Work in Progress: Initial Interviews to Understand the Formation of Engineering Communities of Practice and Identity during the First Year

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Abstract

This Work in Progress paper reports on our efforts to understand the development of engineering identity and engineering communities of First-Year Engineering students. Three phase interviews are being conducted with participants from two different universities (Institution 1 and Institution 2). First phase interviews were conducted with 12 students from Institute 1, and 14 from Institute 2 in Spring 2018. Participants were selected to ensure there was representation of a variety of backgrounds and demographics (e.g., race, ethnicity, life experience.). During the initial interviews, students were asked questions including 1) What kinds of groups did you associate with during your first year? 2) In what ways are you connected to these groups? 3) What was your greatest struggle during your first year? 4) Are you an engineer? To analyze the data gathered from these interviews, we are using two theoretical frameworks: Communities of Practice by Wenger, and Gee's four ways to view identity. The purpose of this Work in Progress (WIP) paper is to detail the interview procedure and explore how the frameworks used provide insight into the data. For example, we observed that when discussing their engineering identity, students tend to talk about other forms of identity highlighting the complex nature of the construct.

Introduction

According to a report entitled "Is U.S. Science and Technology Adrift?" released by the Commission on Professionals in Science and Technology (CPST), the nation's engineering workforce is growing but lagging behind the overall growth of the country [1]. This is resulting in a shortage in the Science, Technology, Engineering, and Math (STEM) workforce. In short, STEM fields are not producing enough graduates to meet growing national needs.

First-year engineering programs enable students to have early engineering experience and provide opportunities for professors to support their transition to engineering [2]. In the United States, the timing and design of students' first-year engineering courses varies from institution to institution. Students' first-year experiences in engineering are shaped by many factors one of which is the design of introduction to engineering programs and courses. Thus, it is important for the engineering education research community to systematically examine the impacts that various first-year engineering designs have on students' pathways into and through engineering, so we can design better experiences.

Two recent studies that provide a foundation for this work are the studies by Chen, Brawner, Ohland, and Orr [3] and Reid, Hertenstein, Fennell, Spingola, and Reeping [4]. In these studies, researchers compare first-year engineering across institutions to create initial knowledge regarding differences across various universities and engineering programs. In the first study, Chen et al. [3] used the Multiple Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD) to create a taxonomy of approaches to matriculation in engineering. Chen et al.'s [3] research gives insight into the administrative perspective on first-year students

experiences. In the second study, Reid et al., [4] focus on the course content in first year engineering programs and found that objectives of engineering courses can be grouped into major categories (e.g., engineering skills, professional skills, orientation to the program from the viewpoint of the university, orientation to the engineering profession). These studies are critical efforts that begin to tease out the differences in first-year engineering programs and courses, but they do not provide insight into the direct experiential impact on students.

This Work in Progress paper will give an overview of our interview procedures, recruitment methods, and selected participant. The larger project examines first-year engineering differences in the context of the student experience. We are specifically focused on understanding how different first-year engineering approaches impact the development of a student's engineering identity and membership in engineering communities of practice. We will also discuss how our theoretical frameworks are supporting our initial data analysis.

Theoretical Framework

First-year engineering approaches provide initial exposure to engineering degree programs and the culture of engineering at the university. First-year engineering programs and courses lay the groundwork for developing engineering identity and entering the engineering community of practice. Through our work, we are looking at these two ideas simultaneously.

Identity, based on Gee's [5] definition is "being recognized as a certain 'kind of person,' in a given context" [5, p. 99]. He established four perspectives on how to view identity." The four perspectives are *Nature Identity*, *Institutional Identity*, *Discourse Identity*, and *Affinity Identity*. *Nature Identity* is part of a person's identity that has not been chosen and is a state that a person cannot change that they have no control over. For example, the statement "I am a brown eyed girl" is an example of *Nature Identity*. Being a girl with brown eyes is a natural state given by nature which cannot be changed. *Institutional Identity* is a part of one's identity that is set by an organization or establishment. Gee gave the example of being a professor and occupying a position composed of rights, duties, and obligations to the university as an example of Institutional Identity. *Discourse Identity* is an identity associated with a personal trait, specific to one's individuality. It is an identity formed around a trait recognized by other people such as being charismatic, charming, and witty [6]. *Affinity Identity* is an identity associated with being part of a like-minded (affinity) group. This form of identity is recognized once a person joins an affinity group and by joining develops an identity through shared experiences or commitments to the group. Affinity identity highlights the interconnection between identity and groups/communities. As engineering students develop their engineering identity, they also begin navigating social experiences afforded by association with first-year engineering programs.

Wenger's framework of Communities of Practice [7]-[9], which builds from the Situated Learning by Lave and Wenger [10], defines a social theory of learning as including community, practice, meaning, and identity. An important component of this theoretical framework is its inclusion of identity. Communities of practice develop around subjects that matter to people.
Therefore, their practices show the members' understanding of what is significant to them.

Boundaries exist for communities of practice, but they are flexible and whomever participates in the practice is considered a member. Communities of practice can exist in different forms: inside a company, across company boundaries, and across company units. It can be known by the organization as it can be unknown to the organization. We use Gee's [5] framework of four ways to view identities and Wenger's framework of Communities of Practice for our initial exploration of how students develop their engineering identities and engineering communities.

Methods

In order to investigate engineering identity and engineering community formation, we conducted a total of 26 initial interviews with undergraduate engineering students. The interviews were conducted at two sites: Institute 1 is located in a rural area in the Southern United States and Institute 2 is located in an urban area in the Midwestern United States. After the surveys were completed [12], [13], we conducted purposeful sampling in order to identify a diverse pool of participants.

The interviews were semi-structured and open-ended in nature. They were conducted following approved IRB procedures. Every interview session was composed of one participant, one interviewer, and one note taker. The interviewer and the note taker were equipped with two audio recorders. Before each interview, the interviewer reviewed the participant's survey response and develop two to three personalized questions from that response. Each participant received a $25 gift card for their participation. The interviews ranged between 35-75 minutes.

The protocol for these first interviews had six primary questions. Questions were designed to elicit conversation about participants' engineering identity (e.g., "Who are you?" and "Are you an engineer?"). Answering these questions provided us with insights into how and when
engineering identities develop and what factors affect their development. The interview protocol also included questions designed to understand the communities that participants were involved in during their first year (e.g., "What kinds of groups did you associate with during your first year?"). These questions enabled us to understand the degree that first-year engineering programs impact students' engineering identities and communities in comparison to other activities participants participate in during their first year of engineering. Table 1 gives a full description of the questions asked during the interviews.

Table 1: Interview questions

#	Base Question	Sample Follow-up Questions
1	Who are you?	What do you do?
		How do others describe you?
2	How was your first year in engineering?	Was it what you expected? Why or why not?
3	What kinds of groups did you associate with during your first year?	*(If question is too broad for the student to speak to)* Were there any professional organizations, clubs, sports teams, etc. that you were a part of?
		How did you get connected to these groups?
		Who was in it?
		Were any of these people in your courses? If so, which ones?
4	In what ways are you connected to these groups now?	If you are still connected, why?
		If you are not connected, why?
		What new groups have you associated with?
5	What was your greatest struggle during your first year?	How did you work through those challenges?
		Who helped you work through those issues?
6	Are you an engineer?	If so, in what ways?
		If not, why and when will you be one?
7	Questions specific to the participant	

Results and Discussion

Overall, a total of 26 interviews were conducted, 12 for Institute 1 and 14 for Institute 2. The participants were from different paths: 17 general students, 9 transfer students. Different matriculations included 11 from First Year Engineering (FYE), 7 students from Direct Matriculation (DM), and 8 from Post General Education (PGE) as defined by [3], [11]. A description of each structure is shown in Table 2.

Table 2: Matriculations in Institute 1 and Institute 2 based on definitions in [3], [11].

Matriculation	Description of the Engineering Path
First Year Engineering	Freshmen pre-major with first year engineering structure
Direct Matriculation	Freshmen direct matriculation with departmental introduction courses in first year
Post-General Education	Transfer students with combined freshmen/transfer student, discipline-specific introduction course
	Transfer students with designated transfer student introduction course
	Transfer students with no introduction course

The participants were from different engineering majors and also varied in respect to sex and race. There were 17 male participants and 9 female participants. Out of the 26 participants, 11 participated in a common first-year engineering program prior to their matriculation into an engineering degree program. Participants were enrolled in their second, third, or fourth year at a university. However, all participants were in their second year of engineering, meaning they completed their first engineering course or program the previous academic year. Table 3 provides a detailed description of the participants ordered alphabetically by pseudonym.

Table 3: Participants description

Pseudonym	Gender	Engineering Major	Pathway	Matriculation	Year
Abe	Male	Civil	General	FYE	2nd
Alex	Male	Mechanical	Transfer	PGE	3rd
Annie	Female	Environmental	General	FYE	2nd
Bill	Male	Computer Science	Transfer	PGE	2nd
Cassidy	Female	Electrical and Computer	General	FYE	2nd
Christy	Female	Chemical	General	DM	3rd
Daniel	Male	Computer Science	General	DM	2nd
Elroy	Male	Industrial Systems	General	FYE	2nd
Emily	Female	Civil	Transfer	FYE	4th
Gabriel	Male	Mechanical	Transfer	PGE	3rd
George	Male	Aerospace	General	FYE	3rd
Harry	Male	Aerospace	Transfer	PGE	4th
Jacob	Male	Computer	Transfer	PGE	2nd
Jamie	Male	Electrical and Computer	General	FYE	2nd
Laura	Female	Electrical	General	PGE	3rd
Lorie	Female	Mechanical	General	PGE	2nd
Malcom	Male	Computer Science	Transfer	FYE	2nd
Nikki	Female	Civil	General	DM	2nd
Ronald	Male	Aerospace	General	DM	2nd
Sam	Male	Aerospace	General	DM	3rd
Sara	Female	Computer Science	General	DM	2nd
Sherry	Female	Mechanical	General	FYE	2nd
Terrell	Male	Civil	Transfer	PGE	2nd
Thomas	Male	Industrial	General	DM	2nd
William	Male	Computer Science	General	FYE	2nd
Zachariah	Male	Electrical and Computer	Transfer	FYE	3rd

We analyzed the transcripts of the interviews for emerging themes concerning identity by coding Institutional Identity, Discourse Identity, Nature Identity, and Affinity Identity. Regarding Institutional Identity, when asked "Who are you?" participants would often say I am [a specific identity given to them by their institution]. For example:

> I'm **orientation leader** for *"Institute 1."* [Thomas]

> I'm also **RA** on campus. [Cassidy]

Institutional Identity was a dominant identity theme across all interviews. This could be due to the context and location of the interviews (on campus), which may have led participants to identify first within the institution boundaries before expressing any other identity.

Another common identity was Discourse Identity. In response to "Who are you?" students would described individual traits. For example:

> I'm probably **compassionate** but also **straightforward**…I'm **outgoing**, **friendly**, gosh I'm not very good…**loyal**. [Christy]

> Very **outgoing**, **charismatic**, **people's person** and usually in the middle of a lot of things. [Thomas]

Nature Identity was coded less frequently and emerged only when the participants were mentioning their gender, race, or age. For example:

> There was a lot of biased against me **as a girl** because I would, and I try to make it objective as possible because I don't want it to sound like. [Annie]

During the analysis of the interviews, Affinity Identity did not emerge. Although we specifically asked participants about their membership in groups (e.g., professional organizations, clubs), the participants did not talk about these groups as part of their own identity. We are continuing to analyze interviews and will continue to code for Affinity Identity during our future interview phases.

We did identity a few identity statements that we did not fit directly within Gee's framework. For example:

> I don't consider myself the perfect model of an engineer. [Thomas]

> I may be a slow engineer, but I can do this. [Christy]

Thomas's statement about not considering himself being the perfect model of an engineer is an identity statement because he is discussing who he is. However, this form of identity cannot be considered Nature Identity because it is not a state given to him by nature; Thomas has control over being an engineer. Institutional Identity is excluded as well because the Institution gives him the status of "engineering student" and not "engineer". Affinity and Discourse identities are not being considered because his statement does not qualify as personality trait nor does he express being part of an affinity group. Christy's statement cannot be considered any of the four identities for the same reasons. These identities will inform us into building more suitable questions in the next phase of interviews.

Conclusion

The results of our initial analyses indicate that when second-year engineering students discuss engineering identity, they reveal different identities such as Nature, Institutional, and Discourse Identities. This indicates the coexistence of the multiple identities, which is consistent with Gee's theory: "It is crucial to realize that these four perspectives are not separate from each other. Both in theory and in practice, they interrelate in complex and important ways." [5, p.101].

Currently, we are using our initial analysis of the interviews to create a codebook. The results of these interviews will inform a second phase of follow-up interviews. The follow-up interviews will be with the same participants to capture additional information about students' identities and community development as they progress through their engineering degree pathways. In the future, the data we capture about the impact of first-year engineering programs and courses on students' engineering identities and communities will allow us to examine how intended student development goals for first-year engineering that are set by instructors, faculty, and administrators align with the student experiences as described by students.

Acknowledgements

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