84	0.793	
I know how to organize others for the purpose of discussing teaching and learning.	Respondents	649	3.10	0.896	0.001
	Non-Respondents	25	3.72	0.891	
	Total	674	3.12	0.902	

Based on our non-response study, we believe that the survey responses of those who did not participate in the survey would not differ significantly from those who did. Thus, we are confident that the findings are generalizable to the population.

<sup>17</sup> Note that the first question was taken from the Teaching-as-Research/Learning Community dimension and the second question was taken from the Learning-through-Diversity dimension.

## 4. RESEARCH FINDINGS

The findings of this study are presented in five sections: 1) attitudes and beliefs about teaching, 2) interest in academic roles, 3) Delta and other professional development experiences, 4) comparison of Delta participants with non-Delta participants, and 5) how attitudes and beliefs about teaching relate to professional development experience for different levels of interest in teaching. In the first three sections, responses from postdoctoral students and doctoral fellows are reported in aggregate.

### 4.1 Attitudes and Beliefs about Teaching

Attitudes and beliefs about teaching for both doctoral and postdoctoral respondents were measured on twelve five-point Likert scales anchored at 1 (“strongly disagree”) and 5 (“strongly agree”). Means and standard deviations for the Teaching-as-Research/Learning Community dimension and the Learning-through-Diversity dimension are reported in Tables 25 and 26, respectively. In addition, the percent of respondents who agreed with each question (i.e., responded “4” for agree or “5” for strongly agree) and disagreed (i.e., responded “2” for disagree or “1” for strongly disagree) are reported. The results for the excluded questions from the Attitudes and Beliefs about Teaching category are reported in Table 27. Doctoral students averaged 4.15 on the teaching-as-research/learning community dimension and 3.94 on the learning-through-diversity dimension, whereas postdoctoral researchers averaged 4.06 on the teaching-as-research/learning community dimension and 3.84 on the learning-through-diversity dimension.

*Table 25: Survey Respondents’ Attitudes towards Teaching-as-Research/Learning Community*

Teaching-as-Research/ Learning Community	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Disagree %	Agree %
Teaching-as-Research/ Learning Community dimension	Doctoral	464	4.15	0.492	0.036	0.6	93.9
	Postdoctoral	185	4.06	0.479		0.5	90.2
	Total	649	4.12	0.490		0.7	92.9
Teaching requires input from others	Doctoral	464	4.42	0.608	0.005	0.4	95.2
	Postdoctoral	185	4.26	0.715		0.5	90.3
	Total	649	4.38	0.643		0.5	93.8
Teachers need not collect data on teaching effectiveness (Reversed)	Doctoral	464	4.30	0.685	0.003	91.4	1.5
	Postdoctoral	185	4.25	0.756		87.1	2.1
	Total	649	4.29	0.706		90.1	1.7
Not important to discuss teaching with others (Reversed)	Doctoral	464	4.19	0.762	0.475	87.2	3.1
	Postdoctoral	185	4.18	0.770		88.1	2.7
	Total	649	4.18	0.764		87.5	2.9
Would study effects of instructional practices	Doctoral	464	4.04	0.701	0.459	2.8	83.0
	Postdoctoral	185	3.85	0.777		3.7	75.7
	Total	649	3.99	0.727		3.1	80.9
Would seek teaching advice outside department	Doctoral	464	3.79	0.831	0.891	6.4	67.4
	Postdoctoral	185	3.74	0.821		5.9	66.5
	Total	649	3.77	0.828		6.4	67.2

Table 26: Survey Respondents' Attitudes towards Learning-through-Diversity

Learning-through-Diversity	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Disagree %	Agree %
Learning-through-Diversity dimension	Doctoral	464	3.94	0.526	0.046	1.0	82.3
	Postdoctoral	185	3.84	0.562		1.5	80.1
	Total	649	3.91	0.538		1.4	81.7
Important to facilitate learning for all students	Doctoral	464	4.32	0.688	0.002	1.9	91.9
	Postdoctoral	185	4.13	0.804		3.3	88.1
	Total	649	4.27	0.727		2.3	90.7
Teachers need to study students' learning styles	Doctoral	464	4.27	0.688	0.023	2.1	91.1
	Postdoctoral	185	4.12	0.794		2.7	84.3
	Total	649	4.23	0.722		2.4	89.3
Would vary how to teach based on knowledge of students	Doctoral	464	4.08	0.707	0.012	2.4	84.2
	Postdoctoral	185	3.92	0.865		4.3	76.8
	Total	649	4.04	0.759		2.9	82.1
Would use teaching activities that reflect students' backgrounds	Doctoral	464	3.85	0.799	0.381	5.4	71.6
	Postdoctoral	185	3.79	0.755		3.2	71.9
	Total	649	3.83	0.786		4.8	71.7
Covering content is more important than student needs (Reversed)	Doctoral	464	3.17	0.904	0.239	38.0	23.7
	Postdoctoral	185	3.26	0.937		38.4	20.0
	Total	649	3.19	0.914		38.1	22.7

Table 27: Survey Respondents' Responses to Excluded Questions

Excluded Questions	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Disagree %	Agree %
I rarely talk to colleagues about teaching (Reversed)	Doctoral	464	3.42	1.107	0.201	54.5	24.8
	Postdoctoral	185	3.30	1.167		47.5	26.0
	Total	649	3.39	1.125		52.4	25.1
I know how to facilitate discussing teaching and learning	Doctoral	464	3.12	0.882	0.370	24.8	35.6
	Postdoctoral	185	3.05	0.928		26.5	32.4
	Total	649	3.10	0.896		25.1	34.7

## 4.2 Interest in Academic Roles

Interest in academic roles for both doctoral and postdoctoral respondents was measured using yes/no questions (with “1” corresponding to “yes” and “0” to “no”). Responses are reported by dimension—undergraduate teaching, graduate teaching, research, and service—in Tables 28, 29, 30, 31, and 32, respectively. Note that 154 (23.7%) of the respondents elected not to answer these questions.

Respondents were split on their level of interest in undergraduate and graduate teaching, with more indicating that they were interested in graduate teaching (67.1%) than undergraduate

teaching (46.9%). Most (74.3%) were interested in teaching at a research university, and the majority (80.4%) were not interested in teaching at an institution other than a university.

The majority of the respondents (78.6%) expressed interest in conducting research, while only 31.5% were interested in serving on departmental and/or institutional committees. Even fewer (14.1%) were interested in serving on disciplinary committees. Only 11.3% indicated an interest in university administration. Nonetheless, the majority (76.3%) plans to work at an educational institution.

Of the doctoral survey respondents, 53.7% are interested in teaching at a teaching university and 23.7% are interested in teaching but not at a teaching university. Of the postdoctoral respondents, only 28.5% are interested in teaching at a teaching university and only 10.8% are interested in teaching but not at a teaching university. Similarly, 66.5% of the doctoral survey respondents are interested in teaching undergraduates and 59.6% are interested in advising undergraduates, whereas 49.4% of postdoctoral researchers are interested in teaching undergraduates and 41.1% are interested in advising undergraduates.

*Table 28: Survey Respondents' Interest in Undergraduate Teaching*

Undergraduate Teaching	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Yes %	No %
Undergraduate Teaching dimension	Doctoral	337	0.51	0.293	0.000	51.6	48.4
	Postdoctoral	158	0.38	0.290		36.7	63.3
	Total	495	0.47	0.297		46.9	53.1
Most interested in teaching undergraduates	Doctoral	337	0.66	0.473	0.000	66.5	33.5
	Postdoctoral	158	0.49	0.502		49.4	50.6
	Total	495	0.61	0.488		61.0	39.0
Most interested in teaching lectures	Doctoral	337	0.63	0.484	0.054	62.9	37.1
	Postdoctoral	158	0.54	0.500		53.8	46.2
	Total	495	0.60	0.490		60.0	40.0
Most interested in advising undergraduates	Doctoral	337	0.60	0.491	0.000	59.6	40.4
	Postdoctoral	158	0.41	0.494		41.1	58.9
	Total	495	0.54	0.499		53.7	46.3
Interested in teaching at a teaching university	Doctoral	337	0.54	0.499	0.000	53.7	46.3
	Postdoctoral	158	0.28	0.453		28.5	71.5
	Total	495	0.46	0.499		45.7	54.3
Most interested in teaching discussions	Doctoral	337	0.46	0.499	0.202	46.0	54.0
	Postdoctoral	158	0.40	0.491		39.9	60.1
	Total	495	0.44	0.497		44.0	56.0
Most interested in teaching labs	Doctoral	337	0.42	0.494	0.436	41.8	58.2
	Postdoctoral	158	0.46	0.500		45.6	54.4
	Total	495	0.43	0.496		43.0	57.0
Interested in teaching not at a university	Doctoral	337	0.24	0.426	0.001	23.7	76.3
	Postdoctoral	158	0.11	0.311		10.8	89.2
	Total	495	0.20	0.397		19.6	80.4

Of the doctoral survey respondents, 70.6% are interested in teaching at a research university, compared to 82.3% of the postdoctoral survey respondents. It is not surprising, then, that 59.6% of doctoral survey respondents are interested in teaching graduates and 56.1% are interested in advising graduates, compared to 69.6% and 68.4%, respectively, of postdoctoral researchers.

*Table 29: Survey Respondents' Interest in Graduate Teaching*

Graduate Teaching	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Yes %	No %
Graduate teaching dimension	Doctoral	337	0.62	0.367	0.001	63.8	36.2
	Postdoctoral	158	0.73	0.344		74.1	25.9
	Total	495	0.66	0.364		67.1	32.9
Interested in teaching at a research university	Doctoral	337	0.71	0.456	0.006	70.6	29.4
	Postdoctoral	158	0.82	0.383		82.3	17.7
	Total	495	0.74	0.437		74.3	25.7
Most interested in teaching graduates	Doctoral	337	0.60	0.491	0.032	59.6	40.4
	Postdoctoral	158	0.70	0.461		69.6	30.4
	Total	495	0.63	0.484		62.8	37.2
Most interested in advising graduates	Doctoral	337	0.56	0.497	0.009	56.1	43.9
	Postdoctoral	158	0.68	0.467		68.4	31.6
	Total	495	0.60	0.490		60.0	40.0

Postdoctoral researchers are generally more interested in conducting research than doctoral students. Of the doctoral survey respondents, 74.5% are most interested in conducting research and 69.7% are interested in conducting research at a university. Of the postdoctoral survey respondents, 87.3% are most interested in conducting research and 78.5% are interested in conducting research at a university.

*Table 30: Survey Respondents' Interest in Research*

Research	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Yes %	No %
Research dimension	Doctoral	337	0.65	0.354	0.140	67.9	32.1
	Postdoctoral	158	0.70	0.314		75.9	24.1
	Total	495	0.67	0.342		70.5	29.5
Most interested in conducting research	Doctoral	337	0.74	0.437	0.001	74.5	25.5
	Postdoctoral	158	0.87	0.334		87.3	12.7
	Total	495	0.79	0.411		78.6	21.4
Interested in doing research at a university	Doctoral	337	0.70	0.460	0.042	69.7	30.3
	Postdoctoral	158	0.78	0.412		78.5	21.5
	Total	495	0.73	0.447		72.5	27.5
Interested in doing research outside a university	Doctoral	337	0.52	0.500	0.148	51.9	48.1
	Postdoctoral	158	0.45	0.499		44.9	55.1
	Total	495	0.50	0.500		49.7	50.3

Table 31: Survey Respondents' Interest in Service

Service	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Yes %	No %
Service dimension	Doctoral	337	0.20	0.278	0.484	18.4	81.6
	Postdoctoral	158	0.18	0.270		16.5	83.5
	Total	495	0.19	0.275		17.8	82.2
Most interested in serving on dept. or institution committees	Doctoral	337	0.33	0.471	0.321	32.9	67.1
	Postdoctoral	158	0.28	0.453		28.5	71.5
	Total	495	0.32	0.465		31.5	68.5
Most interested in serving on disciplinary committees	Doctoral	337	0.15	0.356	0.518	14.8	85.2
	Postdoctoral	158	0.13	0.334		12.7	87.3
	Total	495	0.14	0.349		14.1	85.9
Most interested in university administration	Doctoral	337	0.11	0.313	0.733	11.0	89.0
	Postdoctoral	158	0.12	0.326		12.0	88.0
	Total	495	0.11	0.317		11.3	88.7

Table 32: Survey Respondents' Interest in Type of Organization

Type of Organization	Status	N	Mean	SD	P-Value (Sig. at 0.05)	Yes %	No %
Plan to work in education	Doctoral	464	0.73	0.446	0.001	72.6	27.4
	Postdoctoral	185	0.85	0.354		85.4	14.6
	Total	649	0.76	0.426		76.3	23.7
Plan to work in industry	Doctoral	464	0.51	0.500	0.259	50.9	49.1
	Postdoctoral	185	0.46	0.500		45.9	54.1
	Total	649	0.49	0.500		49.5	50.5
Plan to work in government	Doctoral	464	0.34	0.476	0.246	34.5	65.5
	Postdoctoral	185	0.30	0.458		29.7	70.3
	Total	649	0.33	0.471		33.1	66.9
Plan to work in business	Doctoral	464	0.14	0.343	0.341	13.6	86.4
	Postdoctoral	185	0.11	0.311		10.8	89.2
	Total	649	0.13	0.334		12.8	87.2

### 4.3 Professional Development (PD) Experiences

Fifty-nine (12.7%) of the surveyed doctoral respondents and 36 (19.5%) of the surveyed postdoctoral respondents indicated that they had participated in one or more courses, programs, or events offered by Delta (see Table 12). The specific events that they participated in are reported in Table 33.

While 59 doctoral students indicated they had participated in Delta activities (survey question 10), 60 responded to survey question 11, specifying the activities they participated in. Similarly, 36 postdoctoral researchers indicated they had participated in Delta activities (survey question 8), but 37 responded to survey question 9, specifying the activities they participated in. All

analyses involving the number of Delta participants are based on 59 doctoral students and 36 postdoctoral researchers.

*Table 33: Survey Respondents' Delta Professional Development Experiences: Doctoral vs. Postdoctoral*

Delta Experience	Doctoral Students			Postdoctoral Researchers		
	N	Yes	No	N	Yes	No
Participated in Delta	464	59	405	185	36	149
in roundtable dinners	60	27	33	37	12	25
in brown-bag lunches	60	13	47	37	24	13
in college classroom course	60	10	50	37	4	33
in informal education course	60	7	53	37	3	34
in instructional materials course	60	7	53	37	3	34
in teaching w/ technology course	60	5	55	37	3	34
in internship seminar	60	6	54	37	3	34
in certificate program	60	4	56	37	0	37
in CCLE program	60	7	53	37	1	36
in expeditionary learning program	60	5	55	37	2	35
in workshops	60	25	35	37	14	23
in postdoc discussion groups	60	10	50	37	7	30
in info sessions and socials	60	12	48	37	4	33
in retreats	60	3	57	37	0	37

Many of the survey respondents also reported that they had been a teaching assistant or had participated in professional development activities that were not sponsored by Delta (see Table 34). Among the survey participants, 63.1% of STEM doctoral respondents and 67% of postdoctoral respondents indicated they had been a teaching assistant or graduate student instructor; 67.6% of doctoral respondents and 55.7% of postdocs had participated in formal or informal professional development activities not sponsored by Delta. The top three professional development activities in which doctoral survey respondents participated were TA training, campus speaking engagements, and department activities. For postdoctoral respondents, the most attended events were campus speaking engagements, organization activities, and department activities.

Table 34: Survey Respondents' Other Professional Development Experiences: Doctoral vs. Postdoctoral

Other PD Experiences	Doctoral Students			Postdoctoral Researchers		
	N	Yes	Yes%	N	Yes	Yes%
Was TA/GSI	464	293	63.1	185	124	67.0
Participated in non-Delta activities	464	314	67.7	185	103	55.7
in TA training	464	155	33.4	185	12	6.5
in campus speaking engagements	464	138	29.7	185	48	25.9
in department activities	464	131	28.2	185	34	18.4
in organization activities	464	63	13.6	185	35	18.9
in improving teaching course	464	51	11.0	185	15	8.1
in improving research course	464	50	10.8	185	14	7.6
in other activities	464	47	10.1	185	27	14.6

Of the 59 doctoral respondents who participated in Delta, 44 (74.6%) also participated in other professional development activities on campus (see Table 35). Similarly, of the 36 postdoctoral respondents who participated in Delta, 29 (74.4%) also participated in other professional development activities on campus.

Table 35: Delta and Non-Delta Participation by Doctoral and Postdoctoral Respondents

		Participated in Non-Delta PD Activities		Total	
		Yes	No		
Doctoral Respondents	Participated in Delta	Yes	44	15	59
		No	270	135	405
		Total	314	150	464
Postdoctoral Respondents	Participated in Delta	Yes	29	7	36
		No	74	75	149
		Total	103	82	185

Based on professional development experience, respondents were categorized into three groups:

- 1) Delta PD: The Delta PD group is comprised of the 59 doctoral and 36 postdoctoral respondents who participated in Delta. Of these 95 respondents, 83 participated in both Delta and non-Delta professional development activities.
- 2) Non-Delta PD: The non-Delta PD group is comprised of the 270 doctoral and 74 postdoctoral respondents who did not participate in Delta, but did participate in other professional development activities.
- 3) No PD: The no PD group is comprised of the 135 doctoral and 75 postdoctoral respondents who did not participate in Delta or any other professional development activities.

#### 4.4 Delta Participants vs. Non-Delta Participants

To understand how professional development experience relates to the six measured dimensions (see section 2.5), we compared participants' responses for the Delta PD group, the Non-Delta PD group, and the No PD group on Teaching-as-Research/Learning Community, Learning-through-Diversity, Undergraduate Teaching, Graduate Teaching, Research, and Service. (See Table 36.)

Of the three groups, the Delta PD group had the highest means on the Teaching-as-Research/Learning Community, Learning-through-Diversity, Undergraduate Teaching, and Service dimensions; moreover, the differences between the groups was statistically significant for each of these dimensions. While the mean for Delta participants was lower than the other groups on the Graduate Teaching dimension, the difference was not statistically significant. The mean for the "Research" dimension is lower for Delta participants.

Table 36: Comparison of the Six Dimension Indices by PD Groups

Dimension	PD Group Delta PD, N=95 Non-Delta PD, N=344 No PD, N=210	Mean	P-Value (Significant level: 0.05)	Effect Size
Teaching-as- Research/Learning Community	Delta vs. Non-Delta	4.32 vs. 4.14	0.001	0.38
	Delta vs. No PD	4.32 vs. 4.00	0.000	0.61
	Non-Delta vs. No PD	4.14 vs. 4.00	0.001	0.30
Learning-through- Diversity	Delta vs. Non-Delta	4.11 vs. 3.92	0.001	0.37
	Delta vs. No PD	4.11 vs. 3.81	0.000	0.52
	Non-Delta vs. No PD	3.92 vs. 3.81	0.026	0.20
Undergraduate Teaching	Delta vs. Non-Delta	0.61 vs. 0.45	0.000	0.56
	Delta vs. No PD	0.61 vs. 0.42	0.000	0.60
	Non-Delta vs. No PD	0.45 vs. 0.42	0.424	0.08
Graduate Teaching	Delta vs. Non-Delta	0.61 vs. 0.66	0.317	0.12
	Delta vs. No PD	0.61 vs. 0.69	0.105	0.22
	Non-Delta vs. No PD	0.66 vs. 0.69	0.360	0.09
Research	Delta vs. Non-Delta	0.58 vs. 0.69	0.009	0.32
	Delta vs. No PD	0.58 vs. 0.69	0.021	0.31
	Non-Delta vs. No PD	0.69 vs. 0.69	0.999	0.00
Service	Delta vs. Non-Delta	0.26 vs. 0.19	0.045	0.25
	Delta vs. No PD	0.26 vs. 0.14	0.001	0.44
	Non-Delta vs. No PD	0.19 vs. 0.14	0.041	0.21

From these results, we conclude that 1) Delta participants have more positive attitudes and beliefs about teaching than people who have not participated in any professional development activities or have participated in only non-Delta professional development activities; 2) Delta participants are more interested in undergraduate teaching and service than people in the other groups; and 3) Delta participants are less interested in conducting research than are people in the other groups.

Although the Delta group has a much higher mean than both the Non-Delta PD group and the No PD group on the first two dimensions related to attitudes and beliefs about teaching, note that the Non-Delta PD group also had statistically significantly higher means than the No PD group. In other words, people who did not participate in Delta but did participate in other professional development activities also have more positive attitudes and beliefs about teaching than people who have not participated in any professional development activities. Thus, we can conclude that people who participate in any type of teaching-related professional development activities tend to show more positive attitudes and beliefs about teaching.

Moreover, in analyzing the excluded questions related to attitudes and beliefs about teaching, we discovered that the reversed mean for “Rarely talk to colleagues about teaching” is significantly lower for the No PD group than the other two groups (see Table 37). Thus, there is a positive relationship between participation in any type of professional development activity and attitude towards talking with colleagues about teaching. There are no significant differences among the PD groups for knowing how to facilitate discussing teaching and learning.

*Table 37: Additional Questions Related to Attitudes and Beliefs about Teaching*

Excluded Questions	PD Group	Mean	P-Value (Significant level: 0.05)
	Delta PD, N=95 Non-Delta PD, N=344 No PD, N=210		
Rarely talk to colleagues about teaching (Reversed)	Delta PD vs. Non-Delta PD	3.65 vs. 3.47	0.134
	Delta PD vs. No PD	3.65 vs. 3.14	0.000
	Non-Delta PD vs. No PD	3.47 vs. 3.14	0.001
Know how to facilitate discussing teaching & learning	Delta PD vs. Non-Delta PD	3.14 vs. 3.13	0.908
	Delta PD vs. No PD	3.14 vs. 3.04	0.392
	Non-Delta PD vs. No PD	3.13 vs. 3.04	0.262

#### **4.5 Interest in Teaching**

To further investigate the relationship between professional development (Delta or otherwise) and attitudes/beliefs about teaching, an “Interest in Teaching” control variable was introduced. Survey participants were categorized as high on “Interest in Teaching” if they indicated that they planned to work in education and are interested in teaching at a research university, a teaching university, or other institution.

Of the survey participants, 71.2% were classified as high on “Interest in Teaching” and 28.8% as low on “Interest in Teaching”. Within Delta, 89.5% were high on “Interest in Teaching” and 10.5% were low on “Interest in Teaching”. (See Table 38)

Table 38: High vs. Low Interest in Teaching by PD Group

		Interest in Teaching		Total	
		High	Low		
PD Group	Delta PD	Count	85	10	95
		% within PD Group	89.5%	10.5%	100.0%
		% within Interest in Teaching	18.4%	5.3%	14.6%
		% of Total	13.1%	1.5%	14.6%
	Non-Delta PD	Count	237	107	344
		% within PD Group	68.9%	31.1%	100.0%
		% within Interest in Teaching	51.3%	57.2%	53.0%
		% of Total	36.5%	16.5%	53.0%
	No PD	Count	140	70	210
		% within PD Group	66.7%	33.3%	100.0%
		% within Interest in Teaching	30.3%	37.4%	32.4%
		% of Total	21.6%	10.8%	32.4%
Total	Count	462	187	649	
	% within PD Group	71.2%	28.8%	100.0%	
	% within Interest in Teaching	100.0%	100.0%	100.0%	
	% of Total	71.2%	28.8%	100.0%	

When the survey respondents were split into “high interest in teaching” and “low interest in teaching” groups, a comparison of the attitudes and beliefs about teaching revealed that professional development experience only makes a difference at the “high interest in teaching” level. In other words, when “Interest in Teaching” is introduced as a control variable, the positive relationship between participation in Delta and attitudes/beliefs about teaching is restricted to those respondents who have a high interest in teaching.

### *High Interest in Teaching*

At the “high interest in teaching” level, the means for Delta participants are higher than the means for the non-Delta and the No PD groups for the “Teaching-as-Research/Learning Community” dimension, the “Learning-through-Diversity” dimension, and the two excluded questions (see Tables 39, 40, and 41).

Table 39: Mean Comparison of the “Teaching-as-Research/Learning Community” Dimension by PD Group at the “High Interest in Teaching” Level

Teaching-as-Research/Learning Community	PD Group Delta PD, N=85 Non-Delta PD, N=237 No PD, N=140	Mean	P-Value (Significant at 0.05)	Effect Size
Teaching-as-Research/Learning Community Dimension	Delta vs. Non-Delta	4.37 vs. 4.20	0.003	0.37
	Delta vs. No PD	4.37 vs. 4.02	0.000	0.67
	Non-Delta vs. No PD	4.20 vs. 4.02	0.000	0.40
Teaching requires input from others	Delta vs. Non-Delta	4.62 vs. 4.45	0.012	0.31
	Delta vs. No PD	4.62 vs. 4.21	0.000	0.55
	Non-Delta vs. No PD	4.45 vs. 4.21	0.001	0.36
Teachers need not collect data on teaching effectiveness (reversed)	Delta vs. Non-Delta	4.49 vs. 4.36	0.101	0.20
	Delta vs. No PD	4.49 vs. 4.24	0.011	0.34
	Non-Delta vs. No PD	4.36 vs. 4.24	0.102	0.17
Not important to discuss teaching with others (reversed)	Delta vs. Non-Delta	4.45 vs. 4.31	0.109	0.20
	Delta vs. No PD	4.45 vs. 4.10	0.000	0.51
	Non-Delta vs. No PD	4.31 vs. 4.10	0.007	0.29
Would study effects of instructional practices	Delta vs. Non-Delta	4.28 vs. 4.04	0.005	0.35
	Delta vs. No PD	4.28 vs. 3.94	0.001	0.46
	Non-Delta vs. No PD	4.04 vs. 3.94	0.186	0.14
Would seek teaching advice outside department	Delta vs. Non-Delta	3.99 vs. 3.86	0.214	0.16
	Delta vs. No PD	3.99 vs. 3.59	0.001	0.45
	Non-Delta vs. No PD	3.86 vs. 3.59	0.003	0.32

Table 40: Mean Comparison of the “Learning-through-Diversity” Dimension by PD Group at the “High Interest in Teaching” Level

Learning-through-Diversity	PD Group		Mean	P-Value (Significant at 0.05)	Effect Size
	Delta PD, N=85	Non-Delta PD, N=237 No PD, N=140			
Learning-through-Diversity Dimension	Delta vs. Non-Delta		4.16 vs. 4.00	0.008	0.33
	Delta vs. No PD		4.16 vs. 3.86	0.000	0.54
	Non-Delta vs. No PD		4.00 vs. 3.86	0.008	0.28
Important to facilitate learning for all students	Delta vs. Non-Delta		4.60 vs. 4.38	0.004	0.37
	Delta vs. No PD		4.60 vs. 4.17	0.000	0.57
	Non-Delta vs. No PD		4.38 vs. 4.17	0.003	0.32
Teachers need to study students’ learning styles	Delta vs. Non-Delta		4.41 vs. 4.32	0.252	0.15
	Delta vs. No PD		4.41 vs. 4.19	0.041	0.28
	Non-Delta vs. No PD		4.32 vs. 4.19	0.081	0.18
Would vary how to teach based on knowledge of students	Delta vs. Non-Delta		4.15 vs. 4.14	0.916	0.01
	Delta vs. No PD		4.15 vs. 3.98	0.108	0.22
	Non-Delta vs. No PD		4.14 vs. 3.98	0.026	0.23
Would use teaching activities that reflect students’ backgrounds	Delta vs. Non-Delta		4.07 vs. 3.90	0.053	0.24
	Delta vs. No PD		4.07 vs. 3.77	0.008	0.36
	Non-Delta vs. No PD		3.90 vs. 3.77	0.122	0.17
Covering content is more important than student needs (reversed)	Delta vs. Non-Delta		3.55 vs. 3.24	0.005	0.35
	Delta vs. No PD		3.55 vs. 3.17	0.003	0.41
	Non-Delta vs. No PD		3.24 vs. 3.17	0.493	0.07

Table 41: Mean Comparison of the Excluded Questions by PD Group at the “High Interest in Teaching” Level

Excluded Questions	PD Group		Mean	P-Value (Significant at 0.05)	Effect Size
	Delta PD, N=85	Non-Delta PD, N=237 No PD, N=140			
Rarely talk to colleagues about teaching (Reversed)	Delta vs. Non-Delta		3.73 vs. 3.68	0.678	0.05
	Delta vs. No PD		3.73 vs. 3.24	0.001	0.44
	Non-Delta vs. No PD		3.68 vs. 3.24	0.000	0.40
Know how to facilitate discussing teaching & learning	Delta vs. Non-Delta		3.13 vs. 3.15	0.844	0.02
	Delta vs. No PD		3.13 vs. 3.05	0.532	0.09
	Non-Delta vs. No PD		3.15 vs. 3.05	0.279	0.11

### Low Interest in Teaching

At the “low interest in teaching” level, there are no statistically significant differences among the three PD groups (see Tables 42, 43, and 44).

Table 42: Mean Comparison of the “Teaching-as-Research/Learning Community” Dimension by PD Group at the “Low Interest in Teaching” Level

Teaching-as-Research/Learning Community	PD Group Delta PD, N=10 Non-Delta PD, N=107 No PD, N=70	Mean	P-Value (Significant level: 0.05)
Teaching-as-Research/Learning Community Dimension	Delta PD vs. Non-Delta PD	3.92 vs. 4.01	0.592
	Delta PD vs. No PD	3.92 vs. 3.96	0.832
	Non-Delta PD vs. No PD	4.01 vs. 3.96	0.529
Teaching requires input from others	Delta PD vs. Non-Delta PD	4.40 vs. 4.29	0.584
	Delta PD vs. No PD	4.40 vs. 4.29	0.603
	Non-Delta PD vs. No PD	4.29 vs. 4.29	0.966
Teachers need not collect data on teaching effectiveness (reversed)	Delta PD vs. Non-Delta PD	3.90 vs. 4.21	0.189
	Delta PD vs. No PD	3.90 vs. 4.07	0.478
	Non-Delta PD vs. No PD	4.21 vs. 4.07	0.215
Not important to discuss teaching with others (reversed)	Delta PD vs. Non-Delta PD	3.90 vs. 4.07	0.481
	Delta PD vs. No PD	3.90 vs. 3.83	0.830
	Non-Delta PD vs. No PD	4.07 vs. 3.83	0.068
Would study effects of instructional practices	Delta PD vs. Non-Delta PD	3.90 vs. 3.79	0.668
	Delta PD vs. No PD	3.90 vs. 3.84	0.793
	Non-Delta PD vs. No PD	3.79 vs. 3.84	0.622
Would seek teaching advice outside department	Delta PD vs. Non-Delta PD	3.50 vs. 3.67	0.522
	Delta PD vs. No PD	3.50 vs. 3.76	0.288
	Non-Delta PD vs. No PD	3.67 vs. 3.76	0.491

Table 43: Mean Comparison of the “Learning-through-Diversity” Dimension by PD Group at the “Low Interest in Teaching” Level

Learning-through-Diversity Dimension	PD Group		Mean	P-Value (Significant level: 0.05)
	Delta PD, N=10	Non-Delta PD, N=107		
		No PD, N=70		
Learning-through-Diversity Dimension	Delta PD vs. Non-Delta PD		3.70 vs. 3.73	0.851
	Delta PD vs. No PD		3.70 vs. 3.72	0.909
	Non-Delta PD vs. No PD		3.73 vs. 3.72	0.894
Important to facilitate learning for all students	Delta PD vs. Non-Delta PD		3.90 vs. 4.07	0.527
	Delta PD vs. No PD		3.90 vs. 4.01	0.696
	Non-Delta PD vs. No PD		4.07 vs. 4.01	0.688
Would vary how to teach based on knowledge of students	Delta PD vs. Non-Delta PD		3.80 vs. 3.93	0.593
	Delta PD vs. No PD		3.80 vs. 3.84	0.890
	Non-Delta PD vs. No PD		3.93 vs. 3.84	0.472
Would use teaching activities that reflect students’ backgrounds	Delta PD vs. Non-Delta PD		3.80 vs. 3.66	0.607
	Delta PD vs. No PD		3.80 vs. 3.70	0.729
	Non-Delta PD vs. No PD		3.66 vs. 3.70	0.777
Teachers need to study students’ learning styles	Delta PD vs. Non-Delta PD		3.60 vs. 4.07	0.049
	Delta PD vs. No PD		3.60 vs. 4.06	0.089
	Non-Delta PD vs. No PD		4.07 vs. 4.06	0.881
Covering content is more important than student needs (reversed)	Delta PD vs. Non-Delta PD		3.40 vs. 2.93	0.096
	Delta PD vs. No PD		3.40 vs. 3.00	0.175
	Non-Delta PD vs. No PD		2.93 vs. 3.00	0.623

Table 44: Mean Comparison of Excluded Questions by PD Group at the “Low Interest in Teaching” Level

Excluded Questions	PD Group		Mean	P-Value (Significant level: 0.05)
	Delta PD, N=10	Non-Delta PD, N=107		
		No PD, N=70		
Know how to facilitate discussing teaching & learning	Delta PD vs. Non-Delta PD		3.20 vs. 3.07	0.631
	Delta PD vs. No PD		3.20 vs. 3.01	0.571
	Non-Delta PD vs. No PD		3.07 vs. 3.01	0.710
Rarely talk to colleagues about teaching (Reversed)	Delta PD vs. Non-Delta PD		3.00 vs. 3.00	1.000
	Delta PD vs. No PD		3.00 vs. 2.94	0.890
	Non-Delta PD vs. No PD		3.00 vs. 2.94	0.742

The findings indicate that among individuals who have high interest in teaching, Delta participants have more positive attitudes and beliefs about teaching than people who have not participated in any professional development activities or have participated in only non-Delta professional development activities. Note that the means for the Non-Delta PD group are also statistically significantly higher than the means for the No PD group. In other words, people who are interested in teaching and did not participate in Delta but did participate in other professional development activities also have more positive attitudes and beliefs about teaching than people who did not participate in any professional development activities. Thus, we can

conclude that individuals who have high interest in teaching and who participate in teaching-related professional development activities tend to show more positive attitudes and beliefs about teaching.

## **5. SUMMARY AND DISCUSSION**

General findings from the research are summarized in section 5.1. The implications of the findings from this report and recommendations for future action are presented in section 5.2.

### **5.1 Summary of Results**

The findings of this research suggest that attitudes and beliefs about teaching were more positive for Delta participants than for doctoral students and postdoctoral researchers who had not participated in Delta. In addition, Delta participants were more interested in undergraduate teaching and in working as an educator. Specifically, 1) 91.6% of Delta participants planned to work in education, whereas only 73.6% of non-participants planned to work in education; 2) Delta participants were more interested in undergraduate teaching (75.9%) than non-participants (57.8%); 3) Delta participants were more interested in university administration (24.1%) and serving on department or institution-wide committees (41.4%) compared to non-participants (8.6% and 29.4%, respectively); and 4) among individuals who had high interest in teaching, Delta participants had more positive attitudes and beliefs about teaching than non-participants (see Table 45).

Table 45: Where Survey Respondents Differ: Delta Participants vs. Non-participants

	Delta Participants N=95	Non-participants N=554
Attitudes and Beliefs about Teaching	On a scale of 1 to 5, with 5 being “the most positive,” Delta participants averaged 4.32 on the teaching-as-research/learning community dimension and 4.11 on the learning-through-diversity dimension. Delta participants had significantly higher means than non-participants on all of the five items that measure the teaching-as-research/learning community dimension.	On the same scale, non-participants averaged 4.09 on the teaching-as-research/learning community dimension and 3.88 on the learning-through-diversity dimension.
Career Choice	91.6% planned to work in education and 29.5% planned to work in industry; only 5.3% planned to work in business.	73.6% planned to work in education, 52.9% planned to work in industry, and 14.1% planned to work in business.
Preferred Institution	70.1% were interested in teaching at a teaching university and 33.3% were interested in teaching but not at a university.	Only 40.4% were interested in teaching at a teaching university and only 16.7% were interested in teaching but not at a university.
Type of Teaching	63.2% were interested in teaching discussions and 58.6% were interested in teaching labs.	Only 40.0% were interested in teaching discussions; 39.7% were interested in teaching labs.
Undergraduate Teaching	75.9% were interested in teaching undergraduates and 66.7% were interested in advising undergraduates.	57.8% were interested in teaching undergraduates and 51.0% were interested in advising undergraduates.
Research	64.4% were most interested in conducting research.	81.6% were most interested in conducting research.
Service	24.1% were interested in university administration and 41.4% were interested in serving on department or institution-wide committees.	Only 8.6% were interested in university administration; however, 29.4% were interested in serving on department or institution-wide committees.

Compared to STEM postdoctoral researchers, doctoral students had more positive attitudes and beliefs about teaching. However, only 72.6% of doctoral students planned to work in education, compared to 85.4% of postdoctoral researchers (see Table 46).

*Table 46: Where Survey Respondents Differ: Doctoral Students vs. Postdoctoral Researchers*

	Doctoral Students N=464	Postdoctoral Researchers N=185
Attitudes and Beliefs about Teaching	On a scale of 1 to 5, with 5 being “the most positive,” doctoral students averaged 4.15 on the teaching-as-research/learning community dimension and 3.94 on the learning-through-diversity dimension.	On the same scale, postdoctoral researchers averaged 4.06 on the teaching-as-research/learning community dimension and 3.84 on the learning-through-diversity dimension.
Career Choice	72.6% planned to work in education	85.4% planned to work in education
Preferred Institution	70.6% were interested in teaching at a research university, 53.7% were interested in teaching at a teaching university, and 23.7% were interested in teaching but not at a university.	82.3% were interested in teaching at a research university. Only 28.5% were interested in teaching at a teaching university and only 10.8% were interested in teaching but not at a university.
Undergraduate Teaching	66.5% were interested in teaching undergraduates and 59.6% were interested in advising undergraduates.	49.4% were interested in teaching undergraduates and 41.1% were interested in advising undergraduates.
Graduate Teaching	59.6% were interested in teaching graduates and 56.1% were interested in advising graduates.	69.6% were interested in teaching graduates and 68.4% were interested in advising graduates.
Research	74.5% were most interested in conducting research and 69.7% were interested in conducting research at a university.	87.3% were most interested in conducting research and 78.5% were interested in conducting research at a university.

An analysis of the survey responses based on academic status, gender, and citizenship revealed the following additional findings:

STEM female doctoral students and postdoctoral researchers had more positive attitudes and beliefs about teaching than their male counterparts. Women (68.7%) were more interested in teaching undergraduate students than were men (55.2%). Women were less interested in teaching graduate students (only 54.2% of women compared to 69.4% of men) and conducting research (only 72.4% of women compared to 83.3% of men). (See Table 47).

Table 47: Where Survey Respondents Differ: Women vs. Men

	Women N=276	Men N=373
Attitudes and Beliefs about Teaching	On a scale of 1 to 5, with 5 being “the most positive,” women averaged 4.18 on the teaching-as-research/learning community dimension and 4.03 on the learning-through-diversity dimension. Women had significantly higher means than men on all of the five items that measure the learning-through-diversity dimension.	On the same scale, men scored an average of 4.08 on the teaching-as-research/learning community dimension and 3.82 on the learning-through-diversity dimension.
Career Choice	8.7% planned to work in business.	15.8% planned to work in business.
Preferred Institution	65.9% were interested in teaching at a research university. 54.2% were interested in teaching at a teaching university. 25.2% were interested in teaching but not at a university.	80.8% were interested in teaching at a research university. Only 39.1% were interested in teaching at a teaching university; 15.3% were interested in teaching but not at a university.
Type of Teaching	49.1% were interested in teaching discussions.	40.2% were interested in teaching discussions.
Undergraduate Teaching	68.7% were interested in teaching undergraduates and 62.1% were interested in advising undergraduates.	55.2% were interested in teaching undergraduates and 47.3% were interested in advising undergraduates.
Graduate Teaching	54.2% were interested in teaching graduates and 53.3% were interested in advising graduates.	69.4% were interested in teaching graduates and 65.1% were interested in advising graduates.
Research	72.4% were most interested in conducting research.	83.3% were most interested in conducting research.

Doctoral students and postdoctoral researchers in STEM who are U.S. citizens had more favorable attitudes and beliefs about teaching than non-U.S. citizens. Of U.S. citizens (both doctoral students and postdoctoral researchers), 69.8% were interested in teaching at a research university and 71.3% were interested in teaching undergraduate students. Of non-U.S. citizens (both doctoral students and postdoctoral researchers), 82.8% were interested in teaching at a research university, whereas only 42.0% were interested in teaching undergraduate students. (See Table 48).

Table 48: Where Survey Respondents Differ: U.S. Citizens vs. Non-U.S. Citizens

	U.S. Citizens N=423	Non-U.S. Citizens N=226
Attitudes and Beliefs about Teaching	On a scale of 1 to 5, with 5 being “the most positive,” U.S. citizens averaged 4.17 on the teaching-as-research/learning community dimension.	On the same scale, non-U.S. citizens averaged 4.03 on the teaching-as-research/learning community dimension. However, non-U.S. citizens scored higher on “I would use teaching activities that take into account the different backgrounds of my students” (3.92 vs. 3.78) and “I know how to organize others for the purpose of discussing teaching and learning” (3.29 vs. 3.00).
Career Choice	40.2% planned to work in government	19.9% planned to work in government
Preferred Institution	69.8% were interested in teaching at a research university. 57.9% were interested in teaching at a teaching university. 26.5% were interested in teaching but not at a university.	82.8% were interested in teaching at a research university. Only 23.0% were interested in teaching at a teaching university; 6.9% were interested in teaching but not at a university.
Type of Teaching	52.6% were interested in teaching discussions and 49.2% were interested in teaching labs.	Only 28.2% were interested in teaching discussions; 31.6% were interested in teaching labs.
Undergraduate Teaching	71.3% were interested in teaching undergraduates and 62.9% were interested in advising undergraduates.	42.0% were interested in teaching undergraduates and 36.8% were interested in advising undergraduates.
Graduate Teaching	56.4% were most interested in advising graduates.	66.7% were most interested in advising graduates.
Research	53.3% were interested in conducting research outside a university.	Only 43.1% were interested in conducting research outside a university.
Service	15.6% were interested in university administration. Only 11.2% were interested in serving on disciplinary committees.	Only 3.4% were interested in university administration; however, 19.5% were interested in serving on disciplinary committees.

## 5.2 Implications and Recommendations

The findings of this research suggest that attitudes and beliefs about teaching were more positive for Delta participants than for doctoral students and postdoctoral researchers who had not

participated in Delta. In addition, doctoral students generally had more positive attitudes and beliefs about teaching than postdoctoral researchers, female doctoral students and postdoctoral researchers had more positive attitudes and beliefs about teaching than their male counterparts, and doctoral students and postdoctoral researchers who were U.S. citizens had more favorable attitudes and beliefs about teaching than non-U.S. citizens.

It is difficult to disentangle the relationship between participation in Delta and respondents' view toward teaching. Those graduate students and postdoctoral researchers who are most interested in teaching may be the ones who seek out and participate in a program such as Delta. What the data indicate is that the participating students are different in belief and aspiration than students who have not participated in Delta or have not participated in any other professional development experience.

Based on the findings of this study, we recommend the following:

- 1) Since STEM doctoral students and postdoctoral researchers who participate in teaching-related professional development demonstrate more positive attitudes and beliefs about teaching, institutions of higher education should provide students with these types of programs and encourage students to participate.
- 2) The professional development programs that emphasize teaching preparation appear to differentiate more among students who have high interest in teaching than among students who have low interest in teaching. This suggests that interest is a factor in gaining the most from the such professional development programs.
- 3) Since more postdoctoral researchers than doctoral students plan to work in education—yet the attitudes and beliefs about teaching among postdoctoral researchers are significantly lower than those among doctoral students—institutions of higher education should actively recruit postdoctoral researchers to teaching-related professional development programs.
- 4) Since the attitudes and beliefs about teaching among men are generally less favorable than the attitudes and beliefs among women, male doctoral students and postdoctoral researchers should be targeted by teaching-related professional development programs.
- 5) Since the attitudes and beliefs about teaching among non-U.S. citizens are less favorable than the attitudes and beliefs among U.S. citizens and 83% of non-U.S. citizens plan to teach at a research university, institutions of higher education should reach out to non-U.S. citizens in their teaching-related professional development programs.

The cross-sectional study conducted for this report has some limitations. Since the study was descriptive in nature, seeking to obtain an accurate description of the attitudes, beliefs, and professional development experiences of STEM doctoral students and postdoctoral researchers, the findings are descriptive rather than causal. That is, even though the findings suggest a relationship between positive attitudes and beliefs about teaching and participating in teaching-related professional development programs such as Delta, additional research needs to be

conducted to demonstrate any causality. This is the focus of the longitudinal study on the impact of Delta that is being conducted by the CIRTL Evaluation and Research Team.

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## APPENDICES

### Appendix A: Survey

#### *Survey for Doctoral Students*

1 What is your principal field or discipline of study? Please select the one field that is closest to yours.  
(Categories determined by NSF discipline codes)

- Agricultural Sciences (e.g., *Food Sciences, Conservation, Forestry*)
- Biological Sciences (e.g., *Anatomy, Genetics, Pharmacology, Botany, Molecular Biology*)
- Computer Science
- Earth, Atmospheric, & Ocean Sciences (e.g., *Meteorology, Geosciences, Oceanography*)
- Engineering
- Mathematics/Statistics
- Physical Sciences (e.g., *Astronomy, Physics, Chemistry*)
- Social Sciences (e.g., *Psychology, Geography*)
- Other, please specify \_\_\_\_\_

2 Please provide us with the name of your doctoral program and department.

Program \_\_\_\_\_  
Department \_\_\_\_\_

3 Which semester **and** year did you first register in a master's or doctoral program as a graduate student at UW-Madison?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4 Check the types of degrees you are planning to complete while at UW - Madison.

- Master's
- Doctoral

5 Have you passed the preliminaries/qualifying exam in your graduate program?

- Yes
- No

6 When do you anticipate completing your Ph. D. ?

- Before May 31,2006
- After June 1,2006

7 While in your current graduate program, did you ever hold a teaching assistantship or graduate student instructor position?

- Yes
- No

8 Were you aware of the Delta Program prior to coming to the UW - Madison?

- Yes
- No

9 Did the existence of the Delta Program at the UW - Madison help persuade you to attend the UW - Madison?

- Yes
- No

10 Have you ever participated in a Delta Program activity?

- Yes
- No

11 In which of the following elements of the Delta Program have you participated? (select all that apply)

- Roundtables
- Brownbags
- College Classroom course
- Informal Education course
- Instructional Materials Development course
- Teaching with Technology course
- Internship program and seminar activities
- Certificate program
- Creating a Collaborative Learning Environment
- Expeditionary Learning program
- Workshops (e.g., *ILSE Evaluation, ILSE/TEaching portfolio, NSF Broader Impact*)
- Discussions and discussion groups
- Delta Informational sessions and networking socials (e.g., *certificate launch*)
- CIRTL/Delta retreats

12 What types of formal or informal activities related to developing yourself in teaching and/or research have you participated in over the last year, which are **not** sponsored by the Delta Program?

- Have not participated in activities
- A course related to improving teaching
- A course related to improving research
- Department-sponsored activities
- Professional organization activities
- TA training
- Speakers on campus
- Other (*please specify*) \_\_\_\_\_

13 Why did you choose to participate in the activities highlighted in the previous question?

- Have not participated in activities
- Interest in learning more about teaching
- Interest in improving research
- Required to do so
- Other (*please specify*) \_\_\_\_\_

14 Do you feel the UW - Madison has provided sufficient resources for your professional development interests?

- Yes
- No

15 What other activities would you like to see on this campus related to your professional development interests?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

For items 16 to 27, we are interested in learning more about your conceptions of teaching. Please indicate the extent you disagree or agree with each statement.

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree.

	1	2	3	4	5
16 Effective teaching requires input from others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17 As a teacher, I would study the effects of different instructional practices in my own classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18 As a teacher, I would seek pedagogical advice from those outside my department.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19 An effective teacher studies his/her students' learning in order to teach students of all types effectively.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20 I rarely talk to my colleagues about teaching.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21 A teacher does not need to collect data on the effectiveness of his/her teaching.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22 I believe it is important to try to facilitate learning among all the	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

students in my class.					
23 As a teacher, I would vary how I teach my courses, based on my own knowledge about my students and their learning issues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24 It is not important for me to discuss my teaching with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25 As a teacher, I would use teaching activities that take into account the different backgrounds of my students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
26 As a teacher, it would be more important for me to cover the course content than to attend to the different needs of the students in the course.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27 I know how to organize others for the purpose of discussing teaching and learning.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

28 When you leave the UW - Madison, what types of organizations are you planning on obtaining a professional position in? (*Please select all that apply*)

- Government
- Industry
- Business
- Education

29 As you look forward toward your career, which types of roles that involve education would you be interested in pursuing? (*Please select all that apply*)

- Teaching at a research university
- Teaching at a teaching-intensive university
- Teaching but not in a university setting
- Conducting research in a university setting
- Conducting research outside a university setting
- University administration
- Other (please specify) \_\_\_\_\_

30 As you look forward toward your career as an educator, what tasks are you most interested in? (*select all that apply*)

- Teaching lecture courses
- Teaching discussion sections and courses
- Teaching laboratory courses
- Teaching undergraduate courses
- Teaching graduate courses
- Advising undergraduate students
- Advising graduate students
- Conducting research
- Serving on disciplinary committees
- Serving on department- /institution-wide committees
- Other faculty tasks (*please specify*) \_\_\_\_\_

31 Are you a U.S. citizen?

- Yes
- No

32 Are you of Hispanic or Latino origin or descent?

- Yes, Hispanic or Latino
- No, not Hispanic or Latino

33 What is your race?

- American Indian or Alaskan native
- Asian or Pacific Islander
- African American/Black
- White
- Other (*please specify*) \_\_\_\_\_

34 What is your gender?

- Female
- Male

*Survey for Postdoctoral Researchers*

1 What is your principal field or discipline of study? Please select the one field that is closest to yours.  
(Categories determined by NSF discipline codes)

- Agricultural Sciences (e.g., *Food Sciences, Conservation, Forestry*)
- Biological Sciences (e.g., *Anatomy, Genetics, Pharmacology, Botany, Molecular Biology*)
- Computer Science
- Earth, Atmospheric, & Ocean Sciences (e.g., *Meteorology, Geosciences, Oceanography*)
- Engineering
- Mathematics/Statistics
- Physical Sciences (e.g., *Astronomy, Physics, Chemistry*)
- Social Sciences (e.g., *Psychology, Geography*)
- Other, please specify \_\_\_\_\_

2 Please provide us with the name of the college/school within the university and department (or disciplinary committee, center, institute, etc.) where you are currently working as a post-doctoral researcher.

College/School of: \_\_\_\_\_  
Department/Center: \_\_\_\_\_

3 Which semester and year did you begin working as a post-doctoral research at UW-Madison?

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4 Please provide us with the name of the university, the college/school within the university, and department (or interdisciplinary committee, center, institute, etc.) that supervised your doctoral program.

University: \_\_\_\_\_  
College/School of: \_\_\_\_\_  
Department/Center: \_\_\_\_\_

5 While in your graduate program, did you ever hold a teaching assistantship or graduate student instructor position?

- Yes
- No

6 Were you aware of the Delta Program prior to coming to the UW - Madison?

- Yes
- No

7 Did the existence of the Delta Program at the UW - Madison help persuade you to attend the UW - Madison?

- Yes
- No

8 Have you ever participated in a Delta Program activity?

- Yes
- No

9 In which of the following elements of the Delta Program have you participated? (select all that apply)

- Roundtables
- Brownbags
- College Classroom course
- Informal Education course
- Instructional Materials Development course
- Teaching with Technology course
- Internship program and seminar activities
- Certificate program
- Creating a Collaborative Learning Environment

- Expeditionary Learning program
- Workshops (e.g., *ILSE Evaluation, ILSE/TEaching portfolio, NSF Broader Impact*)
- Discussions and discussion groups
- Delta Informational sessions and networking socials (e.g., *certificate launch*)
- CIRTL/Delta retreats

10 What types of formal or informal activities related to developing yourself in teaching and/or research have you participated in over the last year, which are **not** sponsored by the Delta Program?

- Have not participated in activities
- A course related to improving teaching
- A course related to improving research
- Department-sponsored activities
- Professional organization activities
- TA training
- Speakers on campus
- Other (*please specify*) \_\_\_\_\_

11 Why did you choose to participate in the activities highlighted in the previous question?

- Have not participated in activities
- Interest in learning more about teaching
- Interest in improving research
- Required to do so
- Other (*please specify*) \_\_\_\_\_

12 Do you feel the UW - Madison has provided sufficient resources for your professional development interests?

- Yes
- No

13 What other activities would you like to see on this campus related to your professional development interests?

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

For items 14 to 25, we are interested in learning more about your conceptions of teaching. Please indicate the extent you disagree or agree with each statement.

1: Strongly Disagree, 2: Disagree, 3: Neutral, 4: Agree, 5: Strongly Agree.

	1	2	3	4	5
14 Effective teaching requires input from others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15 As a teacher, I would study the effects of different instructional practices in my own classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16 As a teacher, I would seek pedagogical advice from those outside my department.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17 An effective teacher studies his/her students' learning in order to teach students of all types effectively.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18 I rarely talk to my colleagues about teaching.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19 A teacher does not need to collect data on the effectiveness of his/her teaching.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20 I believe it is important to try to facilitate learning among all the students in my class.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21 As a teacher, I would vary how I teach my courses, based on my own knowledge about my students and their learning issues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22 It is not important for me to discuss my teaching with others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23 As a teacher, I would use teaching activities that take into account the different backgrounds of my students.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
24 As a teacher, it would be more important for me to cover the course content than to attend to the different needs of the students in the course.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25 I know how to organize others for the purpose of discussing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

teaching and learning.					
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26 When you leave the UW - Madison, what types of organizations are you planning on obtaining a professional position in? (*Please select all that apply*)

- Government
- Industry
- Business
- Education

27 As you look forward toward your career, which types of roles that involve education would you be interested in pursuing? (*Please select all that apply*)

- Teaching at a research university
- Teaching at a teaching-intensive university
- Teaching but not in a university setting
- Conducting research in a university setting
- Conducting research outside a university setting
- University administration
- Other (please specify) \_\_\_\_\_

28 As you look forward toward your career as an educator, what tasks are you most interested in? (*select all that apply*)

- Teaching lecture courses
- Teaching discussion sections and courses
- Teaching laboratory courses
- Teaching undergraduate courses
- Teaching graduate courses
- Advising undergraduate students
- Advising graduate students
- Conducting research
- Serving on disciplinary committees
- Serving on department- /institution-wide committees
- Other faculty tasks (*please specify*) \_\_\_\_\_

29 Are you a U.S. citizen?

- Yes
- No

30 Are you of Hispanic or Latino origin or descent?

- Yes, Hispanic or Latino
- No, not Hispanic or Latino

31 What is your race?

- American Indian or Alaskan native
- Asian or Pacific Islander
- African American/Black
- White
- Other (*please specify*) \_\_\_\_\_

32 What is your gender?

- Female
- Male

## Appendix B: Invitation E-Mail Message

Dear %First Name%:

The Center for the Integration of Research, Teaching, and Learning (CIRTL) is funded by the National Science Foundation to create an interdisciplinary program to prepare graduate students, post-doctorial researchers, and current faculty and staff to meet the future challenges of science, technology, engineering, and mathematics (STEM) higher education. An evaluation is being conducted of CIRTL at the University of Wisconsin - Madison (named the Delta Program in Research, Teaching, and Learning) by researchers at the Wisconsin Center for Education Research (WCER).

As future STEM faculty, doctoral students at research universities are in an especially critical leverage point for national reform of STEM education. Approximately 100 research universities train the doctoral students who will join STEM faculties at all undergraduate institutions, dispersing among more than 3,500 research universities, comprehensive universities, liberal arts colleges, and community colleges.

To help CIRTL learn more about the impact of the Delta Program in Research, Teaching, and Learning on the UW doctoral student population, we would appreciate your completing the following brief questionnaire. Your responses to this questionnaire will provide information that will enable CIRTL's leaders to improve the Delta Program and to evaluate its effectiveness as required by NSF.

This questionnaire will take you no more than 15 minutes to complete.

There are no risks in providing the requested information. Filling out this questionnaire is completely voluntary. All information you provide will be kept confidential and stored without any individual identification. Results from the questionnaire will be reported only in aggregate form. There is no penalty or loss of benefits for not providing any or all of the information we are requesting.

Click here to begin:

[<http://cirtl.wceruw.org/surveys/CIRTL\\_CS\\_docsurvey\\_sampleb/csdocsurvey.htm?>](http://cirtl.wceruw.org/surveys/CIRTL_CS_docsurvey_sampleb/csdocsurvey.htm?>)

Please complete this questionnaire before Friday, April 22, 2005.

If the link above is not highlighted, please copy and paste it into the address bar of your browser's window.

To obtain more information about this questionnaire and the study, please contact WCER evaluation team leader Norman Webb at (608)263-4287 or nlwebb@wisc.edu.

Thank you for your assistance,

Norman L. Webb  
Senior Research Scientist  
Wisconsin Center for Education Research

## Appendix C: Followup E-Mail Messages

Dear %First Name%:

On April 14 you were sent a request to complete a short questionnaire from the Center of the Integration of Research, Teaching and Learning (CIRTL). The questionnaire takes less than 15 minutes to complete. We need your responses at the end of this school year to report to the National Science Foundation (NSF) and to help improve what programs are offered to graduate students and post doctoral staff. We need responses both from those who have participated in CIRTL events and those who have not.

Click here to begin:

<[http://cirtl.wceruw.org/surveys/CIRTL\\_CS\\_docsurvey\\_sampleb/csdocsurvey.htm?>](http://cirtl.wceruw.org/surveys/CIRTL_CS_docsurvey_sampleb/csdocsurvey.htm?>)

If the link above is not highlighted, please copy and paste it into the address bar of you browser's window.

To obtain more information about this questionnaire and the study, please contact WCER evaluation team leader Norman Webb at (608)263-4287 or nlwebb@wisc.edu.

Thank you for your willingness to help.,

Norman L. Webb  
Senior Research Scientist  
Wisconsin Center for Education Research

Dear %First Name%,

We need your help to improve UW-Madison professional development programs for doctoral students and postdocs!

Recently you received a short questionnaire on your experiences as a doctoral student and/or postdoc at UW-Madison. We noticed that you haven't completed the questionnaire yet. We encourage you to do so today by clicking on the following link:

<[http://cirtl.wceruw.org/surveys/CIRTL\\_CS\\_docsurvey\\_sampleb/csdocsurvey.htm?>](http://cirtl.wceruw.org/surveys/CIRTL_CS_docsurvey_sampleb/csdocsurvey.htm?>)

The questionnaire only takes a short time to complete, but it is of great importance to improving the programs offered to you at UW-Madison. Your input is vital! Please complete the questionnaire as soon as possible so that we can include your experiences and opinions in our study.

If you have any questions or comments about this questionnaire -- or if you have any difficulties accessing the questionnaire -- please e-mail me. Your participation is greatly appreciated!

Sincerely,  
Norman Webb  
Senior Research Scientist  
Wisconsin Center for Education Research

p.s. If the link above is not highlighted, you may copy and paste the web address into the address bar of your browser's window.

<[http://cirtl.wceruw.org/surveys/CIRTL\\_CS\\_docsurvey\\_sampleb/csdocsurvey.htm?>](http://cirtl.wceruw.org/surveys/CIRTL_CS_docsurvey_sampleb/csdocsurvey.htm?>)

## Appendix D: Telephone Interview Protocol

Hi \_\_\_\_\_, [please record the interviewee's name and gender \_\_\_\_ ]

My name is \_\_\_\_\_ and I'm calling on behalf of UW-Madison CIRTL. Last April we sent you a survey for doctoral students. Could I take a minute of your time to ask you 8 brief questions?

Yes No [circle one]

If yes:

1. Do you remember receiving this survey? Yes No [circle one]

2. Why did you not respond to the survey? [circle one or write in other reason]

didn't receive it

too busy

forgot to do it

not applicable

unable due to technical difficulties

not interested

other: \_\_\_\_\_

3. What is your field of study? \_\_\_\_\_

4. Have you ever participated in a Delta Program activity? Yes No [circle one]

5. Please tell me how strongly you agree or disagree with the following statements:

As a teacher, I would study the effects of different practices in my own classroom.

Strongly disagree, Disagree, Neutral, Agree, Strongly agree [circle one]

As a teacher, I would use teaching activities that take into account the different backgrounds of my students.

Strongly disagree, Disagree, Neutral, Agree, Strongly agree [circle one]

I know how to organize others for the purpose of discussing teaching and learning.

Strongly disagree, Disagree, Neutral, Agree, Strongly agree [circle one]

Thank you very much for your help!