Innov High Educ (2014) 39:93–107
DOI 10.1007/s10755-013-9265-0

FAST-Future Academic Scholars in Teaching: A High-Engagement Development Program for Future STEM Faculty

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Published online: 14 July 2013

Abstract Doctoral granting institutions prepare future faculty members for academic positions at institutions of higher education across the nation. Growing concerns about whether these institutions are adequately preparing students to meet the demands of a changing academic environment have prompted several reform efforts. We describe a professional

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development model designed to prepare the future faculty to integrate the multiple components of academic careers. The program emphasizes the study and application of effective teaching practices centered on student learning and assessment and expectations for faculty careers. We describe the impact of the program on its participants.

Keywords STEM doctoral students · Professional development · Teaching-as-research

Background

Two characteristics are common to many doctoral programs: (1) the primary purpose is to prepare students to conduct rigorous research, and (2) they follow an apprenticeship model in which students learn alongside an experienced researcher, the advisor, so as to eventually become independent scholars. Immersion in the research process is the foundation upon which students learn how to develop, conduct, defend, and publish research findings in their respective disciplines (Campa et al. 2000; Fairweather 2002, 2005). Hoffer et al. (2007) in the *Survey of Earned Doctorates* showed that 417 universities in the United States awarded at least one doctoral degree; the mean number of doctorates awarded per institution was 109 while the median was 40. As the difference between the mean and the median indicates, a relatively small number of doctoral granting institutions in the United States, the top ten

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percent, granted 47% of all doctorates; and these institutions prepare the large majority of faculty members who will occupy positions at research universities, comprehensive universities, liberal arts colleges, and community colleges (Hoffer et al. 2007). The realities of academic professional practice require that over time scholars engage in a range of responsibilities and activities. These responsibilities and activities fall within the broader definition of scholarship developed by Boyer (1990); and it includes four distinct yet integrated domains—application, discovery, integration, and teaching (Boyer 1990).

Over the past decade, several studies have highlighted concerns about whether graduate education is preparing the future faculty well enough for the diverse professorial roles that include not only research, but also teaching and learning and professional service (Austin 2002, 2010; Colbeck et al. 2008; Committee on Science, Engineering, and Public Policy 1995). Looking at the landscape of doctoral education from the students' perspective reveals similar concerns. In a survey report about students' experiences with doctoral education Golde and Dore (2001) concluded that there is a mismatch between student goals and expectations and the training that they receive. For example, the report stated that, while 83% of respondents said that enjoyment of teaching motivated them to be a faculty member, only 51.2% learned about teaching in their discipline. In relation to particular aspects of teaching only 44.7% and 36.1% of respondents believed that their graduate programs prepared them to teach a laboratory course or a lecture course, respectively (Golde and Dore 2001). Underscoring the importance of the teaching domain, the Boyer Commission on Educating Undergraduates in the Research University (2002) emphasized the importance of preparing the future faculty to teach undergraduates as part of their graduate education. More recently, Walker et al. (2008), referring to lessons learned from the Carnegie Initiative on the Doctorate, pointed to "the need not only for more teaching but for better, more systematic feedback and reflection that can turn pedagogical experience into pedagogical expertise" (p. 4).

Fortunately, reforms have been and are being implemented to prepare doctoral students in a holistic way for the responsibilities they will encounter in their future professional roles. At the national level, the Preparing Future Faculty Program (Pruitt-Logan and Gaff 2004), the Carnegie Initiative on the Doctorate (Walker 2004), the Responsive Ph.D. Program (Weisbuch 2004), and the activities of the Center for the Integration of Research, Teaching, and Learning (CIRTL; www.cirtl.net) are examples of programs that seek to prepare doctoral students to integrate elements from Boyer's (1990) four scholarship domains into their professional practice. At the institutional level, programs such as DELTA (Gillian-Daniel 2008) at the University of Wisconsin–Madison and the Planning, Resilience, Engagement, and Professionalism Program (Stoddart and Campa 2009; http://grad.msu.edu/prep/) at Michigan State University provide training, resources, and information about topics that range from access to the job market to choosing and working with an academic advisor and to professorial expectations at all types of higher education institutions. However, when it comes to innovative practices in doctoral education, these examples constitute exceptions rather than national norms.

The Future Academic Scholars in Teaching (FAST) Fellowship Program described in this article represents a professional development model for preparing a new generation of science, technology, engineering and mathematics (STEM) faculty members who are committed to teaching and learning and understand the roles and responsibilities that are part of an academic career. Specifically in this article we (1) describe the structure and initial three years (2006–2009) of implementing the program at Michigan State University, (2) present and discuss our evaluation results during those years, and (3) discuss the short-term impacts of the program on participating students.

The Future Academic Scholars in Teaching (FAST) Fellowship Program

Program Development and Purposes

The majority of graduate students (63%) in traditional arts and sciences disciplines are primarily interested in a faculty career; these same students have indicated that they feel inadequately prepared for the full range of responsibilities that a faculty job entails (Golde and Dore 2001, 2004). In general, doctoral training still focuses on research, and the predominant culture in research-intensive institutions still values research over teaching (Fairweather 2002, 2005). Consequently, the prevalent model is one where doctoral students receive minimal formal training concerning teaching and student learning (Austin 2010; Boyer Commission 2002; Gaff et al. 2000; Golde and Dore 2001, 2004).

The FAST program was initiated in 2006 under the umbrella of the Planning, Resilience, Engagement, and Professionalism Program (PREP; http://grad.msu.edu/prep/) at Michigan State University, and it was conceived to support the career needs of doctoral students pursuing academic careers (FAST; http://grad.msu.edu/fast/). FAST is a prototype high-engagement program associated with the Center for the Integration of Research, Teaching, and Learning (CIRTL; www.cirtl.net). The "CIRTL Network" is comprised of a number of diverse research universities across the nation engaged in implementing effective teaching practices for diverse student audiences. Three CIRTL conceptual principles are an integral part of FAST: (1) teaching-as-research (TAR) "involves the deliberate, systematic, and reflective use of research methods to develop and implement teaching practices that advance the learning experiences and outcomes of students and teachers"; (2) learning communities "bring together groups of people for shared learning, discovery, and generation of knowledge;" and (3) learning through-diversity, "capitalizes on the rich array of [participants'] experiences, backgrounds, and skills to enhance the learning of all" (Austin et al. 2008).

A fundamental assumption guiding the development of the FAST program is that improving the preparation of doctoral students as effective teachers will have a positive impact on undergraduate STEM education. A second assumption is that familiarizing doctoral students with the expectations, responsibilities, and challenges of faculty roles will allow them to compete better for academic jobs and ultimately position them for more productive and rewarding careers. The goals of the program are for participants to:

- Apply effective teaching practices grounded in the use of research methods to inform their teaching and their students' learning (e.g. forming objectives, framing questions, collecting and analyzing data, drawing conclusions);
- Develop assessments of student learning;
- Use literature and other resources associated with teaching and learning and assessment; and
- Have an increased awareness of the expectations, responsibilities, and challenges involved in academic positions.

Program Description

FAST is a cohort-based, academic year-long program that targets mid-to-senior level STEM doctoral students. Under the guidance of the FAST Fellowship Program Steering Committee and faculty mentors, fellows study effective teaching practices; develop, implement and assess the effectiveness of an original TAR project; and become part of a broader learning

community actively engaged in enhancing undergraduate education. The Teaching as Research (TAR) component is central to the FAST program. TAR projects range from classroom interventions to enhance teaching and learning questions and objectives to those projects that assess a teaching and learning-related issue or need that may warrant future interventions (See Table 1). For the projects requiring classroom interventions, fellows who are teaching assistants (TAs) typically implement their TAR projects in the classes they are teaching; for fellows who are not TAs during their fellowship, both mentors and steering committee members help fellows connect with faculty members who are willing to allow them to use their classrooms to implement a TAR project.

Operationally, fellows and steering committee members meet every two weeks for about 1.5 hours to discuss a variety of topics and engage in activities related to teaching and learning, the development of their TAR projects, and career preparation needs. Some of the discussions are facilitated by invited speakers and include issues such as balancing professional and personal life, dealing with and understanding tenure and promotion, and preparing for the unexpected during academic interviews. Table 2 presents an overview of the main program areas and specific topics aligned to program goals. At the start of the fellowship participants receive books and other resources on teaching and learning including *How People Learn* (Bransford 2000), *Classroom Assessment Techniques* (Angelo and Cross 1993), and *Active Learning: Cooperation in the College Classroom* (Johnson et al. 2006). Fellows also receive a $1000 stipend to assist them in conducting and disseminating their TAR project results.

The development of TAR projects is iterative. Typically, fellows begin with a research question, refine their research question and objectives, revisit their objectives to determine if they are measurable, develop their methods (data collection and analyses), and then prepare their data interpretation and results. Finally, fellows address how they will use their results to inform teaching and learning. The scheme mirrors the way in which graduate students regularly present their research progress in disciplinary research group meetings. During the first meeting, fellows share a research question that frames their TAR project; the steering committee and other fellows ask questions and provide feedback. This presentation and feedback activity is repeated throughout the year as the fellows develop their projects and, combined with the topic discussions, provide a scaffolding approach that helps fellows design, implement, and evaluate their TAR projects.

Additionally, fellows can participate in professional development workshops offered by the Graduate School at Michigan State University. Topics include teaching and learning seminars and hands-on workshops, sessions about possible career paths, preparation of a

Table 1 Exemplifying TAR Projects Conducted by Future Academic Scholars in Teaching (FAST) Fellowship Program Participants

Project Title	Description
Using simple cooperative learning techniques in a plant propagation course (Getter and Rowe 2008)	Implementing a new teaching technique (think-pair-share exercises) to improve student learning
Scientific reasoning ability of Cantho University students	Developing a tool to evaluate scientific literacy of students in different majors
Looking at Calculus Students' Understanding From the Inside-out: The Relationship Between the Chain Rule and Function Composition (Horvath 2008)	Explore students understanding of function composition using familiar, less familiar and unfamiliar calculus functions
Teaching life sciences via videoconference using inquiry	Evaluating the success of the […] project to stimulate inquiry in middle school students

Table 2 Future Academic Scholars in Teaching (FAST) Program Overview

FAST Program Area	Program Topics	Program Goals Addressed
Teaching & Learning	- Instructional Design & Pedagogy	- Foster a commitment to apply effective teaching practices.
	- Backward Design	- Enhance the ability of doctoral students to develop assessments of student learning.
	- Learning Objectives & Bloom's Taxonomy	- Engage doctoral students in the use of literature and other resources associated with teaching and learning and assessment.
	- Active Learning	
	- Inquiry Based Learning	
	- Cooperative Learning	
	- Assessment of Student Learning	
	- Multiculturalism and Inclusive Learning Environments	
Teaching as Research Project	- Scholarship of Teaching & Learning	- Foster a commitment to apply effective teaching practices grounded in the use of research methods to inform their teaching and students' learning.
	- TAR Project Development	- Enhance the ability of doctoral students to develop assessments of student learning.
	- Quantitative and qualitative data analysis	- Engage doctoral students in the use of literature and other resources associated with teaching and learning and assessment.
	- Data management	
	- IRB Process	
Career Preparation	- Teaching Philosophy	- Raise awareness of the expectations, responsibilities, and challenges of academic positions.
	- Teaching Portfolio	
	- Job search and interview	
	- Academic career expectations	
	- Work-life balance in academia	

teaching portfolio, writing an effective CV, preparing for a successful job interview, and resources and strategies for competing in the job market. Fellows also participate in CIRTL Network events such as on-line courses; seminars and informal discussions (CIRTL Coffee Hour); and the CIRTL Exchange Program, where fellows have the opportunity to visit institutions that are part of the CIRTL Network to present their TAR projects and a disciplinary research seminar. (http://www.cirtl.net/).

Selection of Participants

Applicants must be enrolled in a STEM Ph.D. program at Michigan State University, be in good academic standing, and making progress towards degree completion. Annually we select between 10 and 13 fellows from a total of 30–45 applications. Application requirements include approval from the applicants' department chair and dissertation advisor; submission of a current CV; and a brief essay describing career goals, interest in the program, and ways that their participation will enhance their professional development. Returning FAST fellows applying for a second fellowship year must describe and justify

their plans for the additional year. The selection process involves individual members of the steering committee studying the applications and making comments for each applicant. The steering committee then meets to discuss and finalize the selection of fellows. Selected applicants receive a letter of acceptance by mid-April and are invited to attend the current year's FAST fellows' symposium to observe fellows' presentations of their TAR projects.

The combined number of participants for the years 2006 to 2009 was 25; the demographic composition of the combined cohorts is summarized in Table 3. The majority of the participants were women (52%); most participants were from the College of Agriculture and Natural Resources (48%) followed by the College of Natural Sciences (36%), College of Engineering (12%), and College of Social Sciences (4%).

Steering Committee and TAR Mentors

The steering committee is the core group of people responsible for developing, organizing, and evaluating the program. It consists of 6–8 faculty and staff members at different stages of their careers and representing different academic units across Michigan State University as well as a previous FAST Fellow. This 2:1 ratio of fellows to steering committee members provides individualized attention for the fellows and a diverse range of perspectives, teaching and learning interests, and expertise. Participation in the steering committee is voluntary; members share a commitment to improving the preparation of doctoral students as effective teachers. Additionally, the program recruits faculty mentors to help participants develop, implement, and assess their TAR projects. Typically these mentors are members of the students' departments and/or have expertise related to their TAR project.

Program Evaluation

To determine the impact of the program and to guide program improvements, we gather data from participants primarily at the beginning and end of the program. The main program components evaluated are TAR, mentoring, assessment of student learning, resources for teaching and learning, and professional development. The objectives of the evaluation are to determine fellows' experiences, opinions, and knowledge about (1) the program in general, in particular as related to teaching and learning, applying research methods to inform and

Table 3 Demographic characteristics of Future Academic Scholars in Teaching (FAST) Program participants (2006–2009)

Demographic Characteristics	Count (Percent)*
Combined participants 2006-2009	25
Educational Background	
B.Sc.	13 (52%)
Masters	12 (48%)
Gender	
Female	13 (52%)
Male	12 (48%)
College Representation	
College of Agriculture and Natural Resources	12 (48%)
College of Natural Sciences	9 (36%)
College of Engineering	3 (12%)
College of Social Sciences	1 (4%)

* Unique participants combined for the three cohorts.

improve their teaching and their students' learning (i. e. TAR), and assessment of student learning; (2) their use of literature and other resources associated with teaching, learning, and assessment; and (3) ways in which the FAST program may have impacted their current (and future) teaching and career development practices.

Data collection includes beginning (i.e., during the first two weeks of the academic year) and end-of-program (i.e., following program completion at the end of the academic year) surveys administered on-line and semi-structured interviews with each participant conducted within 3–6 months after completing the program. The interview protocol is designed to ask participants about their overall experiences in the program as well as to ask them specifically about each program component (TAR, mentoring, assessment of student learning, resources for teaching and learning, and professional development). During the interviews participants are allowed to talk freely, but probes are designed to ensure that each program component is included. The interviews last approximately one hour and are conducted face-to-face or by telephone. All interviews are audio recorded with the participants' consent and later transcribed verbatim. We obtained the appropriate Institutional Review Board (IRB) authorization for all data collection procedures (IRB # X06-481/APP# i025197).

In this article we present data collected from the first three program cohorts (2006–2009). Our initial intent was to publish an article that would discuss the program from its start in 2006 to 2012. As we were planning this article, it became obvious that the implementation was naturally divided in two phases: An initial implementation phase from 2006 to 2009 and a more steady state implementation phase from 2009 to 2012 (manuscript in preparation). During the initial phase the program was evolving based on feedback from the participants and steering committee members and with the development of new material to share with the fellows. For example, while the program components remained the same, we modified some of the implementation strategies so as to achieve the program goals better. Documenting our experience and the participants' outcomes during these initial stages provides insights that will ideally help practitioners at other institutions who are considering similar high engagement, teaching-related, professional development programs for graduate students.

During the initial stage (2006 – 2009) we also made changes to the survey questionnaires, which resulted in some of the survey data being incomplete or different from one cohort to the next. Interview data, on the other hand, are comparable across all three cohorts and include 19 individual interviews with student participants in the FAST program from a total participant number of 25 for a response rate of 76%. Hence the interview transcripts constitute the primary source for the data analyses discussed in this article.

Data Analyses

The analysis of the interview data proceeded in a "spiral process" beginning with data organization whereby transcripts were broken down into smaller units (Creswell 1998) that mirror the evaluation components of the program: TAR, mentoring, assessment of student learning, resources for teaching and learning, and professional development. Although these components were treated as distinct units for analysis, significant overlap exists between and among them.

We read all transcripts to get a sense of the whole and to begin to establish emergent themes (Creswell 1998). We coded the participants' responses using the following categories: knowledge as determined by participants' awareness and/or perception with respect to the program components; reasoning related to the participants' capacity to analyze, interpret and understand program components; and judgment related to the participants' opinions, views and/or beliefs about the program components.

Findings

Ninety-two percent of the total number of participants interviewed (n=19) were satisfied or very satisfied with the program; the metric for satisfaction with the program included all positive comments about the program as a whole. To document gains related to each of the program components, we analyzed the interviews using a coding scheme that illustrates gains *explicitly* associated with participation in the program. Results from these analyses are depicted in Table 4, which includes sample interview fragments. For example, the 56% figure for TAR (Table 4) includes only answers that *explicitly* mentioned self-reported gains about the TAR concept as a result of participating in FAST. Other answers that conveyed a high level of satisfaction/gains related to TAR but were more general are not included in this figure but are included in the overall satisfaction category (92%). In the following sections

Table 4 Self-reported gains for each of the program components explicitly related to participation in the Future Academic Scholars in Teaching (FAST) Program (2006–2009)

Program Component	% Participants (n=19)	Exemplifying Interview Fragments
Resources on teaching and learning	68 %	- "FAST was the first time I saw these materials now when I am grading some piece [..] I recall what I heard in those meetings and apply it [..]"
		- "I thought that Bloom's Taxonomy was a really helpful resource that they exposed to us. I had never [before FAST] experienced that before, that kind of made sense to me when I read about it."
Mentoring	60 %	- "The interaction with other fellows and the [steering committee] in small groups really helped. I got to talk about my actual project."
		- "I've had more peer mentoring in the FAST program than I've had in my disciplinary research. [..] I haven't had so many mentors before [FAST]."
Assessment of student learning	56 %	- "I had the interest but I didn't know exactly what I could do [..]. FAST helped me fuel this interest and gave me a supportive place to figure out what I want to do."
		- "I hadn't thought about it [assessment] before FAST. It really broadened my horizons."
TAR	56 %	- "I just didn't know anything about [TAR] so the project really forced me to get into the lit[erature] and expand my horizons."
		- "All that [TAR] was new to me coming from a science and engineering perspective. [After FAST] I was comfortable with approaching a [TAR] question."
Professional development	48 %	- "The contacts that I made, the mentors, [..] I have people to go to and ask. The contacts expanded my career opportunities."
		- "The [FAST] meetings and resources definitely helped with the academic side of the prof[essional] development."
Diversity	28 %	- "FAST is really diverse in terms of gender, culture and academic background. Bringing that together was really helpful to me."

we document participants' opinions about self-reported gains and discuss what specific characteristics of the program components contributed to the satisfaction and/or gains from the participants' perspective. We use quotes to illustrate the arguments; participants' names have been changed to maintain anonymity.

Teaching-As-Research (TAR)

Developing a TAR project involves framing a teaching and learning-related question, designing the project, collecting and analyzing data, and disseminating the findings (see Table 1). Fifty-six percent of fellows (see Table 4), regardless of disciplinary background, indicated that they did not know about the concept of "teaching-as-research" prior to participating in FAST. Juana, a fellow from the Ecology, Evolutionary Biology, and Behavior Program said:

> I didn't know about how teaching [as] research was. When I thought about teaching, I always had this question in my mind about well how would [sic] you know what your students knew beforehand and where to start. […] Being a [FAST fellow] opened my eyes. I had no idea there was lit[erature] out there on scientific teaching.

Fellows also indicated that the TAR project provided an incentive to explore questions about which they had previously thought but were not sure how to address; TAR also forced them to investigate the literature relevant to their questions. Dina, a fellow from the Department of Plant Biology commented:

> Doing FAST pushed me and gave me a chance to do a study, to try something else I wouldn't have done otherwise. I stayed on that path. I knew from my FAST experience I had a taste of what I really wanted to do.

Another student said, "I just didn't know anything about teaching as research so the project really forced me to get into the lit[erature] and expand my horizons."

FAST participants represent diverse disciplinary backgrounds (see Table 3) and possess different levels of experience related to teaching and learning and the scholarship of teaching and learning —probably attributable to where they were in their graduate program (mid vs. late) and their departments, some of which have more TA positions available than others. This diversity had an impact on the ways fellows developed their TAR projects. For example, Anna, a third year student in the Department of Food Science and Human Nutrition, explained, "My [disciplinary] research is very experimental […] so I brought that to the way I designed my project. I definitely designed it to my comfort level to be more of an experimental design because of my background." Marcia, a student from the Department of Chemical Engineering and Materials Science pointed out, "Actually the disciplinary research didn't influence my project as much as my previous work experience. I used more of my industry experience in the actual activities that I did [for the TAR project]." Other students took advantage of their previous experience with teaching and learning projects; for example Louise used some of her existing data: "This [her existing data] is such a rich data source that I don't need to go and do a whole new project. This is my practicum project, and I am in FAST to help me iron this out."

Overall, participants' backgrounds had an impact on the ways fellows experienced the program and the development of the TAR project. However, regardless of their backgrounds FAST fellows reported benefits from participating in the TAR project and believed that their knowledge about scholarly approaches to teaching and learning increased.

Mentoring

The majority of the interviewees (60%, see Table 4) explicitly mentioned mentoring as an important and successful part of the program. Participants cited the steering committee and their peers as the main mentors; a few mentioned their disciplinary advisors as important mentors or as encouraging them through the program. Fellows also identified the diverse composition of the group as a positive component of the program. Martin, a student from the Department of Fisheries and Wildlife indicated:

> So you actually do have a lot of face time with the steering committee; and I'd say that in any given meeting, we probably had seven or eight of the FAST fellows and then five or six of the steering committee members.

Another student commented:

> The interaction with other fellows and the steering committee in small groups really helped. I got to talk about my actual project […] I got a lot from my fellows because a lot of them had more teaching experience than I did.

The structure of the FAST program promotes informal mentoring opportunities. Discussions occur in an informal and open setting; and steering committee members frequently engage in story telling, during which they share their experiences with the fellows. Students value the opportunity to discuss the challenges and rewards of academic life with a diverse group of experienced mentors. Miranda reflected:

> Getting to interact with faculty [members] around campus in a more simple [sic] setting helped the faculty share their personal experiences. In that setting people were much more open. Those instances were great. That helped give me an idea of what it actually looks like to be a professor and how one moves in that direction.

Fellows also identified a sense of community that crossed disciplinary boundaries and allowed them to explore a common interest in teaching and learning. For example, Jon, a fellow from the Department of Mathematics, said:

> As a group of fellows, we all have this interest, and we were not just doing science but we thought about [student] learning. It was like I want to do this, but I don't know how, and I found more people who felt the same.

Lina, a fellow from the program for mathematics education, indicated:

> So a lot of the people I interact with personally are just doing math education. So it was an opportunity to still work on things I was interested in, but [also] talk with other people whether it was from physics or even pre-med and just a variety [of disciplines] instead of just my own little circle.

Our data suggest that mentoring by numerous people from diverse backgrounds and career stages plays an important role in the success of the program. The open structure of the program allows all participants, including students and steering committee mentors, to engage in formal and informal mentoring experiences. The graduate students also developed a sense of community outside of their disciplines, where they can explore and expand their interest in teaching and student learning.

Assessment of Student Learning

Fifty-six percent of the fellows agreed that the FAST program affected, sometimes drastically, their views about the assessment of teaching and learning (see Table 4). For example, one fellow said:

> I thought that assessment was a necessary evil. You had to give student a grade so you make a test. I see it as so much more now [after FAST], it can help to evaluate my teaching and to see if what I think I'm saying are [sic] what the students [perceive].

Another student indicated, "It [FAST] really changed my idea about how you can go back and address problems that students are having. I hadn't thought of assessment being used to inform my teaching."

Fellows specifically mentioned increased knowledge about the resources available on assessment and the different uses for assessment techniques. Cliff said, "FAST gave me more ideas about how to assess in a classroom; admittedly before I joined FAST and before I had that classroom assessment textbook, I had very limited knowledge about assessment". The program increased participants' awareness about how assessment can be used not only to inform their teaching and students' learning but also how to conduct TAR with the same rigor that they apply to their disciplinary research.

Resources for Teaching & Learning

Most fellows (68% see Table 4) were satisfied with the resources available through the program; they also indicated that they had not been aware of these resources before participating in FAST. Most of them mentioned *Classroom Assessment Techniques* (Angelo and Cross 1993) and *Active Learning* (Johnson, et al. 2006) as important resources that they still use following program completion. Hannah commented, "I really appreciated the books that they gave us in the FAST program. I'll be taking all of them. They've been really great". Lucy commented, "I had no idea that was so much out there. […] Going to FAST really opened my eyes to all the resources that exist."

Fellows viewed the workshops offered in the context of the FAST program and other resources outside the program but advertised through FAST as an important complement to the program resources. Lucas from the College of Engineering commented, "Workshops were excellent and the bringing in [of] external people to talk to and talking about careers and professional development". Another student said:

> Some of the greatest experiences at Michigan State have been things I learnt [sic] about through the FAST program. This past May I did the learning experience through diversity, and that was great; it was a cooperative learning group. I've done other teaching workshops that I would never have known about [without FAST].

Professional Development

Fellows had a diversity of ideas and perceptions about what constitutes professional development: a way to expand and augment their knowledge, an opportunity to gain new skills, something that they need to do to enhance and build their resumes and that is necessary throughout their graduate careers and professional lives. Regardless of their ideas about what constitutes professional development, 48% (see Table 4) agreed that FAST provided opportunities for professional development and/or viewed FAST as a professional

development undertaking. One fellow indicated, "I always get things through the FAST fellowship group. I've had a lot more opportunities to do professional development in my teaching because I hear about it more. I've become more aware of teaching opportunities." Another important point relates to building relationships and networking opportunities across disciplines. In general, fellows agreed that the FAST program allowed them access to a broader network of professional relationships.

Discussion and Implications

The large majority of faculty members who will occupy positions at research and comprehensive universities, liberal arts colleges, and community colleges graduate from just one hundred institutions (Hoffer et al. 2007). Given that doctoral granting institutions are the only place where future faculty members are prepared for their careers, it is critical to implement programs to prepare them for diverse, professorial roles. The primary goal of the FAST program is to improve the preparation of future STEM faculty members who are committed to teaching and learning. To achieve this goal, the FAST model emphasizes teaching-as-research (TAR) as a way to help doctoral students develop research methods—not unlike those formulated for their disciplinary research—to explore and inform their teaching and their students' learning. The structure of the program provides an inclusive community for graduate students interested in teaching and learning. This is a significant outcome at a large research-intensive institution where the communal environment for graduate students is generally restricted to their department and often to their laboratories (Austin 2002). The FAST program shifts the socialization of the graduate students from a research-centered focus to a more integrated training that acknowledges the importance of pursuing teaching excellence and the scholarship of teaching as part of their career preparation.

We acknowledge that systematic studies are needed, i.e., longitudinal studies to track program participants after graduation in order to examine the impact that the program has had in their careers. Another vital piece of the puzzle relates to undergraduate student learning and how this program has affected the learning outcomes for the undergraduate students who are the ultimate stakeholders in the teaching and learning process. Evidence for gains on this front will involve cross-institutional studies over an extended period of time.

Conclusion

The structure of the FAST program and the strategies that we implement represent a model that can be adapted by doctoral-granting institutions interested in preparing future faculty. While it is important that institutions adapt a model to fit their context and culture, we recommend consideration of key features from the FAST program. These features are an extended (preferably academic year-long) program, design and implementation of a TAR project, a diverse community of mentors and peers, promotion of an inclusive learning environment that fosters informal interactions among mentors and peers, and access to a diverse variety of resources and activities on topics in teaching and learning and the academic career.

By disseminating information about the structure of the FAST program and our experiences during the first three years of implementation we hope to contribute to the larger conversation about the preparation of future faculty who will ultimately have a direct impact on undergraduate student learning.

Acknowledgements Funding NSF award # 0717768. The authors thank Karen Klomparens, Ph.D., for support and encouragement during the development and implementation of this program and Natasha Speer, Ph.D., for her insight to help initiate the program.

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