Faculty Motivations and Barriers for Engineering Education Research

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Mia is a 4th year undergraduate student studying Bioengineering with a minor in Material Science and Engineering at the University of Illinois at Urbana Champaign. On campus, she actively participates as an Engineering Ambassador: encouraging younger students' interest in STEM related fields while changing the definition and conversation of what it means to be an engineer. Her research interests include motivation and STEM curriculum development and evaluation. She is very excited to be a part of this community and hopes to spark the interest of engineering education research within her peer groups and to return to education after industry experience.

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Joseph Mirabelli is an Educational Psychology graduate student at the University of Illinois at Urbana-Champaign with a focus in Engineering Education. His interests are centered around mentorship, mental health, and retention in STEM students and faculty. He was awarded the 2019 NAGAP Graduate Education Gold Research Grant award to study engineering faculty perceptions of graduate student well-being and attrition. Before studying education at UIUC, Joseph earned an MS degree in Physics from Indiana University in Bloomington and a BS in Engineering Physics at UIUC.

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Ally Barlow graduated with her Doctoral Degree in Civil Engineering from Oregon State University, where she fused her technical background with her passion for education; her doctoral research focused on the exploration of student engagement from multiple methodological standpoints. Now she works as a Postdoctoral Scholar at University of Nevada Reno, expanding her knowledge of the field through work on faculty-faculty mentorship modes. Her research interests include student cognitive engagement and teacher best practices for in-class and out-of-class learning.

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Karin Jensen, Ph.D. is a Teaching Assistant Professor in bioengineering at the University of Illinois Urbana-Champaign. Her research interests include student mental health and wellness, engineering student career pathways, and engagement of engineering faculty in engineering education research. She was awarded a CAREER award from the National Science Foundation for her research on undergraduate mental health in engineering programs. Before joining UIUC she completed a post-doctoral fellowship at Sanofi Oncology in Cambridge, MA. She earned a bachelor's degree in biological engineering from Cornell University and a Ph.D. in biomedical engineering from the University of Virginia.

Dr. Kelly J. Cross, University of Nevada, Reno

Dr. Cross is currently an Assistant Professor in the Chemical and Materials Engineering Department at the University Nevada Reno. After completing her PhD in Engineering Education at Virginia Tech in 2015, Dr. Cross worked as a post-doctoral researcher with the Illinois Foundry for Innovation in Engineering Education and in the Department of Bioengineering with the Revolutionizing Engineering Departments (RED) grant at the University of Illinois at Urbana-Champaign. Dr. Cross' scholarship investigated student teams in engineering, faculty communities of practice, and the intersectionality of multiple identity dimensions. Her research interests include diversity and inclusion in STEM, intersectionality, teamwork and communication skills, assessment, and identity construction. Her teaching philosophy focuses on student centered approaches such as culturally relevant pedagogy. Dr. Cross' complimentary professional activities promote inclusive excellence through collaboration.

Work in Progress: Faculty Motivation and Barriers for Engineering Education Research

Introduction

Founded in the synergy of theoretical scholarship and practical application, engineering education research (EER) supports high quality education for students to be maintained by connections between developing knowledge and defining theory [1]. However, engineering education researchers must reach a wide range of engineering domains and programs in order to wholly succeed at improving engineering education. Thus, expanding the EER community is a growing mission for academia and organizations such as the National Science Foundation. Although funding opportunities like the NSF's Professional Formation of Engineers: Research Initiation in Engineering Formation (NSF PFE: RIEF) grant provide an opportunity for faculty interested in conducting EER, overall awareness of EER remains limited thus restricts the expansion of research and community [2].

Recent research indicates that unfamiliarity with qualitative methods and theoretical frameworks are barriers of entry to EER [3]. Entrants often become frustrated when implementing traditional educational models to solve new problems. Thus, they become motivated to improve equity, access, and quality of the classroom experience. Even with this motivation there is an activation barrier, whether it be the lack of time or student resistance, that engineering faculty encounter when implementing research-based instructional strategies [4]. Resistance in engaging with the scholarship of teaching and learning (SoTL) further limits access to EER. While these barriers of entry have been identified, there is limited research conducted as to how these barriers affect the level of participation of engineering faculty with EER.

Expectancy value theory. The grounding theory for this study is expectancy value theory (EVT). Classically, EVT identifies motivation as the product of expectancy and value [5], however, recent literature captures the multidimensional factors within this theory. One of these factors is cost [6]. While both expectancy and value are needed for EVT to exist, cost determines whether there is enough value for motivation to exist. If costs outweigh value, motivation can be limited or nullified [6]. We include this dimension of motivation to identify the role of barriers with participation levels of EER.

Research Questions. Our research team's goal is to expand the EER community through identifying and providing needed resources to engineering faculty [7]. Here we ask the following research questions: *How do expectation, value and cost relate for engineering faculty interested in conducting EER? How do prospective entrants of EER experience expectation, value, and cost?*

Methods

Interview protocol design. Interviews were semi-structured and designed to explore faculty's general motivations for academia and connect their interests to their understanding of EER. The protocol design allowed for participants to discuss answers to the research questions as well as share their experiences with EER. Based in EVT, the interview was divided into three sections: (1) background and timeline of EER awareness in career; (2) motivations and barriers of participating with EER ("What perceptions do you have of EER that are restricting or benefitting your career?") and the perceived values of EER ("How do you value EER compared to your

institution?”); and (3) resources or other factors needed to succeed in EER. The protocol was reviewed by team members with expertise in qualitative methods and piloted with a participant external to the sample.

Recruitment and sampling. A demographic survey was sent to engineering faculty members through ASEE listservs and personal contacts for voluntary participation with the study. As a case study, participants were grouped and selected into four predetermined categories aimed to highlight the various interest and previous engagement with EER. The first case was a faculty member whose primary research was not in EER, but was interested to begin their involvement with the field. The second case was a faculty member whose primary research was not EER, but had added EER to their research. A faculty member who had made a career switch from a non-EER discipline to EER was the third case, and the final case was a faculty member whose primary research was not EER, was interested in engineering education scholarship, however, was not looking to participate in EER. Eight faculty members with a diverse range of job positions, current institutions, research interests, and EER experience were categorized based on the demographic survey, selected, and interviewed.

Data collection and analysis. Data collection was approved by institution IRB #10072020. A demographic survey was created using SurveyMonkey and consisted of questions about job position/rank, tenure status, institution type, and EER interest level. Interviews were scheduled using WhenIsGood and participants were contacted via email to confirm interview times. Interviews were conducted and recorded through Zoom. Interviews were intended to last 30-45 minutes and the actual interview range was 23 minutes to 45 minutes. Interviews were transcribed verbatim by a professional transcription service, and participants were assigned pseudonyms. Transcripts of the interviews were then cleaned of any identifying information and analyzed using MaxQDA. We thematically coded one interview using an open codebook to gather initial findings. However, because of the small sample size, we decided to add a codebook grounded *a priori* in EVT to better focus on answering the research questions. Sample codes and major themes are presented in the results section. Final codes were discussed among team members and to ensure validity of this codebook.

Results

We present three primary themes developed from the EVT grounded codebook that describe the relationship between participants’ value of EER and the motivators or barriers related to their participation in EER. For this Work in Progress paper, we have selected themes that may inform administrators of the synergy between engineering and education and interested engineering faculty trying to enter the EER field of shared experiences. A table summarizing each theme with an example from the interview data is attached at the end of this section.

Barrier due to job position. Participants often had difficulty in having the bandwidth to fulfill their job responsibilities, conduct EER, and maintain a work-life balance. As their position outlines a limited amount of scholarship, these participants are unable to engage with the research despite having the motivation or interest.

Motivation to benefit students. Most participants discuss teaching, inspiring, and developing students as a main motivator for participating in EER. This motivation causes participants to engage with EER beyond implementing SoTL practices.

EER participation value > EER participation cost. Motivation is achieved when expectation and value outweigh cost. While participants identify potential barriers, they discuss how these barriers are offset by the overwhelming value and interest for EER. This relationship is considered positive in terms of engaging with EER.

Table 1. Summary of addressed themes from participants.

	Theme	***Example Quote***
Cost	Barrier due to job position	***Josh:*** *In my department those who are doing educational research are the faculty who happened to have the heaviest teaching loads because they're good at it. And so when the department leans on certain faculty to teach, let's say larger class sizes or more critical core engineering courses,...the people that are effective teaching faculty are the ones that are likely more effective because they care and they're investing themselves in it [EER].*
Value	Motivation to benefit students	***Kevin:*** *I love to see when my students can go from novice to experts. [...] I've noticed that I kind of switched over my EER, to how students can mature into their own self-driven learning*
Positive result between value and cost	EER participation value > EER participation cost	***Addison:*** *I'm not technically getting credit for doing research within my job title. [...] so it's not necessarily teaching within my own courses but it's additional content that I've taught outside of the courses that I do for the department.*

Discussion

There are limited studies and training introducing engineering faculty to EER. The lack of training in EER results in lack of awareness of the field itself that restricts the expansion of the EER community. At its best potential, EER's influence can widen out in creating a standard value for EER in institutions: supporting and valuing faculties' participation with EER.

We found that new EER researchers perceive that in order to be successful and involved in the EER community, they must conduct theory research. This expectation is a cost to engineering faculty interested in EER. A participant who identifies as uninterested in conducting EER makes this distinction clear: "I think of [EER] as ERM, engineering and research methods, which I'm not super interested in. I guess I'm more interested in using the existing survey instruments out there to conduct studies." While this participant may not be interested in the theory research portion of EER, he actively participates with EER to produce his own studies, which is still within the EER field. This disconnect with EER's language causes friction for engineering faculty to actively engage with EER as they perceive that they are not actually conducting EER.

Through our analysis, we are able to conclude that resources or training that guide the EER process step-by-step, from proposal development to IRB submission to collecting and analyzing data, are needed for engineering faculty to adequately feel prepared to start conducting EER. These resources help to greater define EER as a field from the broader SoTL community. Institutions can support this interest by decreasing the costs associated with the lack of institutional support. Further research the extent to which external factors such as institutional and peer support affect engineering faculty's motivation and decisions to conduct EER.

Limitations. While our sample considered the diversity of participants, institution type and size, job position and varying levels of interest to conduct EER, our small sample size across four cases is our primary limitation. Expanding the number of participants would expand the experiences recorded, however, our case study method with a smaller sample size best provided clarity in participant recruitment and data analysis. Furthermore, it is important to note that the impact of motivations and barriers vary from participant to participant: motivation and costs may be mirrored between two participants but can result in very different outcomes.

Conclusions

Studying faculty's motivations and limitations for EER provides a greater understanding of the relationship between passion and participation with EER. Furthering this research, we intend to interview more participants. Future work is needed to provide resources, opportunities, and visibility to engineering faculty interested in EER to cultivate more EER researchers.

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