"I realized that I myself am on the path to being a pioneer": Characterizing the experiences of graduate students in an innovative interviewing experience

Natascha M Trellinger, Purdue University, West Lafayette

Natascha Trellinger is a second year Ph.D. student in the School of Engineering Education at Purdue University. She received her B.S. in Aerospace Engineering from Syracuse University where her interest in the teaching and learning aspects of engineering began. At Purdue, Natascha is a member of the Global Engineering Education Collaboratory (GEEC) and is particularly interested in graduate level engineering education.

Dr. Brook Sattler, University of Washington

Dr. Sattler is a Research Scientist for the Center for Engineering Learning & Teaching (CELT) and a Multi-Campus Coordinator for the Consortium to Promote Reflection in Engineering Education (CPREE) at the University of Washington. Her research interests include understanding and promoting self-authoring engineers.

Dr. Jennifer A Turns, University of Washington

“I realized that I myself am on the path to being a pioneer”: Characterizing the experiences of graduate students in a blended interviewing experience

Abstract

Socialization in graduate school is critical to personal and professional success, and encompasses both the development as a researcher and as a member of the field. This paper discusses the experiences of 28 graduate students through their participation in an engineering education research project. The blended experience included online training workshops, qualitative research tasks, and culminated in a final meeting at the 2014 ASEE annual conference in Indianapolis. The graduate student participants reflected on their participation in an online survey, which was coded for individual descriptions of their experiences.

The results are presented as four experience descriptors: 1. Exceptionally good experience: “I realized that I myself am on the path to being a pioneer,” 2. Good experience: “This project really confirmed that I enjoy the work I do,” 3. Mundane experience: " I didn't feel that I was a big part of the research,” and 4. Disappointing experience: "I wouldn't say I learned something significant during this study.” Most participants had a good experience, but insight from the other three experience descriptors give valuable perspective into the varied experiences. This analysis is helpful to both graduate students interested in research and professional development (i.e. blended) experiences, and educators creating blended experiences in that it demonstrates that a common blended experience can provide many students with important opportunities from which they can take away what is important and relevant to them.

Introduction

The graduate student experience is multidimensional. Being a graduate student includes many socialization experiences that encompass the academic, social, and professional aspects of graduate education. Socialization in the sense that it is discussed in this paper aligns with the description offered by Ann Austin[1]:

> Socialization for doctoral students is largely about making sense of graduate school and the academic career, developing one's interests and areas of strength, determining how one's values and commitments relate to those in the profession, and developing one's own sense of place and competence within that profession. The time and support for reflection are important ingredients in the socialization process.

The role that socialization has in educating engineering education Ph.D. students has not been discussed explicitly in formal research [2]. The graduate student experience in engineering education is of particular interest due to its interdisciplinary nature of bringing many people of differing backgrounds together [3,4]. Although the number of graduate programs in engineering education has increased and continues to grow, much of the research in the field is still conducted by researchers and graduate students in traditional disciplines, such as engineering and education.

The future of the field of engineering education depends on the development of new researchers, teachers, and scholars; therefore, the training of current graduate students is of particular interest. Preparing graduate students to become members of the field of engineering education depends greatly on the socialization experiences they participate in. Learning about the research in a situated context [5,6] and within a community of practice has been shown to be successful [7].

There have been a number of efforts that have this goal of socialization of graduate students into the field of engineering education in mind. For example, conferences such as the American Society for Engineering Education (ASEE) provide a venue where people doing engineering education research can come together and talk about this type of work in one common place. The development of new scholars in this field has been supported, as evidenced by efforts such as the ASEE Student Division and Graduate Engineering Education Consortium for Students (GEECS)[8]. Furthermore, in the last couple decades, new departments with degree programs in engineering education have been developed, such as at Purdue University and Virginia Tech, among others[9,10]. This paper discusses the effort made by the University of Washington, which provided a short term blended experience for graduate students that spanned universities, disciplines, and familiarity with the field of engineering education.

Background: The Engineering Education Pioneers and Trajectories of Impact Project

The development of engineering education as a field is like many new fields, and a lot of that history has remained within the minds of the pioneers who were a part of the development and growth of the field. The Engineering Education Pioneers and Trajectories of Impact Project has two main goals, of which the first is to document and expose the stories and history of the development of engineering education research, and the second is to catalyze and study the development of future scholars in the field of engineering education. The first goal is accomplished through interviews and analysis of pioneers which were conducted by graduate students across the country. The second goal is partially described and understood through this paper: the analysis of the impact of project participation on the graduate students.

Graduate students were chosen to conduct the interviews with the engineering education pioneers for multiple reasons. They would interview and author profiles of the pioneers, deriving a distinct set of immediate and long-term benefits, including learning about how these pioneers contributed to transformation in engineering education and how their stories can inform and support the students' development as future pioneers. Blended experiences such as this one, where the graduate students were able to engage in an engineering education research project and connect with others in the field, can be very beneficial in preparing future scholars.

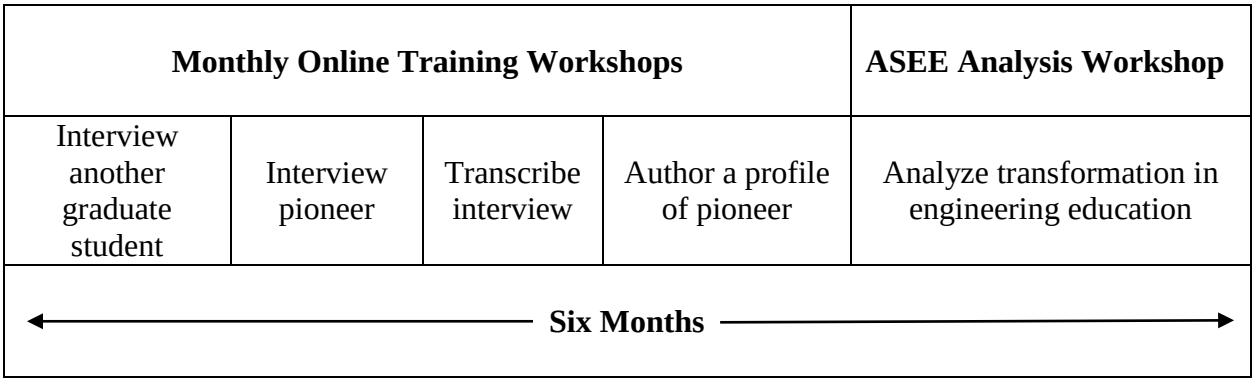
The blended experience was carefully designed for the graduate students to aid their development as engineering education scholars. The graduate students had the opportunity to learn about research activities through online workshops and then immediately implement these ideas. First, the graduate students practiced interviewing and using the protocol by practicing with another graduate student. Next they transcribed and analyzed the interview with their pioneer, and finally, the graduate students authored a profile about their pioneer. Literature on informal science education suggests that informal research experiences can impact a student's excitement, curiosity, and identity[11]. This project in particular was structured so that graduate

students were exposed to a distributed research project that presented various methodological considerations. The project was organized and scaffolded in a way that would introduce new researchers to engineering education research that would make them comfortable in the field[12]. The following potential results of participation were marketed to graduate students in an email:

- Belonging. Increase your sense of belonging to the engineering education community;
- Personal reflection. Engage in reflection on your own trajectories, plans, and expectations;
- Curiosity. Become increasingly curious about issues of transformation in engineering education;
- Strategies. Gain immediate insight into how to impact transformation;
- Methodological and pedagogical ideas. Gain insights into both research methodology and innovative pedagogy.

The activities and timeline for the graduate students involved is provided in Figure 1, which shows that the blended experience consisted of online training workshops, independent research activities, and an analysis workshop at ASEE. The monthly online training workshops were run using Adobe Connect and were based on the pedagogical approach of active learning – some lecture, group discussion, and small group breakout sessions. The research team also provided a pre- and post-workshop survey to the graduate students as a venue to reflect and to provide feedback. What is not shown in the figure is how the activities and tasks provided an arena for networking and connecting with others, which contributed a great deal to the socialization experience of the graduate students.

Figure 1: Timeline and Research Activities



In line with the project goal of studying the development of the graduate students, the research team explored the individual experiences of the graduate student participants. Thus, the analysis and discussion was informed by the following research question:

How do the individual graduate students who interviewed pioneers in the field describe their experiences?

This study sought to increase the engineering education community's understanding of how participation in this project contributed to the professional development of its participants. The

results of this study have the potential to contribute to the engineering education community's understanding of graduate student experiences and how to design blended experiences that contribute to their research skills and professional development.

Methods

This paper describes the experiences of the graduate student participants to better understand blended experiences in engineering education during graduate school. This section contains descriptions of the participants and the tasks and activities they participated in. The qualitative research approach that was taken in order to understand their individual experiences is described.

Participants: Thirty-nine graduate students participated in the project from more than twenty institutions across the country in various departments, including one international graduate student. Some of these graduate students were experienced researchers who were well integrated into the field and some were less familiar with engineering education research and came from a traditional engineering department or education department. Graduate students were recruited to participate in this study through national engineering education email lists. Graduate students of all levels of interviewing and research experience were invited to apply to participate in the research project.

The graduate student participants came from 22 different universities in more than 10 departments. The institutions represented were the following: University of California (Santa Barbara), Tufts University, Arizona State University, Purdue University, Georgia Tech, University of North Carolina (Wilmington), Virginia Tech, University of Michigan, Harvard University, University of Colorado (Boulder), Utah State University, University of Illinois (Urbana-Champaign), Universiti Teknologi Malaysia, Dalhousie University, Embry-Riddle Aeronautical University, Texas A&M University, Stanford University, Colorado School of Mines, Syracuse University, University of Pittsburg, Rensselaer Polytechnic Institute, and University of North Carolina (Chapel Hill). Furthermore, the departments the participants were enrolled in were: Electrical Engineering, Engineering Education, Engineering & Computing Systems, Aerospace Engineering, Education Leadership, Biomedical Engineering, Architectural Engineering, Mechanical Engineering, Materials Science and Engineering, Industrial and Enterprise Systems Engineering, Chemical and Biological Engineering, Civil Engineering, and Science and Technology Studies.

Thirty of the 39 total graduate student project participants responded to the professional development survey, which was administered after the ASEE analysis workshop. The 28 graduate students who responded to the open ended questions serve as the data for this analysis. About two-thirds of the participants were female, and a third identified as belonging to an underrepresented racial or ethnic group. In the data, each participant was assigned a number, as the data was collected anonymously.

The prior experience with engineering education work of the participants spanned a number of years, as can be seen in Table 1. Although this diverse group of graduate students had many different backgrounds, skills sets, interests and abilities, they all participated in the same online training workshops and activities. The experience with conducting and analyzing interviews

ranged from 1-2 to more than 12. Nine of the graduate student participants had participated in a pilot program and were invited to participate again. Although a few participants that had been involved in a pilot program as graduate students were no longer graduate students at the time of this project, all participants will be referred to as graduate students for consistency.

Table 1: Background information about the graduate student participants

(# of interviews)	Experience **conducting** interviews (# of graduate students)	Experience **analyzing** interviews (# of graduate students)
1-2	8	9
3-6	9	6
7-12	6	8
more than 12	17	17

Professional Development Survey: The professional development survey was sent out to all graduate student participants a week after the analysis workshop at ASEE. The survey consisted of a series of rating-scale and open-ended questions designed to solicit the participant's thoughts and opinions about their experience. Appendix A contains the survey questions. Although the survey collected quantitative data (the rating-scale questions), this paper only examines the qualitative responses to the open-ended questions.

The Codebook: The research team's exploratory analysis resulted in four experience descriptions. After the first read through of the data and initial coding, it was determined that most participants had a good experience. A smaller number of participants described their experience as something distinctly different than good, and these participants were coded as having either an exceptionally good experience, a mundane experience, or even a disappointing experience.

Making Sense of the Data: The first author organized the data by participant number, and then read through each participants responses individually. Remarks that were about the experience of participation were coded using thematic analysis.[13] After coding each participant's survey responses, the first author met with the other two research team members who looked through the participant responses for cross-checking and getting a sense of how they were being coded. After this meeting, the first author used a clean set of data to re-code all 28 participant's survey responses, and then cross checking against the first set to check for consistency and to confirm initial interpretations of the data.

Each participant's open-ended survey responses were examined individually. While some participants might have described one aspect of their experience as good and another as disappointing, each participant was given a final experience descriptor that best represented their participation experiences as a whole.

Results

The responses to the open-ended survey questions were coded into four experience descriptors: 1. Exceptionally good experience: "I realized that I myself am on the path to being a pioneer," 2.

Good experience: “This project really confirmed that I enjoy the work I do,” 3. Mundane experience: " I didn't feel that I was a big part of the research,” and 4. Disappointing experience: "I wouldn't say I learned something significant during this study.”

Table 2 below summarizes the findings in response to the research question: how do the individual graduate students who interviewed pioneers in the field describe their experience? The experience descriptors were given a representative quote to demonstrate the general sense of that described experience. In addition, some common descriptive words and phrases that were used in responses to the survey questions are included in Table 2. Finally, the table summarizes the distribution of experience among the 28 graduate students who responded to the open-ended survey questions.

Table 2: Summary of graduate student experience descriptions

Experience Descriptor	**Common Experience Descriptors used by Participants**	**# of Participants**
Exceptionally Good: “I realized that I myself am on the path to being a pioneer”	finally; fabulous; honored; excellent; awesome; invaluable; meaningful	6
Good: “This project really confirmed that I enjoy the work I do”	refreshing; helpful; comfortable; enjoyed; successful; excited; great	15
Mundane: “I didn't feel that I was a big part of the research”	repetitive; drawn out; difficult to relate; bored; pleased; not sure	4
Disappointing: "I wouldn't say I learned something significant during this study"	frustrating; never felt connected; terribly ineffective; much left to be desired; tedious; lackluster; dreaded	3

Exceptionally Good Experience: “I realized that I myself am on the path to being a pioneer”
Six participants were coded as having an exceptional experience. These participants almost all only had positive things to say about their participation, and often included explanation points to emphasize their enthusiasm. Even when a participant made a negative comment, an understanding for the context of the experience was acknowledged and a suggestion for improvement was made. Graduate students with exceptionally good experiences reported enjoyment regarding meeting their pioneer and the other students; discussed feelings of belonging to the engineering education community; described a change in perception of the online workshops; and spoke about their development as new pioneers.

Meeting their pioneer and the other graduate students in the project was a highlight for graduate students who had an exceptionally good experience. These graduate students frequently elaborated extensively, for example:

> “I’m not sure I would have ever had the opportunity to meet and talk with my pioneer if it weren’t for this experience. And he was wonderful to talk to! I think I

> realized through this experience that I shouldn't be intimidated to go speak to people that I read about in articles. If approached in a respectful was, the interactions with these "big name people" can be amazing!" (Participant 21, Question 5)

> "I really enjoyed meeting other graduate students. I feel that I finally have a research cohort I'm able to connect with beyond my campus." (Participant 11, Question 13)

Along with this idea of meeting others, responses related to feelings of belonging were also a prominent aspect of the graduate student's exceptionally good experiences. These feelings of belonging related to the community as a whole and the community of graduate students, such as:

> "This project made me feel as though I'm (finally) a part of the Engineering Education Community." (Participant 11, Question 2)

> "Networking with grad students and pioneers was essential. It gave me a better sense of belonging, a better sense of how my research compares to others, and ultimately motivated me to continue on my path." (Participant 13, Question 18)

> "It was an amazing experience, especially for me as a graduate student at a school where very few people are interested in engineering education. It made me more aware of what is out there, gave me the opportunity to participate in a great research project, and helped me feel less lonely professionally. Thank you! (Participant 23, Question 18)

One participant described how she felt about the online workshops and how she changed her perception from negative to positive about the workshops as a result of the project:

> "I dreaded the workshops before we started. I thought "These are going to be boring and terrible." But they were the exact opposite! The scaffolded approach that was used for this project was excellent." (Participant 21, Question 16)

Similarly, another participant was surprised to see the success of the online pedagogy.

> "It was invaluable to see a successful project that made me feel important that was all online and via distance tools. It gave me more confidence in what is possible." (Participant 22, Question 17)

One of the goals of the project at large was to study the development of emerging pioneers, i.e. the graduate students. A few participants spoke to this development specifically, in very positive ways:

> "I realized that I myself am on the path to being a pioneer. I realized this when one of the pioneers sought me out. That was a very cool event because here I am hoping to introduce myself and the pioneer was hoping to do the same. I truly feel like I am a big part of this community." (Participant 9, Question 7)

> "This project made me excited to be a part of a growing community, where becoming a technical, expert engineering is not a 'given' career path. Instead, like the Pioneers, I hope to diversify my career and participate in cross-disciplinary educational experiences. I'm also excited (and honored) to be considered a future pioneer!" (Participant 11, Question 5)

The exceptionally good experiences described above included strong positive language from the graduate students as they reflected on the project. Most students, however, described their experience as good, with some positive language and expressed how this experience was meaningful to them.

Good Experience: "This project really confirmed that I enjoy the work I do"
Graduate students who described their experience as good seemed to find a lot of meaning in the project. Fifteen graduate students who participated in this project seemed to have had a good experience. Some of these graduate students responded consistently with positive remarks about their experience, and others responded with some exceptional comments about certain aspects and more negative comments about other aspects. As with the students who described their experience as exceptional, these students also enjoyed meeting their pioneer and other project participants. Feelings of belonging to the community and descriptions of how the project was reaffirming were also described by these graduate students. An example of a graduate student that described some aspects very positively but other aspects negatively is also described. In comparison with the students who had exceptional experiences, not as much enthusiasm was found in the written responses for the graduate students who had good experiences.

Most graduate students who had good experiences said something positive about meeting their pioneer and meeting the other graduate students, such as:

> "I think the most significant portion of the experience was the interaction with other people at my level. There are a lot of aspiring researchers, and we are all struggling to get to the next level, but we have a lot to share in helping each other make the journey." (Participant 4, Question 2)

> "I expected to grow as an individual in relative isolation, but instead the biggest effect was to feel mort connect to others (rather than develop my individual skills)." (Participant 24, Question 4)

Many of these graduate students also discussed feelings of belonging to the engineering education community, which was often attributed to their opportunity for participation at the ASEE annual conference in Indianapolis.

> "It is unique to be a part of a field that is young enough that the primary leaders are still around. The inspiration of their stories and the chance to meet so many of them at ASEE was the most important part of the experience for me." (Participant 6, Question 18)

> "I enjoyed getting to interact with the pioneers and the fellow research team at ASEE." (Participant 10, Question 2)

> "Having shared experiences with others in the field, building personal relationships with people I look forward to seeing again at FIE and ASEE, really helps to feel that I am "belonging" and getting somewhere in my career path." (Participant 18, Question 13)

Some graduate students found the project reaffirming of current interests and goals related to engineering education, such as:

> "I have been trying to decide whether to stay within the field or go into industry, and this project really confirmed that I enjoy the work that I do, and would have a place of likeminded people here." (Participant 3, Question 18)

> "Reflecting on the process of participation in the project through these survey and on my own to consider how I want to navigate the field of engineering education, if the change categories ring true to me and, as a result, how I perceive my own personal capacity to enact change in engineering culture." (Participant 18, Question 18)

A couple of participants had extremely varied responses that included both very positive and very negative remarks. For example, participant 25 was described as having a good experience, but had some exceptionally good aspects, such as:

> "I realized I can make a difference if I continue on this path. I can be like other pioneers and make a difference in my community." (Participant 25, Question 7).

But then when asked if there was anything else they would like to share with the research team, this participant said:

> "I was very disappointed to see that there were no pioneers in engineering education with a Latino background. I am not even sure I saw many African Americans or Native Americans. Are there really no pioneers with that cultural background? To some extent, it makes me think about what the future holds for minority students who really want to pursue a career in engineering. There is not representation, no role models, no one to go to. I really hope this changes with time." (Participant 15, Question 19)

Even though this second excerpt was negative, this graduate student was able to take away some very significant things from the experience, but still had some negative aspects within the experience. It truly appears that this graduate student has new aspirations to create change as a result of this experience.

The graduate students who had good experiences seemed to have a positive experience that was meaningful to them. Graduate students that did not make any significant connections to the

research or group were coded as having a mundane experience, which was described with fewer positive words and phrases and included a number of negative comments as well.

Mundane Experience: "I didn't feel that I was a big part of the research"
Some participants that were coded as having a mundane experience had some negative comments. These four graduate students often sounded hesitant about their learning and the value of the project. Sometimes, a participant would qualify their learning as positive with a negative aspect, or explained why their particular experience was negative. These graduate students spoke hesitantly about their experience in general and discussed their frustrations with the experience.

The graduate students who seemed to have a mundane experience spoke hesitantly about the connections between this project and any impact it had on them. For example:

> "I'm still not sure how to effect change." (Participant 7, Question 12)

> "Project was neat opportunity to explore engineering education, however it was a bit overwhelming for those without an engineering education background." (Participant 17, Question 19)

> "I was already planning on working within engineering education, so I don't know how much I shifted." (Participant 26, Question 12)

In response to what was frustrating about the project, one participant responded with a remark that describes their overall experience well:

> "I didn't feel that I was a big part of the research because I never seemed to grasp some of the overall goals." (Participant 28, Question 6)

In comparison with the graduate students who were coded as having good experiences, the graduate students who were coded as having a mundane experience seemed to gain some valuable skills but didn't seem to have much personal growth. Finally, some graduate students discussed their experience in a mostly negative sense, and seemed to be disappointed overall with the project experience.

Disappointing Experience: "I wouldn't say I learned something significant during this study"
Graduate students who described their experience in this negative way often had short responses to the survey questions. Although their experiences seemed to be mostly disappointing, most of these graduate students included a few positive aspects regarding their experience. These three graduate students felt strongly negative in regards to the online workshops, and were specifically disappointed in the focus the project placed on the engineering education system.

In response to their experience with the online workshops, two participants described them negatively:

> "I was not a fan of the online sessions at all; I actually dreaded having to connect to them and feel like many others felt the same way." (Participant 1, Question 16).

Another participant described the online workshops as "terribly ineffective" (Participant 5, Question 16).

In regards to being asked what was significant about being a part of a project that exposed them to issues and opportunities in the engineering education system, two participants reacted very negatively:

> "Being a part of this project and attending the conference actually made me less optimistic about the engineering education system." (Participant 1, Question 14)

> "I found it frustrating that there was so much emphasis about what was wrong with the system rather than discussing how to change it. It felt like group therapy at times." (Participant 15, Question 14)

While only three participants seemed to have disappointing experiences, it is important to note that each of them also had something positive to say, such as "It was inspiring to hear the pioneers tell their story" (Participant 15, Question 3).

The findings suggest that the graduate students experienced their participations in this project in four ways: 1. Exceptionally good, 2. Good, 3. Mundane, and 4. Disappointing. Overall, graduate student's descriptions of their experience were quite positive in nature. It is important to note that almost every graduate student had at least one positive comment about the project and most had a number of positive comments about the project. However, while this project was seeking to understand the experiences of the participants on a whole, better understanding these negative experiences could lead to better blended experiences in the future.

Discussion and Implications

The graduate students who participated in this blended experience all had something positive to say about their participation. Some graduate students spoke highly about all aspects, some offered suggestions for improvement for the aspects they didn't like, some didn't gain much from their participation, and very few made more negative comments than positive. These various reflections about the blended experience suggest that even though everyone didn't walk away with an entirely positive experience, the experience on a whole was very positive and benefits the socialization efforts for graduate students exploring engineering education research and the community.

While four experience descriptors are presented here, the researchers want to emphasize that this analysis is offered to better understand the possible socialization experiences of the graduate students and does not claim to be a complete and whole representation. A limitation of this work is that it used a relatively modest set of responses from the participants which might not have done justice to their full experiences. However, drawing on inspiration from a phenomenological approach, the experiences of the graduate students were characterized by the nature of their experiences and allowed for us to honor the different graduate student experiences. The mundane and disappointing categories in particular provide an opportunity for us as researchers to determine how the project may have been unsatisfying for some and to attempt to provide an understanding for how to make better blended experiences in the future.

When invited to apply to participate, students were made aware of five possible aspects of their participation: having an increased sense of belonging, having a chance to reflect on personal trajectories, having an increased sense of curiosity, gaining insight for transformation strategies, and gaining insight about methodological and pedagogical techniques. Within the open-ended survey responses that were analyzed, belonging and personal trajectories were most prevalent. The other three aspects of the experience were not as pronounced or directly discussed in the open-ended responses. This may be because they may not have been the most significant take-aways for the graduate students and therefore not discussed in detail or these survey questions did not elicit responses to such ideas.

Even though there were only three participants that were coded as having a disappointing experience, it is important to recognize that every graduate student will have a different experience, which is often dependent on their prior knowledge, experiences, and expectations. However, much can be gained from understanding these negative experiences.

The variation in response to certain aspects of the project, such as the online workshops, was large, ranging from some graduate students absolutely loving them to others hating them. It is likely that each graduate student had different expectations and wanted to gain different skills as a result of the experience.

The online workshops were run using Adobe Connect. Some challenges with online workshops in general is the lack of visual feedback from participants as well as no advanced version for the students who were already familiar with research techniques. In the workshops for this project, the students were placed into small breakout groups as a way to encourage more interaction. As a way to promote reflection and to improve the sessions throughout the project, feedback surveys were sent out to the graduate students. Overall, what was most challenging was that the background of the graduate students was too varied to provide appropriate material and activities for every level. The online workshops were, therefore, designed to ensure no student was left behind. Making this pedagogical decision clear to the graduate students in future blended experiences would likely be beneficial for everyone involved.

Since most participants had exceptionally good and good experiences, it is evident that this type of blended experience is valuable to graduate students in general. It is interesting that all the graduate students went through the same experiences, yet each took something individual and appropriate for them away from the experience. While these differences cannot be completely eliminated, graduate students in future blended experiences might benefit from the knowledge that such experiences will resonate differently for each of them. However, it is also important to recognize that this variation is not necessarily a bad thing and such experiences can still contribute to positive socialization opportunities.

The professional development survey administered by the research team sought to understand how the interviewing experience helped the graduate students make sense of graduate school and their place within the field of engineering education. Additionally, it was hoped that the act of completing the professional development survey provided the time and venue for the graduate students to reflect upon the experience.

Conclusion

Graduate students and their training and development as scholars in engineering education is of particular interest as an interdisciplinary arena for socialization. This paper examined a distinct blended experience that provided personal and professional development experiences to the graduate student participants. It is clear that socialization in graduate school is critical and necessary to success, and this paper shows that an organized, multi-dimensional project can have diverse impact on diverse individuals. The differences in take aways from the same experience demonstrate that each graduate student, no matter what level of experience or background, can come together to learn about themselves, the community, research, and professional skills in the way that is appropriate and valuable for them.

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References

1. Austin, A. E. Preparing the next generation of faculty: Graduate school as socialization to the academic career. *J. Higher Educ.* **73,** 94–122 (2002).

2. Cox, M. F. *et al.* Attributes for success for engineering PhDs: Perspectives from academia and industry. in *Proc. 2011 Am. Soc. Eng. Educ. Annu. Conf. Expo.* (2011).

3. Maura Borrego & Lynita K. Newswander. Definitions of Interdisciplinary Research: Toward Graduate-Level Interdisciplinary Learning Outcomes. *Rev. High. Educ.* **34,** 61–84 (2010).

4. Newswander, L. K. & Borrego, M. Engagement in two interdisciplinary graduate programs. *High. Educ.* **58,** 551–562 (2009).

5. Rogoff, B. in *Everyday Cogn. Its Dev. Soc. Context* (Rogoff, B. & Lave, J.) (Harvard University Press, 1984).

6. Lave, J. in *Perspect. Soc. Shar. Cogn.* (Resnick, L. B., Levine, J. M. & Teasley, S. D.) 63–82 (American Psychological Assossiation, 1991).

7. Adams, R. *et al.* A community of practice approach to becoming an engineering education re- search professional. in *121st ASEE Annu. Conf. Expo.* (2014).

8. Sattler, B., Carberry, A. R. & Thomas, L. D. Graduate student peer mentoring: A means for creating an engineering education reseracg community. in *Am. Soc. Eng. Educ.* (2012).

9. Jesiek, B. K., Newswander, L. K. & Borrego, M. Engineering Education Research: Discipline, Community, or Field? *J. Eng. Educ.* (2009).

10. Katehi, L. *et al.* Development of Graduate Programs in Engineering Education. in *Proc. 2004 Am. Soc. Eng. Educ.* (2004).

11. Bell, P., Lewenstein, B., Shouse, A. W. & Feder, M. a. *Learning science in informal environments: People, places, and pursuits*. *Learn. Sci. Informal Environ. People, Places, Purs.* (2009). at <https://books.google.com/books?hl=en&lr=&id=EzP737BHvrUC&oi=fnd&pg=PP1&dq=Learning+Science+in+Informal+Environments:+&ots=7vcj5RgSIO&sig=-Aqdm300kkrXbhwvYCcT30mhJQM>

12. Borrego, M. Conceptual Difficulties Experienced by Trained Engineers Learning Educational Research Methods. *J. Eng. Educ.* 91–102 (2007).

13. Creswell, J. W. *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research*. (2012).

14. Boden, D., Borrego, M. & Newswander, L. K. Student socialization in interdisciplinary doctoral education. *High. Educ.* **62,** 741–755 (2011).

Appendix A

Professional Development Survey Question Prompts. Quantitative prompts, in gray, not fully represented. (Question numbers here are referred to in quotes)

PD Survey Sections	Question Number	Question
General Experience Questions		Set of rating scale questions. Participation in this project has helped me… - Learn something new - Identify and overcome misconceptions - Become more aware of key issues - Gain skills - Increase my sense of belonging - Increase my sense of what is important to me - Validate my sense of what is important to me - Increase my awareness of my skills - Increase my sense of my skills relative to the skills of others in this area - Become more curious - Become more likely to use something learned from this project in future projects - Become more confident - Increase my sense of what I am capable of accomplishing
	1	Use the space below if there is anything else you would like to add to your above responses.
	2	What was significant to you about your participation in this project?
	3	What are your key take-aways from this experience?
	4	What surprised you about your participation in this project?
	5	What excited you about your participation in this project?
	6	What frustrated you about your participation in this project?
	7	What was an "aha" moment from your participation in this project?
Research		Set of rating scale questions relating to research
	8	Use the space below if there is anything else you would like to add to your above responses.
	9	What was significant to you about your experience learning about and conducting research?
Change		Set of rating scale questions relating to change
	10	Use the space below if there is anything else you would like to add to your above responses.
	11	What was significant to you about being part of a project that was examining issues about how to effect change in engineering education?

Engineering Education System		Set of rating scale questions relating to the engineering education system
	12	Use the space below if there is anything else you would like to add to your above responses.
	13	Some Pioneer Interviewers commented that project participation was an opportunity to meet other graduate students and build a network within engineering education. To what extent does this characterize your experience? Please explain.
	14	What was significant to you about your experience (being part of a project) in which you were exposed to issues and opportunities related to the engineering education system?
Pedagogy		Set of rating scale questions relating to pedagogy
	15	Use the space below if there is anything else you would like to add to your above responses.
	16	Would you use the pedagogies employed in this project? Would you recommend the pedagogies employed in it to others? Please explain.
	17	What was significant to you about this project in terms of pedagogy?
Concluding Remarks	18	What was most significant to you about your participation in this project?
	19	Use the space below if there is anything else you would like to share with us.
	20	Why did you want to participate in this project?