

Board 103: EAGER: Barriers to Participation in Intensive Professional Development Opportunities

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Abstract

The Rising Engineering Education Faculty Experience program (REEFE) is a professional development program that connects graduate students in engineering education with faculty members at teaching-focused institutions. The program goal is to simultaneously support faculty growth in engineering education and graduate student growth as academic change agents. Our program has transitioned from a partnership between one engineering education graduate program and one engineering institution to a consortium of engineering education graduate programs that sends students to multiple institutions across the country. The REEFE Consortium also developed a unique partnership with the Making Academic Change Happen initiative to offer continuous training to graduate students during their REEFE experience.

Many positive outcomes have come from the development of the REEFE Consortium, including better graduate training in research at the coordinating institution, a better understanding of program logistics, and new and strengthened professional relationships. We discovered a number of challenges associated with providing intensive professional development opportunities to graduate students, including timing of experiences relative to degree progress, loss of connection to the home research community, and financial impact, especially as it relates to travel and housing.

While a search of existing literature in professional development in higher education has provided best practices for existing programs, there is little to no available research highlighting barriers that exist to offering different types of professional development opportunities to graduate student populations. These barriers are important to highlight as they provide critical information needed in the design and decision making for those seeking to create useful professional development opportunities for graduate populations.

This paper provides an updated description of the Rising Engineering Education Faculty Experience program as we attempt to scale the program. We summarize the existing literature on barriers to participation in professional development opportunities for graduate students. Finally, we describe how REEFE both addresses and fails to address these barriers.

Introduction

Within the science, technology, engineering, and mathematics (STEM) education community, national voices make repeated calls to change the way we educate our students (e.g., the National Academy of Engineering's Engineer of 2020; President Obama's Educate to Innovate program; AAU's Undergraduate STEM Education Initiative). These calls for change extend beyond the classroom experience to the curricular, co-curricular, and institutional levels. In response, recent

change efforts have targeted necessary components for comprehensive change, such as the development of targeted networks [1] and theoretical frameworks on systemic change in STEM education [2, 3]. The Journal of Engineering Education published a special issue [4] dedicated to research on change process strategies that can impact faculty teaching and student learning. Similarly, the National Science Foundation's (NSF) ongoing Revolutionizing Engineering Departments (RED) initiative [5] partners engineers and social scientists to promote cultural, not just curricular, change.

In addition to these efforts, several schools have created Departments of Engineering Education (e.g., Virginia Tech, Purdue, Ohio State, Arizona State, Rowan, with others and more in formation) to focus on advancing engineering education research and practice. Recently, the NSF initiated a new program that partners engineering educators with social/learning scientists to conduct education research projects; the Research Initiation in Engineering Formation program. However, even with a multitude of efforts, significant gaps in the research-practice cycle [6] still exist: two specific gaps being 1) engineering education research's struggle to permeate into the classroom and 2) classroom experiences and potential learning improvements often do not inform future engineering education research.

To fill these gaps, our field could benefit from a stronger connection between engineering education researchers and engineering education practitioners.

The aforementioned activities are undoubtedly striving to address this connection; however, one untapped resource in this area is the professional development of engineering education graduate students. In their roles as engineering education researchers- and practitioners-in-training, they represent the next generation of engineering education researchers and/or practitioners some of whom will serve as agents of change. To be professionally successful, engineering education graduate students must be prepared to leverage their knowledge of theory in both research and practice. Importantly, they must understand the variety of professional contexts and settings in which they may use that knowledge. As future faculty they are developing the knowledge and skills that can support institutions with or without dedicated engineering education departments or programs. Some engineering education doctoral graduates will join departments dedicated to engineering education research. Others will seek careers in less research-intensive environments and will find professional opportunities on campuses where teaching engineering courses is the main focus or in departments where they are the only expert in engineering education research. While this breadth of possibilities can be advantageous to graduating students' career prospects, it can also produced confusion when making career decisions and during professional identity development. Addressing this breadth can also be a daunting task for engineering education departments preparing future engineering education professionals. This sentiment was affirmed by multiple stakeholders interviews that included graduate program directors, hiring committees for new faculty, graduate students and potential funding organizations. Furthermore, traditional engineering departments could benefit from hiring new engineering education graduates but may

hesitate to commit due to lack of familiarity with the field of engineering education and concern about hiring outside of a technical field. This sentiment was affirmed by representatives of disciplinary departments during exploratory interviews.

Rising Engineering Education Faculty Experience Consortium

To address these needs, our team is implementing the **Rising Engineering Education Faculty Experience (REEFE) Consortium**, supported by and facilitating research, focused on the interaction between engineering education graduate students and professional engineering educators at multiple schools. The goals of the REEFE Consortium are threefold:

1. to broaden the reach of engineering education theory and research-based instructional strategies into traditional engineering departments, thereby narrowing the gap in the research to practice cycle
2. to address the needs of engineering education graduate students in their role as future faculty and agents for change in the field of engineering education, and
3. to investigate a number of important questions regarding graduate student identity development, adoption of research-based instructional strategies, and how to best amplify the reach of engineering education into disciplinary settings.

A primary outcome of the program is to enable engineering education graduate students to gain exposure to the breadth of possibilities for professional work utilizing their expertise in engineering education. This program places engineering education graduate students in part-time visiting faculty positions in disciplinary departments or academic support offices, and seeks to create of a nationwide consortium of schools for sending and receiving students. The current REEFE team includes eight members serving overlapping and complementary roles (Table 1).

The implementation of the REEFE Consortium focuses on:

- the matching of graduate students to receiving schools that results in a short-term, on campus experience for the REEFE participants, during which they are treated as incoming, new faculty and may be involved with a number of diverse opportunities during their experience,
- the opportunity to learn, through the on-campus experience, about the campus environment, college culture, and possibilities for professional experience, and
- professional development in academic change using the Making Academic Change Happen (MACH) framework as a structure. This professional development will include a consortium meeting at the American Society for Engineering Education meeting of all REEFE participants (past and future), the coordinator staff, and other key personnel, as well as monthly all-campus calls (e.g. Adobe Connect meetings) to promote a cohort experience for graduate students, emphasizing the developmental nature of the experience, and highlight key experiences related to being academic change agents.

Through these activities, the REEFE Consortium seeks to better understanding graduate student professional identity development, the connection between engineering education research and practice, and the challenges associated with scaling new engineering education professional development programs. Therefore, a subset of the eight-member team also conducts research into these topics.

Table 1: Primary Roles within the REEFE Consortium		
REEFE Consortium Coordinator	The REEFE Consortium Coordinator is responsible for the overall coordination of the REEFE programmatic activities, which include: - Solicitation of Sending and Receiving Schools for consortium - Coordination of Recruitment, Interviewing, and Matching of REEFE participants with Sending and Receiving Schools - Planning consortium activities, including introduction meeting and MACH training throughout experience - Main contact for program evaluation - Overseeing GA for program responsibilities - Responsible for pursuing sustainability plan of program	Rachel McCord^{P, R} : Lecturer and Research Assistant Professor at UTK (<i>PI</i>)
REEFE Research Coordinator	The REEFE Research Coordinator is responsible for the overall coordination of all related research activities, which include: - Overseeing data collection and analysis; - Main contact for research evaluation; - Overseeing GA for research responsibilities; - Responsible for sustainability plan for research for REEFE	Cory Hixson^{P, R} : Assistant Professor at Colorado Christian University (<i>Co-PI</i>)
Sending School Coordinators	The sending school coordinator resides at an institution with an engineering education program or graduate students focusing on engineering education. Responsibilities include: - provide scheduling flexibility and recruiting support - affirm that their REEFE students will be supported via continued connection to their research group - arranging course and dissertation work to allow participation for interested graduate students	Holly Matusovich^{P, R, *} : Assistant Department Head for Graduate Programs & Associate Professor of Engineering Education at VT
		Brent Jesiek[*] : Associate Professor of Engineering Education & Graduate Coordinator at Purdue
Receiving School Coordinators	The receiving school coordinator resides at an institution with an interest in expanding their understanding of engineering education research. Responsibilities include: - provide job descriptions for available positions - affirm that REEFE participants will be integrated into faculty/staff life as appropriate - provide participants with key developmental experiences, - provide typical resources of a visiting faculty member.	Ella Ingram^{P, R, *} : Associate Dean for Professional Development & Associate Professor of Biology and Biomedical Engineering at Rose-Hulman
		Brian Self[*] : Professor of Mechanical Engineering at Cal Poly
Curriculum Coordinator	The MACH curriculum coordinator has expertise in the original MACH curriculum. This coordinator will work with the program	Julia Williams^{P, R, *} : Interim Dean of Cross-Cutting Programs and

	coordinator and GA to develop and implement a REEFE specific MACH curriculum.	Emerging Opportunities & Professor of English at Rose-Hulman
External Evaluator	The external evaluator is charged with evaluating the programmatic and research activities for this proposal.	Cheryl Carrico : President of LLC and Research Associate at VT
Graduate Assistant	• Support MACH curriculum development • support recruitment and matching process • support curriculum implementation • support data collection and analysis activities for research plan	Steph Jarek Graduate Research Assistant UTK
REEFE Consortium Participant	• participate in interviewing and matching • fulfill the requirements of job description for matched role • participate in MACH training throughout REEFE experience	Multiple Institutions

P – REEFE Pilot Team Member

R – REEFE Research Team Member

* - Responsibilities for REEFE included in typical responsibilities of current position at university

Piloting the REEFE Program

The REEFE program was piloted twice prior to attempting to expand into a consortium model; each pilot involving two students who completed visiting faculty appointments at a receiving institution [7]. All students who participated were doctoral students in Virginia Tech's Engineering Education Department and were hosted by Rose-Hulman Institute of Technology (Rose-Hulman). In both cases, one student worked with Rose-Hulman's Institutional Research, Planning, and Assessment office on special projects, while the other worked with Rose-Hulman's Center for the Practice and Scholarship of Education on special projects. From Rose-Hulman's perspective, the graduate students contributed engineering education expertise to faculty in every academic unit on campus and supported offices ranging from those mentioned above to the Center for Diversity, the Associate Dean of Innovation, and the (student) Leadership Advancement Program. These contributions took the form of one-on-one engineering education research/assessment consultations with Rose-Hulman faculty members, contributions to ongoing engineering education projects, attendance/support at workshops, collaborations with Rose-Hulman faculty, department visits, and more. The reach of the graduate students across Rose-Hulman's campus was notable because their research-informed and research-focused knowledge, skills, and perspective in engineering education was welcomed and desired by many Rose-Hulman faculty members.

During and after pilot implementations of the REEFE program, student participants, mentors, advisors and REEFE program administrators expressed having positive experiences with the program. Specifically, student participants stated that the program supported their professional identity development and progress toward degree [8]. Beyond the graduate student participants' professional identity and skill development, which will be reported on in subsequent

publications, these pilots resulted in additional outcomes. For example, collaborations between Rose-Hulman faculty and graduate participants extended beyond students' time at Rose-Hulman. These collaborations include an ASEE workshop [9], multiple conference papers [10-14], a journal article [15], the formation of a startup company, scholarship detailing the development process behind REEFE [14, 15], a presentation by Rose-Hulman mentors at VT's graduate student seminar, and a significant amount of learning regarding improving the REEFE experience itself.

Customer Discovery and Verifying the Value of REEFE

In order to support the development of the expanded REEFE Consortium, our team conducted a Customer Discovery project that focused on understanding the market for professional development for graduate students in the engineering education community. We interviewed 25 people that served in different roles in the community: graduate students, graduate advisors, engineering education department heads, hiring committee members, and funding agencies. The purpose of this customer discovery project was to understand if a program like REEFE would be valuable to the engineering education community. The methodological approach to this customer discovery project was described in a previous ASEE paper [16]. Consistent themes from the customer discovery data showed a need for a program like REEFE. Some professional development themes included:

- Understand the daily responsibilities of a faculty member
- Understanding the institutional and departmental context and how that impacts daily work
- Opportunity to apply pedagogical and theoretical knowledge in an actual classroom setting
- Experience apart from being a graduate student, especially experience in a different department
- Opportunities to connect research to current practice with other practicing faculty
- Opportunities to build professional network

After the initial review of the customer discovery data, our team determined that the current conceptualization of the REEFE program would be of benefit to the engineering education community and we moved forward with the development of the expanded consortium model. This development took the form of continued feedback via presentations and previously cited publications as well as securing NSF grant funding to develop the expanded consortium model.

Implementing the REEFE Consortium

Consortium Preparation Activities: To begin the collaboration between consortium members, the Program Coordinator will communicate to sending and receiving schools the expectations of their coordinator roles and ask that sending school coordinators provide access to graduate

students and receiving school coordinators develop job descriptions for the positions available to potential participants. The job description will include specific tasks or projects the REEFE participant will work on as well as the research interests of potential faculty members that the REEFE participant would interact with during their stay. The Program Coordinator and GA will use the job descriptions and expectations of the program to develop targeted advertising material to send to all sending schools. The Program Coordinator will work with each sending school to schedule an on-campus visit to present the program and job opportunities to the graduate student population. Finally, the Program Coordinator will work with the MACH Curriculum Coordinator and the GA to develop specific MACH curriculum to be used during the program.

Recruitment and Selection of Participants: The recruitment process will include interviews for REEFE jobs, selection of candidates, and offers from each receiving institution. During the on-campus visit at each sending school, the Program Coordinator will schedule video-conference interviews between potential REEFE participants, the Program Coordinator, and the receiving schools. Eligible students must meet the following criteria: 1) Knowledge of educational research methods, 2) Knowledge of theoretical frameworks in education, and 3) Knowledge of assessment and evaluation techniques. The Program Coordinators and Receiving School Coordinators will discuss potential REEFE participants and match students to the appropriate job descriptions. The matching process will explore expertise offered and expertise needed, disciplinary backgrounds and departmental characteristics, active projects at receiving schools and graduate students' ideas for possible projects, and (if applicable) dissertation research of the graduate student, if that research can be either leveraged or enhanced by participation at a specific site. The Program Coordinator will send out offer letters on behalf of the REEFE Consortium to the accepted applicants. The first REEFE consortium cohort will be limited to four student participants.

REEFE Consortium Experience and MACH Training: All participants that are successfully matched will attend the consortium meeting at the ASEE conference before they report to their assignment. The goals of the consortium meeting are 1) to introduce the student participants to the receiving school coordinators, 2) to have a guided session focused on planning and goal identification for the upcoming semester, and 3) to participate in the first day of the MACH curriculum, which focuses on identity and cultural elements that are critical for understanding the academic change process. In advance of the fall semester, participants will report to the receiving school to start their position. At the receiving school, participants will engage in normal 'new faculty' integration activities such as orientations and trainings.

Continued training throughout experience: During the semester, the REEFE team will conduct monthly conference calls with REEFE participants. The purpose of the monthly calls is to lead the REEFE participants through the entirety of the MACH curriculum and to provide a space to discuss salient events occurring at their particular location. As they see themselves develop through this faculty experience, REEFE participants will be able to visualize themselves as

change agents in their future careers more fully. The participants will also learn from the experiences of participants at other sites. Finally, the monthly calls will provide artifacts for the evaluation and research aspect of the REEFE Consortium.

Challenges in REEFE Consortium Implementation

To date, the implementation of the expanded REEFE consortium has experienced some challenges. One challenge that continues to perplex the REEFE development team is the discrepancy between stakeholders' perceived value of the program and the number of participants willing to sign up and participate. Anecdotal data from students demonstrates that they are interested in the consortium (via one-on-one conversations or feedback after presentations about REEFE); however, few students have actually submitted applications to participate. Because of this discrepancy, we revisited the customer discovery data to glean any additional insights.

Themes from the customer discovery data revealed that some of the barriers to providing professional development in general include lack of knowledge of opportunities for professional development and a limited amount of money to allocate for graduate student professional development. We believe this is not our primary challenge as we have thoroughly informed the students about the program (email description, link to website, webinars, in-person seminars, etc.) and the NSF grant has provided sufficient funds to cover the costs of the program. Other challenges that were discussed in the discovery data, particularly relating to experiences like the REEFE Consortium, were uncertainties about what a fellow in a program like REEFE would be expected to accomplish during one term at a host institution and the distance students would spend away from their home institution, research group, and advisor. Similar concerns were mentioned several times including concerns about being unable to create a completed deliverable and being able to effectively change things in a meaningful way during the time allocated for the program. We believe these concerns may be the primary driver in limited the number of applications, and we are in the process of collecting additional data to further explore this area. We will now preview some of this data.

Beyond revisiting the existing customer discovery data, after the initial recruiting round of the REEFE Consortium did not result in the number of applications expected, our team developed and deployed an open ended survey that was sent to faculty and graduate students at Purdue and Virginia Tech's engineering education programs. The purpose of the open ended survey was to understand what faculty and students saw as the benefits of the REEFE Consortium as well as challenges associated with participating in the program. Out of the 34 responses from the survey, the most common barriers discussed included timing or time spent away from the institution that might result in participants delaying graduation or getting behind in their research (17/34; 50 percent), difficulty with funding and costs that might result from participating in the program (13/34; 38 percent), moving for a short period of time and the costs incurred due to this (14/34; 41 percent), and time spent away from family or difficulties with moving their family for a short period of time (10/34; 29 percent). Other commonly cited barriers included the time commitment

(e.g. too long, too short) of the program (8/34; 24 percent), lack of information about the program (7/34; 21 percent), a perceived lack of experience for advertised positions (5/34; 14 percent), uncertainty about the structure, logistics, and duties associated with the positions (5/34; 14 percent), and concerns about being away from their advisor or research group (4/34; 12 percent).

Summary of Existing Literature on Barriers to Grad Professional Development

At present, a thorough search was conducted for research about the barriers to completing a program similar to REEFE in the field of engineering education, but to the best of our knowledge, no studies of this nature currently exist. However, some similar studies have been done out of other programs. One such program out of UCSF and UCD that provided PhD students in the life sciences the opportunity to complete an internship and job-seeking curriculum found several reasons why doctoral students chose not to participate in the optional program through surveys to those who chose not to participate [17]. This study found that the greatest challenge to completing an internship for students who did not complete an internship was finding the timing around completing “research and academic obligations” (Schnoes, et al., 2018).

While many PhD programs do not require an internship component, many researchers are now studying the effects of a required internship for people in various disciplines. One such study followed doctoral programs in Scotland (across four regions) that required doctoral students to complete a three-month doctoral internship at a placement of their choosing outside of academia (either locally or internationally). Most postgraduate respondents to the survey for this program reported having “very positive” (60%) experiences and reported that they increased their knowledge base (52.3%), increased their overall cognitive abilities (55.4%), and were able to utilize their creativity during the internship period (56.9%) [18].

Another important factor found cited in the literature was that many similar programs where two universities exchanged students have had a presence on the campus or within the department that helped to educate students about the opportunity or that faculty and administration directly chose specific students for the program from within their department or class. One program that exchanges student affairs graduate students between diverse campuses (Florida International University and Bowling Green State University) for one week each year had representatives on campus that founded and ran the exchange program [19]. These faculty members had worked together earlier in their career and collaborated to give graduate students the opportunity to learn about a new campus environment, gain “functional” knowledge of the field by engaging in staff meetings, getting to know other professionals, and completing a week-long internship at a student affairs office on the host campus [19]. Because currently no direct representative of the REEFE Consortium currently exists at Purdue University or Virginia Virginia Polytechnic Institute and State University, there are only entities that relay information to the department, but

that may or may not be successful in telling the story of the program. One study recommended that important factors in creating a graduate or doctoral internship program at a college campus were faculty buy-in and a centralized staff at the target university dedicated to the facilitation of the program [17].

One study looked at the top skills that increase the marketability of a graduate student entering the work force. Employers in Canada reported positive correlations with employability traits of graduate students on the following characteristics: professional maturity, soft skills and problem solving, continuous learning, academic achievement, generic skills like attention to detail, subject-based knowledge, professional manners and behavior, being responsive to feedback and the potential employee's willingness to work [20]. Therefore, the study found that "work-terms" or co-ops can provide a good opportunity for employers to assess the skills of potential workers. One report on a focus group that looked at the mobility of PhD graduate students studying in the UK considering a stint of mobility during their degree listed the following barriers to this opportunity to study abroad: funding, ethical and safety issues, lack of institutional support, time constraints and pressure to complete their doctoral research, personal commitments, cultural and language barriers, barriers toward mobility in non-European or developing countries, and the ease of completing research while abroad [21]. Another study interviewed OB/Gyn medical students and residents to assess their interest in participating in a global health program for additional training in low- and middle-income countries; some common barriers by survey participants were cited including scheduling conflicts and time constraints, concerns about costs and funding, a lack of contact with mentors or other contact points for the program, and length of potential trainings or electives [22]. There was also some statistical significance for barriers such as personal safety, family, lack of resources, and lack of interest from faculty in the program [22]. Another study identified several barriers that exist for graduate students and their ability to participate in professional development opportunities; common barriers that were identified included balance with other commitments such as being a parent, spouse or work responsibilities, time, location, accessibility and finances [23]. Porter and Phelps [24] reported that some limitations to providing doctoral students with work experience that prepares them for careers outside of academia. These limitations included finding it difficult to engage in pursuits outside of traditional academia with the context of the traditional model of academia and that faculty not being positioned to appropriately evaluate products from an "external experience" (Porter & Phelps, 2014).

REEFE Path Forward

In Fall 2018, the REEFE team ran a third iteration of the REEFE program. One graduate student from Purdue worked with the Department of Engineering Design at Rose-Hulman Institute of Technology during this time period. We are in the process of recruiting for a fourth iteration of the REEFE program for Fall 2019. We hope have one graduate student work with the Department of Mechanical Engineering at Cal Poly San Luis Obispo. We are working to analyze

the impact of the REEFE program on graduate student professional identity development and hope to have those results soon to share with the engineering education community.

We are continuing to investigate the barriers to effective implementation for the REEFE program. We hope to share what we have learned to allow others to learn from our experiences and improve their planned graduate student development programs in the future.

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