A community of practice approach to becoming an engineering education research professional

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A Community of Practice Approach to Becoming an Engineering Education Research Professional

Introduction

Engineering education research is an emerging profession that brings together methods, tools, and concepts from many disciplines\textsuperscript{1-4}. As future professionals, entering graduate students are brought into new bodies of knowledge, methods, language, and concepts that may require significant shifts in how they think about scholarly professional work\textsuperscript{1, 5-10}. Similarly, in more established disciplines, graduate students are brought into relatively defined and stable ideas about research (even though new knowledge is constantly emerging) that may be so tacit and deeply embedded in practice that it can be difficult to gain access to and learn about the principles that guide professional work. Having opportunities to discuss and interact with faculty on their research publications and hear the behind-the-scenes “backstory” of the decisions that motivated the research and shaped the research design can ease the transition into new modes of inquiry. It can also help students understand the landscape of a professional community and envision future roles within that profession.

Future engineering education professionals should also be able to translate their own research into practice, what Boyer refers to as a scholarship of application\textsuperscript{11}, and interpret other research into implications for their own scholarly work (research, teaching, and service). In this way, they are becoming both a producer and a consumer of knowledge. This idea of articulating implications of research for broader use plays an important role in strategies for transforming engineering education\textsuperscript{12}. For example, the idea of using evidence to improve education practice is a central change strategy underlying discipline-based education research\textsuperscript{13} and efforts to “close the innovation to practice” gap\textsuperscript{14}. Having access to the backstories of how implications are represented in scholarly work can provide useful insight into strategies for translating research into practice and transforming engineering education.

For graduate education, the community of practice framework\textsuperscript{15-16} can be a useful model for designing learning experiences that bring new people into a profession and support their development of professional ways of thinking, acting, and being. The community of practice framework is a form of cognitive apprenticeship in which experts (old-timers) model their approaches to novices (newcomers), such that newcomers can build their own mental models on what is required to become a professional\textsuperscript{17-18}. This makes visible the how, when, and what that shapes the ways old-timers approach everyday professional work as well as what is involved in being and becoming a member of that community of practice. It also helps newcomers see that learning is about growth and that making mistakes is a natural part of the learning process – getting beyond naïve beliefs about “good performance” as a smooth and easy process. Similarly, frameworks on attributes of professional competencies and professional work can provide guidance on the nature of knowledge future professionals need to develop.
In this “best practices” paper we describe a one credit 50-minute course, *Research in Engineering Education*, in which research faculty in the School of Engineering Education (ENE) have 20 minutes each to share a behind-the-scenes backstory of one of their own research publications (including works-in-progress) – the motivation behind the study, the theories that guided the study, the collaboration experience, the process of building and substantiating findings, the choices made to communicate the impact of the work, and the various failures and false starts experienced over the study timeline. Faculty presenters were also encouraged to share their mentoring philosophies and approaches to apprenticing protégés into the profession. For each faculty presenter, students read the provided publication, posted a reflection using the discussion board tool on Blackboard Vista™, and then participated in an open and informal discussion of the behind-the-scene story of scholarly research in engineering education.

As a best practices paper, we describe the key elements of the course including the theories that shaped the learning environment and learning objectives, provide evidence of student learning outcomes, and suggest ways for using or improving upon this model. Course outcomes are described through the students’ voice as co-authors of this paper. The students used their final reflection assignment to collectively identify their: (1) initial perspectives on engineering education research and the influence of these perspectives on their experience in the course, (2) general “take aways” they believe will have a lasting impact, (3) evolving perspectives on what it means to become an engineering education professional and how they are envisioning themselves as future professionals, (4) characteristics of the course that contributed to their learning, and (5) advice on ways others interested in facilitating the development of professionals could use or improve upon the experience. While this is only the first offering of the course, our experience suggests that this model is a low investment but high impact approach for preparing future professionals.

**Course Overview: Objectives, Structure, Activities**

The central activity for this one credit course, which meets weekly for 50-minutes, is faculty storytelling: sharing the behind-the-scenes story of a work-in-progress or published peer-reviewed research publication. The purpose is for students to be able to:

1. Identify members of the program faculty and describe their research interests and mentoring philosophies
2. Generate questions to learn about the practice of engineering education research
3. Propose connections between research methodologies and research questions
4. Propose connections between engineering education research and practice (policy, curriculum, learning environments, workforce)
5. Consider how faculty interests and mentoring approaches relate to personal interests and mentoring needs

Students take this course during their first term of an engineering education doctoral program in combination with another one credit, 50-minute course that serves as an introduction to the program and field. In addition to the faculty research papers, students read and discussed a report on strategies for impacting engineering education and a
Each week, two program faculty select an example research publication from their own work, lead a 20-minute classroom discussion about the paper, and share the behind-the-scenes story about their own research (e.g., the motivation and significance of the study, how they connected research to practice or policy, and any research, publication, and collaboration decisions that shaped the work). Students read the two faculty papers (which were available on Blackboard Vista™), post before class a 400 maximum word count reflection essay using the Discussion Board tool on Blackboard Vista™, and participate during class in an open discussion. Students were provided minimal guidance, but were provided some scaffolding to help them develop as reflective practitioners. They were simply asked to (1) generate some "behind-the-scenes" questions they wanted to ask the presenting faculty (e.g., what really happened, what were the pitfalls, what were your motivations, what did you hope others would get out of this, etc.), (2) comment on the papers in terms of something that caught their attention, made them think, or related to their own experience, and (3) share any observations or ideas about the implications of the research. Students were encouraged to read and comment on their peers’ postings. In addition to the weekly reflection posts and active class participation, students submit an end-of-course reflection story, which became the data for the outcomes analysis presented in this paper.

Since students were seeking advisors and future committee members, they were asked to familiarize themselves with program faculty using a high quality research report generated by the program. Faculty were encouraged to be open to sharing works in progress or review, which some did. They were asked to avoid a “recruitment pitch” style and instead focus on community building and sharing the “real story” of their scholarly work and any insights about translating the work into practice. Faculty were also encouraged to share mentoring and advising philosophies. Through this storytelling process, students should have opportunities to map out faculty research areas (and to some extent the field as a whole), identify the various communities and organizations associated with the profession, identify aspects of the practice of engineering education research including elements of scholarly inquiry and dissemination, find out about different approaches to advising students, and gain insight into ways to connect research and practice.

The course evaluations suggest that the students found the course engaging, useful, and enjoyable. Overall, the students rated the course as 4.6 and the instructor as 4.8 out of a 5.0 scale. Students also rated the course highly in terms of feeling that their questions or comments would be well respected (4.6 out of 5.0) and that class sessions were interesting and engaging (4.8 out of 5.0). Their responses to the open-ended written comment box suggests that they appreciated the learning environment in terms of having ownership of the discussions and being able to ask whatever they liked, the pace and salience of the topics, the open structure of the class, thinking of questions to ask the professors, and how the backstory discussion increased the respect and approachability of
the faculty from a “student-point-of-view”. One student suggested using a timer so that each professor has the same amount of time.

In the following sections we provide the rationale for the course design, grounding it in theoretical frameworks and prior research on engineering education researcher pathways. We also provide an in-depth analysis of student learning outcomes and discuss how these outcomes relate to course learning objectives.

**The Course: Theoretical Grounding**

Decisions about the course goals and structure were guided by prior research on becoming an engineering education professional and four theoretical frameworks: communities of practice, learning to become a professional, storytelling as a mechanism for situated learning, and attributes of professional work. The following paragraphs provide an overview of these ideas and how they shaped the course design – the learning objectives and the learning environment. This provides a rationale for establishing the course as a model based on best practices.

*Description and explanation of learning objectives*

The central idea of the course is to help graduate students become future professionals. Professional practices are cultivated and sustained either explicitly or implicitly within communities of practice\(^{16}\). As such, the notion of legitimate peripheral participation\(^ {15}\) provides a useful framework for understanding the experiences of graduate students (as future professionals) as they enter, navigate, and work in a new field of research. The community of practice framework is a form of cognitive apprenticeship in which experts (old-timers) model their approaches to novices (newcomers), such that newcomers can build their own mental models on what is required to become a professional\(^ {17-18}\). This makes visible the how, when, what, and why that shapes being and becoming a member of a community of practice (see Table 1): a commitment to a domain of interest, building relationships through community interactions, and shared repertoires of practice\(^ {16}\).

<table>
<thead>
<tr>
<th>Attributes of a Community of Practice</th>
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<tr>
<td><strong>Commitment to a domain of interest</strong></td>
<td>Every community of practice has “an identity defined by a shared domain of interest. Membership therefore implies a commitment to the domain, and therefore a shared competence that distinguishes members from other people.” (emphasis added)</td>
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<tr>
<td><strong>Build relationships through community interactions</strong></td>
<td>Communities of practice require interaction among group members (emphasis added): “In pursuing their interest in their domain, members <em>engage in joint activities and discussions, help each other, and share information. They build relationships that enable them to learn from each other.</em>”</td>
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<tr>
<td><strong>Shared repertoires of practice</strong></td>
<td>“Members of a community of practice are practitioners. They develop a shared repertoire of resources: experiences, stories, tools, ways of addressing recurring problems – in short a shared practice. This takes time and sustained interaction.” (emphasis added)</td>
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As shown in Table 1, commitment to a domain involves distinguishing one kind of profession or professional work from others. Frameworks that describe attributes of professions suggest characteristics of a “shared domain” – a culture of professional
service and obligation of service to others, an understanding of a scholarly or theoretical kind that is systematic and internally consistent, a domain of skilled performance, community sanction to exercise professional judgment under conditions of unavoidable uncertainty, and a professional community to monitor quality, codes of ethics, and aggregate knowledge\textsuperscript{21-22}. These frameworks also suggest examples of community interactions such as aggregating and sharing knowledge, and monitoring professional ethics and work quality.

In addition, frameworks that describe attributes of professional work suggest characteristics of a “shared repertoires of practice”. For example, Shavelson and Towne\textsuperscript{23} describe the basic principles of scientific education research: (1) posing significant questions that can be investigated empirically, (2) linking research to relevant theory, (3) using methods that permit direct investigation of the question, (4) replicating and generalizing across studies, providing a coherent and explicit chain of reasoning, and (6) disclosing research to encourage professional scrutiny and critique. Diamond and Adam\textsuperscript{24} further argue that significant questions should break new ground or have significance beyond the individual context, and dissemination should include a reflective critique that addresses the significance of the work, processes used, and what was learned.

Finally, the community of practice framework suggests that identity development should be explicitly included as a learning objective. In the community of practice framework, newcomers begin participating in an “apprentice” mode, allowing them to gradually increase their participation in ways deemed legitimate by the community, and as they are socialized into the new community\textsuperscript{25-26} their identification with the community evolves. As Lave and Wenger\textsuperscript{15} observe, “Moving toward full participation in practice involves not just a greater commitment of time, intensified effort, more and broader responsibilities within the community, and more difficult and risky tasks, but, more significantly, an increasing sense of identity as a master practitioner”(p. 111). Further, Dall’Alba\textsuperscript{27} argues that neglecting the ontological (“being”) dimensions of learning carries a risk of reinforcing a static, fixed view of expertise, rather than acknowledging variability in ways of experiencing and enacting practice and the associated potential of this variation for a renewal of practice. A focus on technical mastery can encourage narrow conceptualizations of what practice entails. In contrast, embracing variation and ambiguities in learning illustrate how becoming professionals is always open-ended and incomplete. In this way, knowing is enacted and embodied in and through our everyday practice as professionals: “Learning to become a professional involves not only what we know and can do, but also who we are (becoming). It involves the integration of knowing, acting, and being in the form of professional ways of being that unfold over time”\textsuperscript{27} (pp 34). This unfolding professional way of being gives meaning to the knowledge and skills being developed within professional practice, while also incorporating an understanding of the practice itself and who we are as professionals. Other research illustrates that ignoring the role of identity in learning has been associated with: challenges in transferring learning across contexts, restricting the identities aspiring professionals are invited to construct, and an inability to meet the demands of continuously shifting and interacting bodies of knowledge\textsuperscript{28}.
Table 2. Map of course learning objectives to theoretical frameworks.

<table>
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<tr>
<th>Course Learning Objectives</th>
<th>Theoretical Frameworks</th>
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<tr>
<td>1. Identify members of the program faculty and describe their research interests and mentoring philosophies</td>
<td>Community of practice: Shared domain</td>
</tr>
<tr>
<td>2. Generate questions to learn about the practice of engineering education research</td>
<td>Community of practice: Build relationships</td>
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<tr>
<td>3. Propose connections between research methodologies and research questions</td>
<td>Community of practice: Shared repertoires Attributes of professional work Principles of education research</td>
</tr>
<tr>
<td>4. Propose connections between engineering education research and practice (policy, curriculum, learning environments, workforce)</td>
<td>Community of practice: Shared repertoires Attributes of professional work Principles of education research</td>
</tr>
<tr>
<td>5. Consider how faculty interests and mentoring approaches relate to personal interests and mentoring needs</td>
<td>Community of practice: Identity as member Becoming a professional: Link knowing and being</td>
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Overall, these theoretical frameworks mapped out a high-level view of course learning objectives as awareness and commitment to a domain of interest, building relationships through community interactions, gaining awareness of shared repertoires of practice, and developing an evolving identity as a future practitioner. These map broadly to the learning objectives as shown in Table 2, which are more pragmatic, and illustrate why the dimensions of a community of practice (Table 1) were used to describe the course learning outcomes described later in this paper.

Description and explanation of the learning environment
Collectively, the frameworks that shaped the learning objectives emphasize (1) creating a safe environment for open dialogue and a culture of sharing private knowledge, (2) activities that support links between the epistemological and ontological aspects of learning, and (3) the need for learning from experience as theory and practice interact, which is done as part of a community of practice more so than in isolation. Sharing of narratives (e.g., storytelling) has a long tradition of use in education and psychology as a way to support learning and cognitive development, and is becoming a tradition in organizational settings as a way to inspire change, transformation, and innovation. It is also part of a much broader notion of the narrative paradigm or narrative rationality that holds that humans are essentially storytellers and that the world is a series of stories that people match to their beliefs and values. Sharing of narratives is thus a powerful way to communicate knowledge and its inherent tacit nature, moving beyond prescriptive accounts to provide rich descriptive information that can reveal situational and interaction effects.

From a community of practice perspective, narratives are effective tools for supporting participation in and development of a community of practice. Narratives (1) enable
Course activities were designed to scaffold a community of practice storytelling process from generating questions to asking questions, sharing stories, and reflecting on the storytelling experience. Prior research on experiences with becoming and engineering education researchers\textsuperscript{1,10,43-44} suggest that:

- Commitment to a shared domain of interest and sense of belonging may be supported through sharing motivations for becoming an engineering education researcher, personal experiences of impact and persistence in the face of challenges, and learning and collaboration strategies.

- Building relationships and community interactions may be supported through creating opportunities for diverse interactions that support deep discussion and personal connections, and sharing experiences with navigating the community and collaborating with others who may have different backgrounds and experiences.

- Shared repertoires of practice may be supported through sharing stories that reveal the nature of professional work – e.g., research decision-making, publication and representing findings to diverse audiences, collaboration and networking activities, strategies for linking research and practice, interdisciplinary practices with bridging communities or translating across disciplines, and epistemological and ontological assumptions embodied in these activities.

Finally, course assessments were integrated into the reflective practice activities, in particular the end-of-term reflective story. In the following section we describe student learning outcomes, using the communities of practice framework in Table 1 to organize evidence of course impact.

**Evidence of course outcomes and opportunities for improvement**
While the course was evaluated using standard course evaluation forms, the focus of this paper is on sharing course outcomes through the voices of the students - who are also co-authors of this paper. Because this was the first offering of the course, it was important to delve deeply into the learning experience and take a more open-ended approach to characterizing student learning outcomes as well as key features of the learning environment that contributed to student learning.

Data collection and analysis

Ten students enrolled in the course: seven females, three males, and one international student. Eight were part of the incoming PhD cohort, one was transitioning to our program from another college, and one was applying to the program for the fall. Some students were married with children, some had significant workforce experience (in engineering and software development), some had significant teaching experience (in K-12 and higher education), and some had significant experience working with underrepresented and disenfranchised groups. In their reflection stories, many of them shared that they wanted to improve quality and inclusivity in engineering education, and that they enjoyed learning, tinkering, exploring, and discovering new things. While their backgrounds influenced the questions they asked to the presenting faculty, as a group their questions were more alike than they were different. Some students even asked questions during discussions that other students brought up in the discussion board.

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<th>Table 3. End-of-term reflection story assignment.</th>
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<td>(1) My story: Your “take aways” will be influenced or shaped by who you are and the perspectives you brought to class. Provide a brief overview of “your perspective” at the beginning of class (geographical background, gender, age, work/school experience, prior research experience, level of comfort with connecting with faculty about their research, ideas or interests about engineering education research). How do you think this influenced or shaped the questions you wanted to ask? Influenced the ways you experienced this course or your willingness/desire to connect with faculty about research?</td>
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<tr>
<td>(2) General “take aways”: What were some of the most influential “backstory” moments, “insider knowledge”, or pieces of information that you remember – why did you remember them and in what ways might these have a lasting impact for you?</td>
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<tr>
<td>(3) Becoming an engineering education researcher: What has this experience helped you understand about what it means to become an engineering education professional (including ways to connect research and practice)? In what ways did the backstories help you imagine yourself as a future engineering education professional? Can you give an example of one way you think you have changed or grown from this experience, or challenged your prior ideas about what Engineering Education (ENE) would be like?</td>
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<tr>
<td>(4) Improvements or ways to sustain this experience: Looking back, what are some ways this experience could be better / more impactful? Looking forward, what are some ways this experience could be continued or expanded upon (including how it could be connected to other courses)? What advice would you give to someone who wanted to teach this kind of course about the “essence(s)” or “features” of this class that are necessary for this experience to have an impact?</td>
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The data for the analysis presented here is the students’ final reflection assignment, which occurred during the last two weeks of class. Supplementary data, not discussed in this paper that supported the reflection story assignment, included entries from the course
The reflection assignment was limited to 4 pages, single-spaced, and required students to respond to four questions and provide a detailed example to explain any key ideas. The four questions are provided above in Table 3 and were co-developed by the authors and based on considerable discussion and a review of the discussion board.

The analysis of the reflection assignments occurred during the last class meeting. Students worked mostly in pairs using a variation of the constant comparison method. First, each read through someone else’s reflection and then read it a second time. Underlying phrases they felt represented key ideas. When they read it the third and final time they gave a name to the underlined phrases such as “sense of belonging”, “diversity of research”, or “strategies for representing data for impact”. Then each idea was written on a single sticky note with a tick mark indicating the number of times this idea was present in the reflection paper as a whole. In pairs, students shared observations, clarified themes observed in each other’s work, and sorted the sticky notes into piles of similar, different, and interconnected ideas. This was then represented on a large 11 x 17 inch paper as an overall synthesis and shared with the class. The syntheses were combined and the results of this process are presented in the following section.

**Becoming an Engineering Education Professional**

Overall, students identified many ways in which the course helped them understand engineering education as a profession and feel a sense of belonging and identity with the profession. The following paragraphs present the themes students generated, organized into the three community of practice categories: commitment to a domain of interest, build relationships through community interactions, and shared repertoires of practice (see Table 3). For each category, related identity themes are also included. Corresponding excerpts from the data (i.e., quotes from the reflection assignment) are provided as evidence as well as providing information on the ways each theme was represented across multiple students.

**Commitment to a domain of interest**

Similar to the faculty, students had many motivations for entering the profession. Some motivations stemmed from dissatisfactions with current practice. For example, Paul worked as a teaching assistant with some of the faculty in the program and developed “a fondness over the years for the positive impact that I could see each semester in my students. I also saw deficiencies in the teaching for many of my own professors along the way, and began to wonder about why people who were such brilliant minds and respected researchers would not be as effective as teachers.” Some motivations stemmed from a desire to make an impact on the practice of education such as “help educators across the nation [Corey]” and on the practice of the profession such as “the lack of women in STEM [Trina]”. Some stemmed from a desire to be a boundary spanner, contributing “to the wide-boundary but nonetheless relevant body of knowledge in the engineering-education-entrepreneurial [community] [Michael]”.

Two motivations students observed across the faculty was a passion for engineering education research, and a willingness to be a trailblazer, comfortable with taking a non-traditional career path. As Molly notes, “I saw that the successful faculty (all) had one
common link – their passion in EER [engineering education research].” This was both inspiring and contributed to students’ sense of belonging.

“I am often an outcast in my thinking, approaching, and doing….To my surprise, this class offered a litany of other backstories with the same grit, gumption, and galvanizing examples I had originally thought were only part of my wayward way….Having a place to combine imagination with evolutionary concepts is a dream…. [this program and profession] is a place for passion and practice to truly unite, this is what and where I think the ENE platform - launching and affecting so many careers - will indirectly impact the entire global engineering education spectrum.” [Michael]

“I have discovered the passion and desire that my professors have and how they have had to continuously defend why this research was important. It is inspiring to me to hear from the faculty of this trail-blazing department.” [Natascha]

“After listening to the backstories, I was more confident that I belonged in ENE. My story was similar to others.” [Corey]

Students explained that this contributed to an increased confidence in choosing this program as a professional pathway. With this increased sense of belonging, students were able to map out research areas, envision the ways they can be a part of the community, and identify ways they can contribute to the profession.

“This class helped me solidify my decision to change programs at Purdue. I was very apprehensive that my goals did not align, and I would find that I did not belong…. This class helped me identify faculty who shared my interests… in a safe environment.” [Corey]

“And after hearing the back stories from the faculties I felt that my decision was right to join ENE research field. I felt more motivated and inspired towards my goal to become a good engineering education research professional after hearing the faculties’ passion about their research work.” [Neha]

“The stories of umpteen ENE faculty further cement the possibilities that with perseverance and poignancy, a personal platform is obtainable.” [Michael]

“By hearing backstories about the faculty’s research experiences, I was able to envision myself as a part of this community as a researcher. Not only was this the type of research I was interested in, but seeing more than the finished, peer-reviewed, multi-iterated final draft, gave me perspective and made this whole PhD process seem more possible.” [Natascha]

“One thing I did notice was that only few faculty are doing K-12 classroom research. Of those, even fewer have the same type of experiences that I do, and none were 7-12 biology teachers. While at first this made me feel like I really
didn’t belong, now I feel this gives me valuable insight that others do not have which can help me make my own research niche in the future.” [Corey]

A summary of learning outcomes associated with a commitment to a domain of interest is provided below in Table 4. These outcomes map to the following course learning objectives: (1) identify members of the program faculty and describe their research interests and mentoring philosophies, (2) consider how faculty interests and mentoring approaches relate to personal interests and mentoring needs, and (3) propose connections between engineering education research and practice such as a desire for impact.

Table 4. Attributes of commitment to a domain of interest

<table>
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<tr>
<th>Sense of belonging and identity with profession and community:</th>
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<tbody>
<tr>
<td>● Personal connection to faculty passion for engineering education research and engineering profession</td>
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<tr>
<td>● Personal connection to faculty willingness to be a trailblazer, combine imagination with evolutionary concepts</td>
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<tr>
<td>● Increased self-confidence in choosing program as professional pathway</td>
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<td>● Opportunity to provide a unique contribution</td>
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<th>Shared commitments and motivations</th>
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<tr>
<td>● Address dissatisfaction with current practices</td>
</tr>
<tr>
<td>● Desire for positive impact on students, practice of education, profession of engineering</td>
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<tr>
<td>● Be boundary spanner, linking across professions for integrative impact</td>
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Build relationships through community interactions

Students observed the importance of building relationships, collaborating, and networking in the faculty stories. Paul notes, “I learned about the networks that people build, how they select collaborators, how they deal with red tape.” Natascha shared how “[c]ollaboration and keeping in contact with people was mentioned as invaluable by many faculty during the class. She explains, that “[e]ngineering education is a small, welcoming field, and maintaining good collaborators will help to strengthen the research and rigor of engineering education research.” For Neha, the stories made her more aware of different community events and publishing venues. It also helped her understand the “importance of making connections and be active in professional community” and has motivated her to be more proactive with attending conferences and other community gatherings to “help in collaborations on research projects in the future.” For Trina, the faculty stories about partnering with people outside of the department has “encouraged me to start researching what other professors I had met were doing outside of the department related to my interests.”

Students also shared how the storytelling environment supported building relationships between students and faculty. Catherine shared that this was something she had never experienced in academia: “By asking questions of these different resources, we can get a sense of what it means to be a professional in the field. I did not expect to be so very welcomed and encompassed by the faculty community in the field—I have never had an academic experience like this and I found it invaluable.” As shown below, students explained how the back-stories helped make faculty more accessible and the program more welcoming. For some students this increased their self-confidence in general and in their ability to communicate with faculty on their research.
“One of the interesting benefits of learning the “back stories” of research publications is that I have even more respect for the faculty and their rigorous engineering research, but at the same time, I feel like the same faculty that I respect and revere are much more approachable now than they were at the beginning of the semester…” [Catherine]

“The faculty in engineering education are extremely open and welcoming, contributing to the sense of community, and want each of us to succeed and become future collaborators….By getting to know the faculty members through their stories, rather than only through their research papers, I am not nearly as intimidated about completing a PhD.” [Natascha]

“Through this experience I acquired self-confidence and ability to communicate with the faculties to discuss about their research work and various research opportunities.” [Neha]

The back-stories also helped students identify future mentors and advisors. Trina explains, “I am even more excited about becoming an EER because I am more aware now of what all the professor’s research and I know who to pull in depending on the topic I’m focusing on.” Similarly, Natascha notes that having the opportunity to meet professors in this setting gives first-year students “the opportunity to better understand what we are looking for in an advisor and as committee members.”

Another common theme in students’ reflections was increased awareness of the breadth and diversity of the community and how this creates opportunities for them to participate and contribute, which for some contributed to a greater sense of belonging. A benefit of this observation is that students perceived that the field is inclusive of different approaches, which may also contribute to a sense of belonging. As Natascha explains, “each faculty member demonstrated their own leadership and professional styles to us which shows that the field has many faces and values and encourages our own ideas.”

“Another main takeaway I got in general about engineering education research is that the field is still so wide open….So really, I can research pretty much anything as long as it’s at least somewhat related to ENE.” [Emilie]

“I might not otherwise have learned about the extent of research possibilities and the diversity of projects that fall into the field of engineering education without this course…the “backstories” showed me that here are many different approaches to researching the questions in engineering education. I had no idea that there were so many different methods and approaches to understanding a research question.” [Natascha]

“…gave me a lot of awareness about the cross disciplinary field of engineering education. These discussions helped me better understand the engineering education community practice….I observed that every faculty has their own style
A summary of learning outcomes associated with building relationships through community interactions is provided below in Table 5. These outcomes map to the following course learning objectives: (1) identify members of the program faculty and describe their research interests and mentoring philosophies, (2) consider how faculty interests and mentoring approaches relate to personal interests and mentoring needs, and (3) generate questions to learn about the practice of engineering education research such as approaches to collaboration.

Table 5. Attributes of building relationships through community interactions.

<table>
<thead>
<tr>
<th>Building relationships between program students and faculty</th>
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<tbody>
<tr>
<td>● Make visible a welcoming environment - make faculty more accessible and encouragement to explore own ideas</td>
</tr>
<tr>
<td>● Identify future mentors and advisors</td>
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<tr>
<td>● Increased self-confidence in ability to communicate with faculty on their research</td>
</tr>
<tr>
<td>Broadened perspective of community and role of collaboration in profession</td>
</tr>
<tr>
<td>● Learn about networks, communities, events, publishing venues</td>
</tr>
<tr>
<td>● Make visible program and community diversity and cross-disciplinarity – e.g., leadership and professional styles, values, projects, research approaches</td>
</tr>
<tr>
<td>● Insights into selecting and working with collaborators within and outside of the program</td>
</tr>
<tr>
<td>● The importance of collaboration in developing as a professional</td>
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</tbody>
</table>

Shared repertoires of practice
Students asked a variety of backstory questions, although the majority focused on the practice of engineering education research. In particular, students asked about “the choices made in research” and “journal/conference publication logistics”. As faculty shared their stories, new questions emerged about ethics and authorship, the politics of research, boundary setting and life balance, and collaboration strategies.

Perhaps the biggest insight students experienced involved what Emilie described as “the ‘reality’ of research.” In other words, students became more aware of the complexities, chaos, obstacles, and politics of research as well as the inherent challenges of studying humans. The faculty provided stories of these challenges as well as the strategies they used to overcome them. As Corey explains, “I wanted to find out how everyone dealt with situations that I had difficulty in...I want to be prepared for my research, and I found it helpful to know obstacles are presented to all of us.” Similarly, Catherine shares how toward “the middle of the semester, as we became more comfortable with methodologies through other courses, I became more interested some of the issues with the research that didn’t go as planned.” Molly and Emilie provide a broad overview of the kinds of “realities” faculty shared:

“Getting to talk candidly with the authors of these papers made EER seem much more accessible, but also opened my eyes to the intricate difficulties in research...working with multiple IRBs...walking away from projects if you do not have adequate support or if it ends up not being in your best
interest…technical difficulties in capturing data…coding takes a long
time…create a ‘parking lot’ of ideas you find interesting but that aren’t
necessarily directly applicable to current research to come back to later…” [Molly]

“Faculty shared ideas about the “reality” of research: political considerations
within academia; the fact that not every project will be completed successfully;
sometimes research subjects turn you down; sometimes data requires triangulation
of various data sets; you might ‘lose’ data; review processes for large
collaborations take a long time; about 50% of grant money goes to overhead
costs; the logistical difficulties of implementing non-lecture formats in
undergraduate education; peer reviews received for manuscripts will disagree
with each other on certain topics; engineering is naturally conservative; ‘Risk is
not a part of who we are in engineering’.” [Emilie]

Students also talked about particular aspects of the research process such as analyzing
large quantities of data, synthesizing large bodies of work to guide a study, the
complexities of qualitative research, and ways of addressing diversity issues:

“I enjoyed hearing about how he teased out information from the data they had on
people leaving engineering, and learned a lot of things I did not expect at
first…can remember making it clear that the data is rarely as organized as you’d
like it to be at first, and you have to do a significant amount of work to create
order from chaos.” [Paul]

“…how they compress tons of information into a brief summary fit for
publication. Honestly, I still have no clue how they synthesize information from
what can sometimes be more than 100 sources through their literature review, but
I am confident that I will get there eventually.” [Paul]

“…all my experience is in quantitative technical research. Before starting this
program, I’d rarely thought about the rigors of qualitative human research, and
how intensive studying people can be!” [Catherine]

“…mentioned briefly in another article that you ‘endorsed’ the inclusion of
underrepresented populations not because of the need to fill job shortfalls but for
the sake of their inclusion. Have you considered a paper addressing that
specifically….The term ‘border crossers’ is used to represent scholars that
migrated from traditional disciplinary graduate programs; was there discussion or
concern about the derogatory connotations of the term….How will [project]
handle the data of students who self-identify as mixed race? Also, out of curiosity,
how do think multiple classifications and transgenders will affect diversity and
gender studies in the future?” [Cole]

The faculty back-stories also revealed many intricacies of the publishing process. As
Catherine notes, “[b]y hearing from all of the faculty in various stages of their careers, I
also understand how publishing challenges and motivations change through a
researcher’s career.” For example, Molly was surprised how “manuscript review is generally a very long process” and that “journals charge the author per page”, that “you can choose to respectfully ‘disagree’ with your reviewers if you offer justification to the editor”, and that faculty “hold back” findings/information in conference papers” so they may submit that for a manuscript.” Neha explained how the back-stories gave her the “opportunity to know more about publishing criteria of various journals and conference proceedings beforehand.” Emilie provides a useful overview of publishing practices shared from the various faculty (in parentheses):

“…the idea of ‘karma’ of peer-reviewing (Pawley); don’t be afraid to talk to an editor if you’re overwhelmed, especially if the peer reviews are conflicting (Jesiek); be careful with copyright as far as splitting research into conference and journal articles (Pawley); some journals charge per page (Pawley); you don’t have to follow every piece of peer-review advice, but have to justify why not (Jesiek, Cox, Oakes); and to over-justify your methods section, if anything (Cox)” [Emilie]

A set of issues that emerged through the storytelling process was the politics and ethics of research. For example, Paul notes how “the politics of higher education research on K-12 settings was something new to me and highly fascinating”. When one faculty member talked about protecting privacy of the participants in her study he was surprised the lengths she needed to go to even have access to that data. On the other hand, Emilie wasn’t particularly surprised: “…having dealt with the politics of K-12, I had prior knowledge of these kinds of struggles, but I had been hoping that maybe, perhaps they would be less so in the collegiate setting; apparently that is not the case.”

Another new insight about shared practices was about the ways faculty strategically balance their work and life, and plan for long term career impact.

“I think one of the most important lessons I learned through this experience is the importance of personal boundary-setting, in two different respects. First: the boundaries a researcher sets when writing a paper—How much to include, and what to leave out or save for another publication. Through discussions of the “back stories” of the literature that we have read, my peers and I learned that paper writing and scoping is an art form, something that can be learned but not taught.” [Catherine]

“…in class discussion talked about creating personal and professional boundaries. For example he said the decision he took in his carrier to say no to any project was never a “deal -breaker”. That means it’s important to know your limits and sometime it’s better to stop working on a project or a collaboration if it is going beyond your limit. For me it’s a big take away because as a researcher it’s very important to know your capabilities and set limits between professional versus personal life.” [Neha]

“…I experience tremendous amounts of tension between being mom and career
woman. In fact, I remember asking some of the female faculty about how they balance the two. Even though everyone said they had to find ways to make time for family and fun, I still have not found my balance. However, it was encouraging to hear from so many females that have families and are living their dream.” [Corey]

“…discussed how she deliberately selects projects to research that will help her develop her expertise and portfolio, giving up certain opportunities in order to focus her attention on the projects that will advance her career in the path that she desires. This dedication to professional image and devotion to personal goals and limits is a trait that I admire in these researchers and teachers.” [Catherine]

Faculty shared their experiences and approaches to collaboration. While there were many comments regarding this theme, Cole’s reflections were particularly extensive. For him, the sharing of stories and strategies allowed him to move toward a new, healthier reality:

“This experience helped me to shed my blinders to the reality of working with people. It wasn’t really naiveté; I just did not want to accept the reality. My experience working in public education left me incredibly disillusioned. I suppose I pursued engineering education with similar ideals hoping to make up for that experience. I never want to lose my idealism but I need to balance it with healthy realism to develop healthy idealism. People will be petty. People will drop the ball. I will not always agree with business practices. I will need to work closely with my advisor and mentors to maintain a healthy perspective.” [Cole]

“…‘pettiness of colleagues’ in response to her contribution to the handbook of engineering education. I was surprised to hear that some colleagues stopped talking to her and some were outright angry with her for not involving them in the project or not imparting co-authorship for the final contribution. In my naiveté, colleague presumed friend. In light of this discussion, although I may have many colleagues, I need to carefully and mindfully consider who I count as a friend.” [Cole]

Finally, students also shared how the class changed their perspectives – in some cases opening their eyes to new perspectives and in others providing new language such as “coding”, “analysis paralysis”, “cleaning data”, “design research”, and “methods vs. methodology”.

“One of the biggest things I was exposed to was qualitative research. I really only knew about quantitative, experimental research, and this class opened my eyes to not only the idea of qualitative research, but what it can bring to the table. I think the addition of qualitative methods to the field of engineering is what makes engineering education so unique.” [Natascha]

“Another moment that didn’t stand out at the time but I find interesting now is the
introduction of “coding.” I had never heard of coding, other than computer- and death-related coding, so I remember being confused at first about what ‘coding’ was when Dr. Adams discussed it in week 2 of the course. After that, it seemed like coding was everywhere.” [Emilie]

A summary of learning outcomes associated with a commitment to a domain of interest is provided below in Table 6. These outcomes map to the following course learning objectives: (1) generate questions to learn about the practice of engineering education research (e.g., realities of research, collaboration, publishing, and professional work), (2) propose connections between research methodologies and research questions, and (3) propose connections between engineering education research and practice.

<table>
<thead>
<tr>
<th>Table 6. Attributes of shared repertoires of practice.</th>
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<tbody>
<tr>
<td><strong>Realities of research</strong></td>
</tr>
<tr>
<td>● Challenges and obstacles in studying humans (IRB, technical difficulties in collecting data, access to data and study participants, etc.)</td>
</tr>
<tr>
<td>● Ethical research and protecting confidentiality of participants</td>
</tr>
<tr>
<td>● Political considerations within academia – engineering as risk averse and conservative which impacts opportunity for impact of engineering education research</td>
</tr>
<tr>
<td>● Insights: how to tease out findings from large quantities of data, coding is everywhere, relating research motivations to research designs, broadening perspective to include qualitative research</td>
</tr>
<tr>
<td><strong>Realities of collaboration</strong></td>
</tr>
<tr>
<td>● Having a healthy idealism regarding the realities of education systems</td>
</tr>
<tr>
<td>● Ways of thinking about collegiality</td>
</tr>
<tr>
<td><strong>Realities of publishing:</strong></td>
</tr>
<tr>
<td>● Intricacies of the publishing process – duration, conflicting reviews, copyright issues when writing multiple papers on a common topic,</td>
</tr>
<tr>
<td>● Making visible the publication process - page charges, reviewer comments as advice versus directives, justifying responses to reviews</td>
</tr>
<tr>
<td>● Insights into community collegiality</td>
</tr>
<tr>
<td>● Synthesizing large bodies of knowledge into a brief summary for publication</td>
</tr>
<tr>
<td><strong>Realities of professional work</strong></td>
</tr>
<tr>
<td>● Personal boundary-setting and finding balance</td>
</tr>
<tr>
<td>● Creating a “parking lot” for research ideas that are not directly applicable to current work</td>
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<tr>
<td>● Knowing limits regarding research scope and collaboration</td>
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**Identity and growth as future professionals**

Finally, some students shared stories of their own growth and how their evolving understanding of the profession is shaping their identity as a future professional. A subset of these are provided below:

“I found myself analyzing the differences between all these faculty—the best in the world at what they do—and they all have developed a different style of leadership and research through their work. I found myself wanting to emulate the characteristics of certain faculty that I felt drawn to after they discussed their work and their approach to research, and I think the fact that I felt more inspired
to be an engineering education research professional after their talks is the point of the course. I can tell that I have changed through this course: I’m thinking more specifically about my goals as a researcher, and what personal characteristics and traits I have that will support my success, and what my weaknesses are which will need to be developed in the coming years.” [Catherine]

“At the end of the semester I realized that my question were becoming more aligned and focused. For example I started asking about where these papers can be published, how the collaboration with other researchers can be done to conduct research, what faculties’ personal opinion about the research are and how they balance between work and research. Earlier my questions used to be more general or more on surface but as I listened to the discussion on the back stories in the class room my thinking as well as questions evolved and became more in depth” [Neha]

“As I heard the back stories of the research papers I was reading, I started becoming more interested in hearing about their personal motivation and what they learned through the research about themselves. It was extremely important for me to hear about personal growth as researchers and scholars that the faculty went through. Charting the territory of engineering education has been difficult, and hearing about the persistence and resilience the faculty members demonstrated shows me how important this research is…” [Natascha]

“I have grown in the area of slowing down, reading more and being patient when it comes to choosing methodologies, information and formats when writing.” [Trina]

These statements illustrate the ways students were making connections between faculty stories and mentoring approaches and personal interests and mentoring needs. They also suggest students’ awareness of an evolving understanding of engineering education research and identity as a future professional, in particular successful future professionals.

**Critical Course Features and Opportunities for Improvement**

Students identified the features they felt played a critical role in the experience. The idea of revealing the “backstory” of real research was seen as critical to bringing new researchers into the profession. Being able to see the details of a project, that are rarely shared in the final publication, allowed students to connect the dots between the ideas that motivated the research, the decisions embedded in the research approach, and the outcomes of the research. It also allowed students to learn first hand about how faculty approach mentoring. Molly shared how she listened for if and how faculty talked about their students as collaborators, “I noticed when faculty would discuss their grad students as collaborators”. As shown below in the excerpts from the reflection assignments, students felt that this transparency enabled critical insights into the profession, inspired students, and helped them come together as a community.

“Since I had very little research experience coming in, this was extremely valuable to me. It is one thing to just read other research papers and “reverse engineer” that
process to do your own research and publications, but there is so much lost in the “telephone game” that is played with publishing research findings, often due to word count limits or page count costs, etc., so having the faculty at our disposal to share what really happened and how their data, notes, and insights made it into a final product was far more beneficial than just handing us their papers and telling us to read them and reflect on them.” [Paul]

“This experience has helped me understand that there are a lot of little details that aren’t included in the pretty article that gets published. I think I knew that on some level but got lots of great examples in the in-class discussions.” [Molly]

“If someone were to implement this kind of course in another department or at another university, three key aspects are needed for the experience to work in the way in which it is intended: transparency from the faculty about vulnerabilities and uncertainties, mutual respect between faculty and first-year students, and commitment from the faculty that this is an important way to motivate, inspire, and teach future engineering education research professionals.” [Catherine]

“Backstories are what are talked about in the background or in the hallway, but more openness and vulnerability about the research process could bring us together as a community even more.” [Natascha]

Underlying the backstory format was an intentional effort to create a safe environment for sharing, interacting, following tangents and unexpected connections, and learning through each other. Neha noticed that this experience was not typical of her other experiences in engineering. She suggested that faculty interested in doing this kind of course need to “motivate students to ask behind the scene questions. And faculties who are coming to discuss the back stories should also understand the importance and value of such courses and understand that these courses are for motivating students and to give students opportunity to be professional in their respective disciplines.” She also shared that as an international student, “with the language barrier initially I was very hesitant to communicate but these ‘backstories’ on research publications and their discussion in the class made me comfortable to communicate with the faculties.” Others appreciated hearing the perspective of their peers, which broadened their thinking and the benefits of connecting to faculty more intimately through their stories to ease entry into later conversations. Molly noted that having two faculty per class is ideal “because they had enough time to talk and could bounce questions off of each other. Plus they seemed to enjoy hearing each other’s backstories.” Similarly, she suggests keeping the class size small so the “discussions that take place are more likely to be candid in somewhat smaller settings.”

“It was also extremely helpful to hear the questions of my classmates. By keeping an open mind, I was exposed to different types of questions and ideas I hadn’t considered myself….Some topics that I hadn’t considered before piqued my interest, and it was easy to follow-up with the faculty because of the exposure to their work and personality through hearing their backstory in person. While I
enjoy talking to faculty, having this space to get to meet them and kind of ‘start the conversation,’ made the professors more approachable.” [Natascha]

“The greatest impact came about not from reading articles and generating questions but from the interactive discussions that took place in class. Some professors provided an article with a backstory which resulted in a lot of growth for the respective professor and then they shared a little bit of that story to springboard the discussion. I am not recommending that reading articles and generating questions be eliminated; they have a place in this type of course. What I am recommending is that all professors start the discussion with a general idea or theme they want the students to ‘take away’ then let the discussion build from there. This will have a greater impact than beginning with, ‘who has questions?’” [Cole]

Another critical feature of the classroom environment was the loose and informal structure that Corey notes, “made it possible to have authentic conversations, allowing room for students and faculty to discuss what they felt was important.” Paul notes that since the faculty were the source of information, it was important for each faculty member to “take the reins and steer the discussion where they thought the questions might lead them.” In this course, the role of the instructor was as facilitator – making sure we stayed on time and being comfortable with allowing the discussion to adapt to the motivations of the students and presenting faculty.

“keep the class unstructured. Dr. Adams facilitated the course by time-keeping, but she did not guide our questions more than the prompt of: ‘what are some backstory questions you have?’ on the discussion board. This allowed for an open discussion about any and every aspect of research, and gave us the freedom to explore engineering education research without many presumptions. Further, I found it especially interesting to see how the faculty started on their end of the conversation in class. Some jumped into telling us the story of how the research project started, and others immediately asked us if we had any questions. This open dialogue allowed for candid discourse about engineering education that everyone enjoyed and learned something new from.” [Natascha]

Another core part of the success of the course was the pre-class discussion posts. As Emilie notes, “it required me to not only read the papers, but also to gather my thoughts and format questions in advance. Sure, it was nice to be able to ask impromptu questions if the situation arose, but I got the impression that most of the questions asked during class had been thought of beforehand. This is probably the most important piece of advice that I would give others if they wanted to implement this course.” Molly agreed with this comment, adding, “posing a couple of questions regarding the backstory is important so that students are fully engaged prior to coming to class. It is also nice for the faculty to have an opportunity to read the questions prior to class, and I found it very interesting to see what kinds of questions my cohort had.”

The students also had a variety of suggestions for ways to build off this course to improve
learning or enable transfer of learning in other courses. Cole saw the format as “useful in teaching an inquiry class. For me, having faculty share their experiences with specific research methodologies would have a greater impact than just reading a textbook.” Emilie also saw connections with the research inquiry course students take: “Those two courses really played well off of each other. For example, after having read and heard about various research methods displayed in [the] papers, I at least had a vague familiarity with some of the methods we learned about in [the inquiry course]. After learning about ethical research in [the inquiry course] (and also a little in [another course]), I began to ask IRB/ethics type questions in [this course].” Similarly, Molly noticed that her discussion board questions mirrored what she was doing in other courses. For example, in the second class she asked a presenting faculty about how she “organized the literature reviews to synthesize data into a coherent relationship” which was a topic that was under discussion in another class.

Michael offered an intriguing suggestion for ways to expand upon the backstory format – by providing opportunities for students to share their own backstory:

“…allow each Graduate student to present a mini-overture of his or her own possible research topic. This would be an active-research methodology approach of purposeful practice. As such, the Grad student could lead a five minute presentation “teaser” – the ability to offer and then ingest on-the-fly constructive criticism would both provide experience as a conscientious critic as well as the distinct benefit of collecting other lens-worthy aspects as the evolving research topic morphs likely to experience many iterations. This life engagement tool might provide the necessary nudge in what is typically an individual process amongst a group going through very similar steps. In a sense, each Grad student in the end of the semester would be ostensibly pitching their backstory as an echo of what the Faculty provided.”

In terms of improving the course, all the students agreed that this course should be combined with the other one credit introductory course for first year graduate students. In that course, faculty shared their stories of how they got involved in engineering education, the kinds of mentoring they received and its impact on their career trajectory. Catherine explains, “… I think that, especially in ENE, a faculty’s life path and research passions are all tied together, and by doing both background and research back-stories on the same day, we could get an even bigger sense of how life and research are complimentary and interconnected.” Similarly, Natascha felt that combining personal and research stories could allow faculty to “speak about their journey in relation to how the specific research project fit into their life.”

Finally, Trina and others note that the course simply “needed more time. All of the meetings went so well that we would consistently run over schedule…There were many days that very few of the questions were answered that were posted on blackboard…jammed packed with very influential and much needed knowledge so it’s important that some adjustments are made towards the timing.” This included more time
for reflection and potentially requiring students to have a reflective notebook for including their pre and post-story discussion or insights.

**Concluding Remarks**

In this paper we present a first generation “best practices” model for helping graduate students develop as future professionals, in particular engineering education researchers. A unique feature of this paper is that all of the students in the course are co-authors of this paper. We described the critical elements of the course including the theoretical frameworks that guided decisions about the learning objectives and learning environment. These include communities of practice, learning to become professionals, storytelling, and attributes of professions and professional work. We also provided evidence of learning outcomes in relation to the course learning objectives. Overall, the course design, which emphasized faculty storytelling and reflective practice discussions on the nature of engineering education research and learning to become a professional helped students:

- Connect to shared commitments and motivations for engineering education research and develop a sense of belonging, self-confidence, and identity with the profession and community
- Build relationships with students and faculty in the program, and broaden perspectives of the community and collaboration in professional work
- Co-develop an understanding of the realities of research, collaboration, publishing, and professional work including strategies for dealing with these realities
- Envision themselves as future professionals including areas in which they need to grow and develop skills

Finally, we suggest attributes of a potential best practices model with opportunities for improvement. In particular, students described the process of interacting with faculty through the behind-the-scenes backstories of the realities of professional work as making visible critical insights into the profession and the multi-faceted intricacies of engineering education research. Key features of the learning environment, many of which may be mapped to the theoretical framings that guided the course design include:

- Commitment to sharing backstories as an important way to motivate, inspire, teach future engineering education researchers
- Safe and adaptable environment for candid and authentic sharing (student to student, student to faculty), individual and group reflection, interaction, willingness to follow tangents and unexpected insights
- Transparency from faculty about vulnerabilities and uncertainties
- Mutual respect between faculty and students including awareness of language and cultural differences
- Pre-discussion posts to gather thoughts in advance, engage productively in discussion, and build off discussions

Students also identified areas for improvement such as having more time for discussion, a reflection notebook to gather thoughts over time, and combining two one-credit classes to
link faculty career stories with research backstories. More importantly, they suggested a revision to the course objectives that others interested in implementing a scaffolded experience to bring future researchers into a professional community could use:

1. Identify faculty research interests and mentoring styles through facilitated in-class interactions
2. Immersion into the research culture through reading works-in-progress and published papers
3. Confront misconceptions regarding faculty research experiences: Research is not necessarily clean or easy

While this is only the first offering of the course, our experience suggests that this model is a low investment but high impact approach to preparing future professionals – whether they are in engineering education research or other professions. For example, many graduate programs have recurring opportunities where researchers present their work such as research seminars and special events. Priming students to get into the practice of asking backstory questions to presenters, and preparing presenters to share these behind-the-scenes stories can benefit students, faculty, and professional communities in making visible the commitments, interactions, and practices involved in being a professional in a community of practice.

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References


