Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #45906

WIP: Assessing Quality of Interview Protocol for Capturing Students' Sense of Belonging and Wellbeing in a Practice-Based Engineering Education Model

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WIP: Assessing Quality of Interview Protocol for Capturing Students' Sense of Belonging and Engineering Identity in a Co-op Based Engineering Education Model

Introduction

In this work-in-progress empirical research paper, we assess the quality of an interview protocol for capturing students' sense of community and engineering identity. The interview protocol is being used in conjunction with a survey on engineering identity, sense of community, and co-op experiences, in a concurrent mixed-methods research study. In this pilot work, the first round of interviews were assessed for their quality and alignment with the goals of the larger mixed methods study.

Programmatic Context

Iron Range Engineering (IRE), is a co-op based upper division engineering program. Students join IRE from community colleges around the United States after completing their first two years of lower division engineering requirements. They then join on campus at Minnesota State University, Mankato, for one intensive semester, called Bell Academy, developing technical, professional, and design skills before starting paid engineering co-op positions. After two years of working as engineers and completing technical, design, and professionalism credits, students graduate with a B.S. in Engineering. Participants in this study are a part of the IRE STEM Scholars program, which helps financially support low-income, high achieving students for their Bell Academy semester, and provides additional mentorship and career development support resources through to graduation. This program supports a diverse population of individuals on their pathway to graduation, with a range of backgrounds and experiences [1].This work will not focus solely on low-income experiences, but rather the more nuanced identities and experiences of the students [2].

Engineering Identity and Belonging

Engineering identity is defined here as how the student describes themselves in their role as an engineer. Engineering identity is situated within three constructs– interests in engineering, students' beliefs that they are recognized by others as an engineer, and performance/competence beliefs that they can complete engineering work supported by a level of knowledge and skill [3]. Studies have found the importance of engineering identity in supporting feelings of belonging to communities of practice, particularly for minoritized populations in engineering [4]. For example, students who are first generation students utilize funds of knowledge to support their development of engineering identity [5]. Engineering students' formation of engineering identity, feelings of belonging, and perceptions of their future careers are closely tied to their engineering experiences [6]. This work explores the quality of the interview protocol to capture high achieving, low-income students' engineering identity development and feelings of belonging while working in paid engineering positions, while considering their wide range of backgrounds and experiences they are bringing with them to this program.

Methods

Data Collection

Data were collected at the start of students' first summer while on co-op. Participants had one to five months working on co-op experiences at this point. Six participants were interviewed; three of the six interviews were used for an initial analysis to refine the interview protocol and the analysis approach. Interviews were conducted by a researcher who has regular interaction with the students, but does not have any grade entry responsibilities. The interviews were conducted on Zoom, recorded, and transcribed by a transcription service. Interviews were semi-structured, and the interviewer asked follow up questions as needed. The interviews ranged in length from 30-60 minutes. The interview protocol is attached in the appendix.

Participants

Due to the proximity and familiarity of members of the research team with the participants, pseudonyms were assigned to each interviewee prior to analysis, and any attributes that may lead to identification were omitted to ensure confidentiality and help address bias during analysis. Participant demographics will be presented here in aggregate to further protect their identity. All six participants are a part of a scholarship program for low-income, high achieving students at Iron Range Engineering. Three identify as female, two as male, and one as nonbinary. Three identify as White, one as Asian, one as Black or African American, and one did not specify. Three participants are above 24 years old, and three are under 24 years of age. One is a first generation college student, and two identify as neurodivergent.

Data Analysis

Quality of the interview protocol was assessed through two primary analyses– 1) The Interview Quality Reflection Tool (IQRT) [7] to assess each structured question and each follow up question for what content emerged and if that aligns with the goals of the questions, and 2) directed content analysis of four of the interviews using an initial coding using a codebook developed through analyzing written reflections on similar content [8].

1) *Directed Content Analysis:* Each researcher read through one interview transcript. They then wrote down initial impressions and themes. In a second pass of the interview transcript, the researcher marked segments of meaning with a corresponding code from an existing code book. If there was a segment that contributed to the understanding of that transcript but did not fit with an existing code it was marked with a question mark. At this point the research group met together to discuss where unidentified codes were occurring, and initial themes. The lead researcher repeated this process for each of the three interview transcripts. A second pass through the transcripts then occurred where the interviews summarized into key themes by individual researchers. This point is what is presented as preliminary findings in this paper.

2) *Interview Quality Reflection Tool:* Concurrent with this process, the IQRT was filled out with the transcript. The questions from the interview protocol were identified, follow up questions were identified, and the type of follow-up question was labeled as clarifying or expanding. The content, or topics, that occurred as a result of that question were marked. The researcher who conducted the interview then reflected across the three interviews what worked well and what could be improved on for the interview protocol, with the analysis of the IQRT being highly reflective, similar to previous uses of this tool [9].

Results

Coding Scheme

Additional codes emerged, particularly around perceptions of the future and career goals, which has been found to be a mediating factor for engineering identity and continuing engineering major interests [3]. Additionally, new or more nuanced codes around community emerged, related specifically to the resources or funds of knowledge students brought to their engineering experiences, such as connections to mentors and family members and experiences in other careers before returning to school for engineering [5].

Thematic Results

A few key themes emerged from this preliminary approach of the data. Community was frequently discussed with a sense of belonging. Participants indicated not necessarily feeling belonging to engineering, but to the people in engineering. For example, after describing their struggle with imposter syndrome and not trusting that they are proficient enough, Liam indicates feeling a sense of belonging with the community of people at work: "So all that being said with the community, with the people, with all that aspect of it, I definitely do feel like I belong here." They go on to explain,

> "I'm not sure that's necessarily feeling like I'm an engineer and fitting in with the engineers more so having a group that you're going through an experience with. Yeah, I don't totally know on that one. The sense of community, the sense of together and getting through it together was the main thing that's helped me with that." -Liam

Ava describes not feeling as much interest in engineering as their peers, but feeling like they belong in terms of the "social aspects" and making friends with the other interns at their company. Participants frequently referred to past experiences when responding to answers, and referred to their own experiences, as well as the experiences of mentors and family members.

Each participant indicated feeling different in terms of not knowing information or processing information quickly enough. For example, Olivia states:

> "Yeah, so some of the times when I don't feel like I belong is like in learning conversations, for example, me, it takes a bit to process the information. And like, when, like we have these problems presented, it takes a bit for me to like absorb that and be able to process that in my head. So, like, when I see my peers, like, just going at it with the problems, like coming up with all these possible solutions, it makes me like basically an imposter syndrome, you know, because I can't like, process it as fast." -Olivia

And each participant indicated what made them feel most like an engineer was perseverance, hard work, and their ability to improve.

IQRT Results

No significant updates to the interview protocol resulted from the IQRT analysis. The interview questions were reaching their intended goal. Rather the IQRT analysis gave a reflective opportunity to assess the goal of the original interview prompts. There were some instances in

the interview where participants were potentially interrupted or redirected to the original prompts, so the interview protocol instructions are updated to encourage more flexibility to the protocol and follow up questions.

Discussion and Future Work

Given the richness and diverse range of experiences brought up in the first interview, two key results emerged from this analysis. The first is the need for additional interviews with a narrative approach to gather uninterrupted individual stories rather than attempting to constrain the conversation. The goal of a narrative interview is for the participant to drive the conversation through a broadly defined topic; the interviewer avoids bringing their own agenda to the conversation but rather allows the participant's story to emerge through the interview questions [10]. More opportunities for students to share their experiences uninterrupted and to guide the interview would allow for a better understanding of their feelings of belonging.

The proposed second interview will occur before graduation, asking the participant to "Describe how your engineering identity and sense of community in engineering have developed over your time in this program." The first question of a narrative interview is typically an open-ended question, which prompts the participant to tell their story in a narrative [10]. In narrative interviews, the interviewer should focus on listening without interrupting and making a mental note of any follow-up questions to prompt further. After the initial narrative, examples from their first interview will be summarized: "Last time you discussed [review summary with the student]. Is there anything you want to clarify or update about your experiences?"

The second is the approach to the analysis of the interviews - we posit that it is more appropriate to do an emergent thematic analysis with the shift to a more narrative approach to the interviews [11]. Directed content analysis [12] does allow for emergent codes; however, starting with a codebook that was developed on a broader population through written reflections [8] resulted in many unused codes and codes that were similar yet not matching the original intent of the code. Additional codes to connect to career goals and interests were included; however, ultimately a more open thematic approach appeared more beneficial for the data. We were able to better capture experiences related to students' funds of knowledge, including accessing experiences with mentors and past experiences working in different fields, showing support for studies that showed similar findings quantitatively [5].

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Appendix: Interview Protocol

Before the Interview/Instructions for the Interviewer: The goal is to get uninterrupted narratives from the participants; let them guide the conversation. To help them get comfortable with the interview, wear casual clothing, start with informal conversation "How was your weekend?", "Did you get to do any travel this break?", etc. Practice active listening– nodding, taking notes, and waiting for them to finish talking before asking another question. Ask follow up questions as needed, but try to use the wording that they have brought up already. Using your notes or having a second interviewer in the session with you can help with this.

Explain the study: Interested in understanding in more depth how students at Iron Range Engineering are developing their engineering identity, feelings of belonging, and overall wellbeing.

Ask the Participant to Choose their Pseudonym.

Follow the following main prompts, with expanding or clarifying follow-up questions if needed:

Interview Prompts:

1. Does engineering feel like a good fit for you? Why or Why not?
2. Do you feel like you belong in engineering? In What ways?
3. What characteristics of yourself make you like an engineer? and,
4. What characteristics of yourself make you unlike an engineer?
5. What experiences have you had that you feel may contribute to feelings of belonging in engineering?
6. What experiences have you had that you feel may contribute to feelings of not belonging in engineering?
7. What connections, if any, have your feelings of belongingness influenced your overall wellbeing?
8. Has the co-op experience or job-search process affected your feelings of belonging in engineering, and if so how?
9. What areas could improve for the program to further support your identity development?
10. What ways do the program help support your identity development?
11. Why did you choose engineering? This program?

12. Is there anything here that I did not ask you about that you would like to share?

Before the Interview/Instructions for the Interviewer: Before the interview prepare a summary from their previous interview. The goal is to get uninterrupted narratives from the participants; let them guide the conversation. To help them get comfortable with the interview, wear casual clothing, start with informal conversation "How was your weekend?", "Did you get to do any travel this break?", etc. Practice active listening– nodding, taking notes, and waiting for them to finish talking before asking another question. Ask follow up questions as needed, but try to use the wording that they have brought up already. Using your notes or having a second interviewer in the session with you can help with this.

Interview Prompts:

1. Describe how your engineering identity and sense of community in engineering have developed over your time in this program.

[**For the interviewer:** prompt for a clear timeline after the participant is finished speaking if it was unclear].

2. Last time you discussed [review summary with the student]. Is there anything you want to clarify or update about your semester?