Entering the Discipline of Engineering Education Research: A Thematic Analysis

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Enter the Discipline of Engineering Education Research: A Thematic Analysis

Abstract

In this study, we used classical grounded theory and thematic analysis to develop a framework to help us understand the process that academics go through to become engineering education researchers. As a data source, we accessed the publicly available interview transcripts from the Cambridge Handbook of Engineering Education Research: Updated Perspectives (CHEER-UP) 2020 virtual summer seminar. In this series of 15 seminars, 32 CHEER authors engaged in one-hour discussions to elicit their current views on the topic highlighted in their chapters. As part of the introduction to each seminar, the authors answered why and how they entered the field of EER, which we used for our analysis.

Using NVivo 12, we administered a line-by-line coding of the interviews using inductive thematic analysis, identifying themes that helped us answer our research question. We identified five main themes: Engineering Culture, Opportunity, Education Knowledge Community Involvement, and Desire to Right Wrongs. The individual themes identified here are aligned with and supported by publications in engineering education and other disciplines.

The central ideas of our findings are two-fold. First, an Opportunity is often the catalyst for the boundary-crossing between the disparate disciplines of engineering and education. Second, having an intrinsic motivation (i.e., Desire to Right Wrongs) and the external support of Community Involvement are crucial to help the researcher continue to thrive and explore within this dual-discipline in which boundary-crossing is endemic.

Introduction

Work on ways to improve the education of future engineers is not new [1]. For example, in the United States, interest in advancing curriculum and pedagogical practices date back to the late 19th century [2]. However, the acknowledgement of engineering education as a formal research field is relatively new [3, 4]. It is a global movement where research on engineering education, and creation of associations, conferences, graduate programs, and even new academic departments for engineering education research (EER) are happening worldwide [5, 6].

In order to advance EER, researchers have investigated many aspects of the field itself, including efforts to legitimize engineering education research [3, 7], introducing new research methods and designs [8], increasing methodological rigour [9, 10], investigating successful collaborations [11] and resolving epistemological tensions [4, 12]. Research has also been done on the people involved in the field, such as identifying the motivating factors for adopting effective teaching practices [13], engaging in research-to-practice [14], and listening to the stories of faculty who have successfully promoted change (whether cultural or pedagogical) in their universities [15].

To maintain the growth and evolution of EER, we also need to understand how and why people enter the field, as well as their experiences in this process. This is a crucial step in developing strategies to attract both students and experienced researchers, who will enrich EER by bringing new and diverse knowledge, experiences and perspectives. In this topic, Adams et al. [16]
explored students’ stories and how they navigated the process to becoming engineering education researchers. Seniuk Cicek and Friesen [4] also explored their experiences, but focusing on the epistemological tensions as Ph.D. students conducting engineering education research. Similarly, Seniuk Cicek et al. [6] did a study on the identity and experiences of EER students in Canada.

This study aims to add to the EER body of knowledge by exploring the process and motivations for becoming an engineering education researcher. It has two phases. In the first phase, reported on here, we used classical grounded theory [17] and thematic analysis [18] to analyze part of the recordings from the Cambridge Handbook of Engineering Education Research: Updated Perspectives (CHEER-UP) 2020 virtual summer seminar. This seminar was moderated by Aditya Johri, one of the editors of the Cambridge Handbook of Engineering Education Research (CHEER). In this series of 15 seminars, 32 CHEER authors engaged in a one-hour discussion with Johri to elicit their current views on the topics highlighted in their chapters. As part of the introduction to each seminar, Dr. Johri asked the author(s) how they entered the field of EER. The findings from the analysis of this secondary data are used to develop a framework to help answer the research question: How did current engineering education researchers enter the field? This is the first step in our major research goal, which aims to investigate what institutions can do to attract and retain EER researchers.

This research paper starts by detailing our methodology, including our rationale, data collection, methods and limitations the first phase of our research study. Next, we present our findings and then, following the classical grounded theory process, we compare them to other similar findings in the literature. We close the paper with our conclusion, final remarks and next steps.

**Positionality Statement**

The first author of this paper is a PhD student in engineering education, with a master’s in science and technology studies and a bachelor’s in mechanical engineering. Being immersed in both engineering and humanities, he has come to appreciate and value different ways of knowing and producing knowledge, hence, he considers himself a pragmatist. When it comes to questions about natural laws, he sees post-positivist paradigms as more appropriate since he believes there is only one single truth (even though we might not be able to find it and our interpretation of it can change throughout time). However, when the focus of the research is people (such as this study), he believes that “truth” is socially constructed, and we can only understand its versions through people’s eyes – including the researchers’.

As a relatively new qualitative researcher, the second author is just beginning to understand his own epistemology. At this time, he believes he most closely aligns with a pragmatist post-positivist worldview combined with a constructivist curiosity. This has been reinforced by his employment and academic success in technical disciplines (software engineering, human-computer interaction, public administration, and others). For the last 20 years, he has been an adult educator and formed his own instructional design company about 5 years ago. He is coming to realize that he has been surrounded by like-minded people, where he has been professionally rewarded for excelling in a specific understanding of technical competencies.

The third author is situational constructivist through and through, although she has been accused of behaviourism by the second author! She is aligned most closely with interpretivism. Her
education is in the fine arts, creative arts, education, and serendipitously, engineering education, and she identifies as a non-engineer. She is a faculty member who conducts engineering education research and prefers to work with qualitative methodologies.

We all are engineering education researchers – just as the participants of this study. We have had our own trajectory and motivations to come into EER, which made us want to understand other researchers’ journeys into this field. Although we felt we had to “carve out” our way into engineering education, we acknowledge and thank all researchers who came before us and helped develop the field. We are sure they (you) had to explore waters much more uncharted than we did. Thank you for your contribution to the field.

Methodology

This phase of our study follows a constructivist approach to investigate the motivation of scholars entering the EER discipline. We understand that there is no universal truth about this process and that individual pathways are highly contextualized. Thus, through analysis of learned experiences, we sought to find common themes and develop a framework that explains how scholars joined EER. In order to be open to the individual scholar’s experiences, we needed to bracket our own positivist biases and preconceived ideas, such as our own motivations to enter the field and existing knowledge of motivational theories. As the authors are also engineering education research scholars, care, through extensive memoing [19] was required to ensure we remained open.

Since our goal was to create a framework from themes that emerge from the data, we followed the classical grounded theory approach [17]. A key aspect of grounded theory for this study was to conduct the literature review after defining the themes in order to remain true to the inductive process of grounded theory without biasing our findings [17, 19].

Data Collection

As a data source, we accessed the publicly available interview transcripts from the Cambridge Handbook of Engineering Education Research: Updated Perspectives (CHEER-UP) 2020 virtual summer seminar. Even though the seminars were recorded and are publicly available – thus not requiring ethics approval – Dr. Johri and all authors were given the opportunity to opt-out and remove their presentation transcripts from this study. One author opted out, and thus a total of 31 answers transcripts were analyzed.

The seminars were conducted via Zoom, and Otter.ai created automated transcriptions. We downloaded the transcription for each presentation and selected the excerpts related to the opening question (i.e., what brought you to EER). We reviewed a sample of full transcripts, but no further aspects related to our research question were identified outside of our excerpts (the answers to the opening question); thus we accepted this data reduction. To assure the accuracy of the transcriptions, we manually checked and compared them to the video recordings, making corrections as necessary.

Methods

Using NVivo 12, we coded the data using an inductive thematic analysis process as outlined in
Table 1. It is important to note that Braun and Clarke [18] are clear to state that “qualitative analysis guidelines are exactly that - they are not rules, and … will need to be applied flexibly to fit the research questions and data” (p. 86). Essentially, their guidelines are not prescriptive but suggestive and can be modified as necessary to support the research question and data.

**Table 1 – Phases of thematic analysis (adapted from [18])**

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description of the process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>Familiarize yourself with your data</strong></td>
<td>Transcribing data (if necessary), reading and re-reading the data, noting down initial ideas</td>
</tr>
<tr>
<td>2. <strong>Generate initial codes</strong></td>
<td>Coding interesting features of the data in a systematic fashion across the entire data set, collating data relevant to each code</td>
</tr>
<tr>
<td>3. <strong>Searching for themes</strong></td>
<td>Collating codes into potential themes, gathering all the data relevant to each potential theme</td>
</tr>
<tr>
<td>4. <strong>Reviewing themes</strong></td>
<td>Checking if the themes work in relation to the coded extracts (level 1) and the entire data set (level 2), generating a thematic “map” of the analysis</td>
</tr>
<tr>
<td>5. <strong>Defining and naming themes</strong></td>
<td>Ongoing analysis to refine the specifics of each theme, and the overall story the analysis tells, generating clear definitions and names for each theme</td>
</tr>
<tr>
<td>6. <strong>Producing the report</strong></td>
<td>The final opportunity for analysis. Selection of vivid, compelling extract examples, relating back of the analysis to the research question and literature, producing a scholarly report of the analysis</td>
</tr>
</tbody>
</table>

In this study, the familiarization with the data (1) was conducted while manually reviewing the automated transcripts and listening carefully to the video recordings. Minor edits to the transcriptions were completed at this phase to ensure the recordings were transcribed accurately. For generating the initial codes (2), the first two authors individually coded the same one-third of the transcriptions and then met to discuss and build consensus about the codes. This process was used to assure intercoder reliability by aligning the codes and coding rules used by the researchers.

Next, both authors worked jointly to code the remaining (two-thirds) of the transcriptions, where the discussion and consensus-building happened concomitantly using a pair-coding approach (for a discussion of this pair-coding process, see [20]). The searching (3), reviewing (4) and defining (5) themes were an iterative and cyclic process that happened individually for the first iteration and then with both authors for the second and third iterations. The last step, producing the report (6), resulted in this conference paper.
Given the positivist background of the two first authors, we made a conscious effort not to quantify the data (such as statistically analyzing codes and themes) and stay true to the qualitative nature of this research. When explaining the qualitative research process (e.g., collecting, analyzing and reporting the findings), Creswell and Creswell [19] do not mention the frequency of codes or themes a single time, and, more explicitly, Braun and Clarke [18] warn against the tendency to create themes based on the frequency of codes. It is not to say that quantifying qualitative data is not a valid research approach, but in this study it could add a quantitative layer to the qualitative process that can influence the interpretation of the data in ways that would not align with our research methodology.

Lastly, Braun and Clarke’s thematic analysis method [18] aligns with our Classical Grounded Theory methodology in that they suggest that the literature review should be completed after defining the themes. This is in part to remain open to emerging ideas and because Braun and Clarke [18] argue that the writing process is part of the analysis. Therefore, comparing our themes to the literature while analyzing our findings in the early drafts of this paper forced us to be more critical and work to better understand and confirm our themes.

Limitations

Though this study revealed key insights into senior scholar’s motivation to join the discipline of EER, due to the secondary nature of the data, there some limitations to our findings. First, though the nature of Johri’s introductory question aligned with our research question, it was not necessarily asked consistently, changing among interviews, which could interfere with the interpretation of the question and, therefore, the response.

Second, we had no control over the depth or direction of the interview question, thus limiting our ability to probe or prompt scholars to dig into their responses and the meaning of their answer as it related to our research goal; it was not possible to ask follow-up or clarification questions to unpack their answers.

Third, and most critically to our chosen grounded theory methodology, we did not conduct theoretical sampling or achieve saturation. Though signs of saturation were apparent in the coding of the latter transcripts (i.e., we found fewer new codes and no new themes), we are not confident that we reached theoretical or data saturation [19].

Note that as this is the first phase of our study, and it is our goal to reach saturation through future theoretical sampling in the next phase of the study. For example, the fact that the CHEER-UP presenters were successful, experienced engineering education researchers potentially limits generalizing our findings to novice researchers or students. Thus, theoretical sampling encourages us to interview this latter group in a future study.

Findings

Following Braun and Clarke’s thematic analysis method, we found five themes that help us understand how distinguished scholars entered the field of engineering education research. In this section, we will describe the five themes with exemplar codes to support our analysis. The five themes are:
Engineering Culture, Opportunity, and Education Knowledge

The first three themes – Engineering Culture, Opportunity, and Education Knowledge – emerged as the foundation that connected scholars to the engineering education discipline. These three themes were tightly intertwined, and thus, though we identified them as unique themes, we are presenting them together here. In fact, though we have selected specific quotes to represent each theme, you will see elements of other themes in a single quote.

One of the aspects that was intentionally captured in these themes’ names is that the two supporting disciplines – engineering and education – bring different types of expertise depending on the scholar’s initial expertise. We found that those who came from an education background (such as cognitive science, psychology, sociology or linguistics) tended to be immersed in the engineering community and learn about Engineering Culture (i.e., the engineering way of thinking and doing):

“I had worked in two other contexts in which I had interactions with engineers. That helped me understand how they were coming to communication.”

“I discovered that engineers really have the attitude of get’er done …”

On the other hand we saw that those with engineering background were interested and drawn to gain Education Knowledge, such as “new” methods and theories to either improve their teaching or understand how students learn.

“… that was my foray into education. I remember going to those early meetings on the research team and they were talking about pedagogy and scaffolding. I didn’t know what those terms meant… so over the course of two year I became really interested in how video cases were changing preservice teachers, thinking about literacy instruction.”

“I got interested in how people learn engineering and particularly wanted to see why some concepts were so difficult for people to learn.”

“I did a lot of the professional development classes on how to teach”

Although we have represented this distinction with the terms culture vs knowledge, it does not mean that what matters in engineering education is only engineering culture and education knowledge. We understand that engineering knowledge is essential to the discipline and that many engineering educators have advanced degrees in traditional engineering disciplines, but it did not emerge as a theme. These themes represent what these engineering education research scholars gained through the
boundary-crossing, motivated and fostered by Opportunity – a third theme that connects the previous two. It is how the respondents crossed boundaries and gained education knowledge or learned about engineering culture. Opportunities were varied. They involved research, jobs, teaching or training, and chances to apply their expertise within engineering education.

“halfway into my first year I got this notice about a workshop [on teaching]. And I thought, okay, I’ll give it a try.”

“my capstone project supervisor had some money to investigate simulated labs ... to do some simulation of the lab classes that we do.”

“when I came to [institution x], which is almost exclusively engineering and engineers, I had multiple other opportunities to extend those early ideas [on how engineers learn to write] and also to test them.”

Sometimes these opportunities were consciously sought, and sometimes found through a happenstance:

“...and I kind of just took any job I could”

“I had this sense that there has to be a better way to do this [teaching]. And I started looking around and eventually pursuing a PhD in educational psychology”

“One of the managers was on the industry research panel ... and they decided they wanted a project done on [engineering competencies] ... and offered me a scholarship to do that”

Desire to Right Wrongs

Another theme we found is Desire to Right Wrong. We noted that the scholars often revealed dissatisfaction with the way things were and, consequently, a desire to fix it, which moved them forward in the direction of engineering education research. There were many nuances and “wrongs to be fixed,” but they all fit under two broad categories: desire to right pedagogical wrongs and desire to right social wrongs.

The first category – pedagogical wrongs – is attributed to the belief that there is a better way to teach engineering or to noticing that engineering students lack specific skills. This Desire to Right Wrongs was motivated by scholars’ early experiences as engineering students or instructors:

“trying to understand ... why is it my students weren’t learning what I wanted them to learn?”

“I found what I was learning [as an undergrad] was intriguing, but I didn’t enjoy the learning experiences.”

“trying to put my engineering and anthropology together to teach different
Similarly, the second category – social wrongs – is also attributed to their experiences as students or instructors. However, in this case, scholars were not necessarily worried about better ways to teach and learn engineering. Instead, they were focused on improving students’ (as persons) experiences and their social relations, as well as creating a more just society through engineering practice (by training socially just students). Some critical issues in this theme were diversity, inclusivity, and culture, and challenging the believed political neutrality of engineering:

“look at your classroom; does it look like the community around you?”

“I was shocked when I that my peers and even some of my professors really didn’t think I belonged on that campus”

“maybe if we changed engineering culture to be more inclusive and more accepting of other values and so on, perhaps, perhaps that would change engineering practice as well”

“As a history of knowledge that did, at least in the United States, a better job than almost any other body of knowledge of saying that it's not political - it's only technical. Yet, it was clearly a space in a place of whiteness.”

These scholars pursued their career in EER as they saw it as a path to correct these wrongs (whether pedagogical or social). This discipline provided them with a home in which they could research, prosper, and hopefully make a change. However, another common idea within this theme was institutional resistance to change. Respondents discussed how they had to fight to have their voices heard and ideas implemented:

“Some of my colleagues in civil engineering were basically questioning whether those were legitimate capstone projects. They felt that they lacked sufficient technical rigor.”

“In the whole movement of trying to get psychological theories applied in [engineering] educational practice and it was not an easy task.”

Desire to Right Wrong was often the primary motivator for scholars to enter engineering education. In some cases, this desire came early and drove them to consciously seek an Opportunity to pursue their research in this area. In other cases, this realization came after having the Opportunity, which gave scholars the environment and chance to come across these “wrongs to be righted.”

Community Involvement

Finally, we also identified that many respondents described how connecting with others helped them develop in the field. Community Involvement highlights the importance of having a community as scholars developed their interests and careers in this field. There were many different ways of interacting with the community, but they all fall under two broad categories:
collaboration with individuals and collaboration with organizations.

The first category, collaboration with individuals, demonstrated how peers, mentors, and especially role models were crucial in many steps of the journey, such as introducing the person to EER, and providing support, guidance and motivation.

“\textit{I was stalking [pioneer engineering education researcher] for a while there and, of course, hanging out with that group.}”

“\textit{I was impressed with their attitude, and I felt very happy to work with them.}”

“\textit{It was a really good experience, and I really enjoyed working with engineers...}”

However, just as critical as the opportunity to work with peers and role models was the importance of organizations that provided structure (i.e., opportunities, resources and a space) for conducting and learning about EER.

“\textit{And there were about a dozen of these Coalitions funded by the NSF, and their job was to do some research, but most importantly tried to advance engineering education teaching.}”

“\textit{And then lots of other folks at ASEE were doing this very critical work through the lens of Engineering Education Research.}”

“\textit{you find out about these other conferences where you learn so much more.}”

Overall, this theme revealed the importance of a network or community of like-minded researchers and mentors in sparking the interviewee’s interest in the field. Just as the \textit{Desire to Right Wrongs} theme, \textit{Community Involvement} seemed to happen at different stages in the journey to EER. For instance, some mentioned having a mentor early in their career, others mentioned discovering a community supporting and validating their research after they had been researching for some time.

\textit{An Initial Model of the Themes}

This thematic analysis investigation of the CHEER-UP recordings into how scholars entered the discipline of EER revealed five clear themes. The central theme appeared to be \textit{Opportunity}, which enabled the researcher to connect the disparate domains of \textit{Engineering} and \textit{Education}, since the scholars interviewed came from one of these disciplines and crossed onto the other. If they came from \textit{Engineering}, the \textit{Opportunity} exposed them to \textit{Educational Knowledge}. On the other hand, if they came from \textit{Education}, the \textit{Opportunity} exposed them to an \textit{Engineering Culture}.

Next, almost all scholars interviewed discussed how \textit{Community Involvement} provided them with collaboration, support, and role models. This \textit{Community} feedback appeared to be essential to their desire to work and continue in the field. Finally, most scholars interviewed discussed a
strong *Desire to Right Wrongs*, whether pedagogical or social. Within these interviews, some scholars also discussed how there was resistance to the change they saw necessary; however, they persevered and are now distinguished scholars in the field.

The five themes representing the process of becoming an EER scholar are shown graphically in Figure 1. One of the key elements of this model, which emerged through the analysis, is that not all these themes are independent or linear. As shown in the center, *Opportunity* connects the disciplines of Engineering and Education. However, *Community Involvement* and *Desire to Right Wrongs* are external to the central themes, not because they are less critical, but because they tend to occur at different points throughout each individual’s experiences, and informed how the researcher involved themselves in the field.

![Identified Themes that guided scholars to EER](image)

**Figure 1 - Identified Themes that guided scholars to EER**

**Discussion**

Our literature review, which was conducted after our analysis, as per [17, 18], revealed models and frameworks that share components similar to our framework, but they also revealed some unique aspects in our findings. Our literature review focused on scholars who have researched similar questions for EER researchers and for Ph.D. researchers in general.

First, Beigi *et al.* [21] investigated career success among distinguished academics and developed the model shown in Figure 2. Given that the participants in our study are also distinguished scholars in engineering education, it is no surprise that we can draw a direct comparison with their findings. However, our model is also more specific in some cases. For example, under *Knowing why*, the authors identified the importance of *Drive*, which represents the importance of the scholar’s intrinsic, personal motivators [21]. As they discussed, this varies from individual to individual, and the focus there is on having some motivator. For EER researchers, we identified a single specific motivator – *Desire to Right Wrongs.*
Another parallel can be drawn between Knowing with whom [21] and Community Involvement from our model. Both highlight the need for a community of practice or networking opportunities. Additionally, the importance of community and networking was also highlighted by Boklage et al. [15] in their narrative study of academics’ journeys into engineering education. Interestingly, some of the participants’ statements in the study by Beigi et al. [21] are very similar to the statements made by EER researchers in our data:

“Somebody joined my department on the east coast and we started working together ... and I ran into people who were [in] really exciting fields, and so I just thought, well, gee, this is fun” (p. 270).

However, collaborating with others is more than working with peers. In fact, Gibson [22] highlighted the importance of role modes in career development and found they were distinct from mentoring or peer collaboration. A role model provides an idealization of a self-concept that may not have been visualized by the individual without the example of the role model [22]. Again, this was identified in our study under the category of collaboration with individuals in Community Involvement.

“She [pioneer engineering education researcher] was my introduction to engineering education and my mentor as well”

“And then of course meeting [people] like [pioneer engineering education researcher]”

Under Knowing why and Knowing how, Beigi et al. [21] discuss Opportunity-taking and A blue-ocean strategy, where they refer to both strategically seeking unexplored research topics and taking opportunities when they present themselves. This latter concept was the research focus for Kindsiko and Baruch [23] where they identified the role of chance for Ph.D. graduates; they found these chance events often have a greater impact on the notion of a “planned career” than overt actions taken by individuals. Kindsiko and Baruch’s [23] study found many more nuances to chance events than our pilot study, but the concepts outlined by these two studies emerged from our data and analysis in Opportunities, which included both happenstance (chance) events and planned career advancement, as presented earlier. However, a key distinction in the
Opportunities we observed is that they specifically relate to boundary-crossing [24] into a new discipline.

The boundary-crossing phenomenon we identified here, characterized by the themes of Engineering Culture and Education Knowledge, was the focus of research summarized by Akkerman and Bakker [24]. They point out that in order to cross the boundaries from one discipline to another, factors such as supporting objects (i.e., Community Involvement), and intrinsic motivation (i.e., Desire to Right Wrongs) are key in this process. This idea is well represented by our model where, in the center, there is the boundary-crossing process and, outside, there are supporting objects.

Though other frameworks do address the importance of discipline mastery, we saw the nuance of the dual disciplines involved in EER. The difficulties of boundary crossing are well understood; however, they usually refer to developing mastery within a discipline (e.g. from graduate student to tenured researcher) [24]. We found that for EER researchers, there is also the boundary between two disciplines that must be traversed. An essential aspect of our study showed that an opportunity was required as a catalyst for this boundary crossing.

Boundary crossing into new domains is difficult as, after crossing, the individual often feels lost to both domains [24]. We believe that this is why Community Involvement, as a supporting object [24] emerged so strongly at different times through scholars’ processes. We theorize that finding a new domain with a supporting community – a home – was crucial for their continuation and success in EER.

The feeling of homelessness was a central theme observed in the results of an autoethnography conducted by the third author [6]. This research was based on McAlpine et al.’s identity-trajectory network framework [25], and unlike our pilot study, which focused on internationally successful academics, their study focused on graduate students studying engineering education research in Canada. The themes in Seniuk Cicek et al.’s [6] study not only resonate with the struggles of boundary crossing, but also parallel two other aspects of our model. First, their themes of Absent community of practice, Justifying Eng Ed research, Doubting legitimacy of the field, and Homelessness all highlight how the lack of a community experienced by the graduate students contributed to their challenges in the field.

Second, Seniuk Cicek et al. [6] identified the importance of strong intrinsic motivation, or, as they framed it, Trailblazer. In addition to representing the newness of the path they were following, this theme also recognized the “opportunities and privileges they had been afforded” to enable them to forge out in this new area. This resonates with our theme of Desire to Right Wrongs or what Beigi et al. [21] identified as Drive. Interestingly, Boklage et al. [15] also found that “the impetus for change was an internal desire of the participants” (p. 936) in their narrative analysis of a scholar’s journey or career. As well, similar to our findings, this impetus for change occurs throughout the scholar’s career and involves changing both institutionalized and pedagogical practices [15].

Lastly, one of the features of Desire to Right Wrongs we found was that participants had to push against institutional resistance to either have their research topics accepted or have their innovations implemented. This resistance was also identified by [4, 6] in institutional resistance and a central theme in Boklage et al.’s [15] research. Though not identified as an emergent
theme in our research, this resistance can even extend to epistemological and methodological choices of research as highlighted by [26]. Each of these studies described how graduates and scholars had to overcome barriers, that varied from acceptance of peers to available resources or even the research question or method, in order to implement the changes they saw as necessity.

This *Desire to Right Wrongs* was one of the key findings of our study. The EER researchers interviewed during the CHEER-UP virtual summer seminar all appeared to be strongly motivated to fix something. They perceived a wrong, a cultural norm that had been unconsciously accepted (or consciously promoted) as part of engineering. It was in the EER community that they found an accepting home, which allowed them to pursue their beliefs, and encourage them in their desire to change these systemic structures. Either a better way to be an engineer, or a better way to teach engineers.

**Conclusion**

We designed a grounded theory study and thematically analyzed distinguished EER researchers’ answers to how they came to enter the field of engineering education in the CHEER-UP 2020 summer seminar transcripts to answer, *How did current engineering education researchers enter the field?*

We found five themes that formed our model: *Engineering Culture, Education Knowledge, Opportunity, Community Involvement* and *Desire to Right Wrongs*. The individual themes of our research are supported by findings in the literature, especially the few studies in the EER context. They all seem to converge to the idea that having the support of a community and an intrinsic motivation to keep you moving forward are key to overcome the challenges of thriving in a dual-disciplined field and pushing against resistance to change. This idea is well represented in our model, especially when taking into consideration the concept of boundary-crossing [24]. In the center is the boundary-crossing between *Engineering Culture* and *Educational Knowledge*, which is enabled by an *Opportunity*, and outside are the supporting objects, *Community Involvement* and *Desire to right wrongs*, fueling and catalyzing the scholar to enter this new discipline.

By understanding the process these scholars went through to enter the nascent field of EER, we aim to assist institutions in attracting new candidates and developing EER programs. Findings indicate it is important to nurture an EER community (both internally and externally) in which students and researchers feel supported, encouraged, and enabled to build networks. Having a community in which they can find role models and mentors is crucial for scholars’ growth in the field. Thus, *Community Involvement* is essential to develop in this field. Second, institutions must make a conscious effort to remove the barriers to innovation and traditional boundaries, allowing researchers to pursue their *Desires to Right Wrongs*.

**Future Work**

In Phase one, reported on here, we used secondary data to study how experienced researchers in EER entered the field. In Phase two, our plan is to conduct short, focused interviews at an international engineering education conference, which will provide us access to a wide swath of individuals in the discipline with different levels of experience, interests and backgrounds to explore, *How did current engineering education researchers enter the field?* This time, our
analysis will be deductive, using the process model that arose from the findings in Phase one to confirm or refute our findings. Something to consider in Phase two will be whether the experiences of EER scholars differs via geography. The present study is characteristic of the experiences of EER scholars in the USA, as the majority of the CHEER authors are American. It will be important to discern if this process model is valid for EER scholars outside of the USA.

Second, the themes our research are based on successful scholars. In order to help the field of EER to grow, we need to investigate the inverse: are there themes or issues that have driven researchers away from the discipline? Given that this is a different research question from the present study, and the target participants for it are unlikely to be present at an international engineering education conference, a separate study would need to be designed.

References


