

Exploring I-poems to Explore the Identity of Underrepresented Engineering Student Makers

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Abstract—This Work in Progress Paper presents an NSF-funded study focused on understanding the role that makerspaces play in the identity development of engineering students from underrepresented groups (URGs). In recent years, makerspaces have become a popular addition to universities, with an implicit assumption that makerspaces will increase students choosing to major in STEM disciplines. The research question that guided this work is the following: How well do I-poems and thematic analysis help us uncover complex and nuanced understandings of the identities of engineering students and makers who are from URGs? For this paper, we share a passage from an interview and conduct an analysis of that passage using the I-poem analytic strategy and thematic analysis. In particular, we explore the possibilities inherent in using these analytic approaches to understand identity development. We discuss how the I-poem was effective in developing a more complex and nuanced understanding of the identity development of engineering student makers. Further implications of this novel approach are that I-poems show promise to resonate better with the reader and position the researcher and reader as ‘standing alongside’ the participant, instead of a more traditional approach of ‘gazing at’ our participants.

Keywords—making, diversity, inclusion, I-poems, engineering education research

I. INTRODUCTION

In 2014, hundreds of universities made a commitment to promote the maker culture through the establishment or enhancement of university makerspaces [1]. Since that time, there has been a significant rise in the number of makerspaces in universities. There has also been an increase in the number of university-affiliated makerspaces associated with engineering programs within the US and throughout the world.

Something inherently appeals to students and faculty within these makerspaces. These makerspaces offer an informal learning space that promotes students taking ownership of their own learning. For example, students have the opportunity to gain proficiency using tools and equipment previously available to only those lucky few who were trained, selected, and given access to the labs or machine shops. Moreover, these makerspaces expand classroom learning to provide a space that can better promote constructionist learning, or learning by doing [2]. Through sustained engagement in these spaces, students can potentially begin to feel like an engineer, experience a sense of

belonging, and gain skills and abilities as they engage in “doing” engineering.

However, during this period of rapid growth, many conversations and articles discussing makerspaces have focused on the physical layout, equipment within, and the arrangement of this equipment within the makerspace. Implied in these discussions is simply having makerspaces available to students will attract more students into engineering majors. Attracting a more diverse cadre of students into engineering, in light of engineering programs’ increasing difficulty to support, retain, and graduate its most marginalized student populations, is of paramount importance. One way to increase student interest in engaging in such spaces would be through a focus on how students develop their engineering identity through engagement in these spaces, and how this impacts their sense of belonging in engineering.

Identity is a process of understanding one’s self within the larger socio-cultural context [3], [4]. Seen this way, identity involves both personal and social aspects. The personal sense of identity acknowledges how the individual must understand their behaviors, values, and personality on an intimate and unchanging level. At the social level, identity becomes more about aligning these personal values and practices to the rules defining a certain group’s membership. Within engineering education, Tonso defined engineering identity as a sense of belonging to the profession [5]. Tonso also discusses how difficult it can be for students to “be themselves *as engineers*” and the importance of campus engineer identities (social level as described above) in deciding what counts as being an engineer [5, p. 274]. In Tonso’s research, the most common campus engineer identities were identified as nerds, academic-achievers, and Greeks (social achievers). These ways of being engineers in this engineering program, then influenced student’s sense of belonging. In building a professional identity within engineering domains, students must understand and adopt the rules of the engineering profession inclusive of the broader discourse [6], or ways of thinking, feeling, valuing, and acting [5].

As such, we cast doubt upon this reductionist “if we build it, they will come” philosophy, given how much more it will likely take to truly transform the type and quantity of students interested in engineering careers. Thus, we aim to develop an empirical understanding of the more nuanced ways students from underrepresented groups (URGs) may experience making

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in makerspaces. From this, we can uncover ways of better designing and running these makerspaces to avoid perpetuation of exclusionary cultures that exist in engineering environments.

In this Work in Progress paper, we are interested in exploring arts-based research methods of I-poems as an analytic strategy for understanding the identity development of underrepresented engineering students engaging in makerspaces.

II. THEORETICAL APPROACH

Central to our research is the desire to understand and communicate the complex and nuanced stories of our participants. As makerspaces are arguably in their infancy, exploratory research is needed to first understand the experiences of engineering students from URGs who are also makers.

We also understand that, as researchers, we have an authoritative role in presenting the findings from our research studies. Recognizing society's power structures, we acknowledge that the engineering education researcher is positioned as more dominant than the undergraduate engineering participants in our studies. By exploring different ways of representing our participants' lives and experiences, we are also attempting to ease some of the power differential common in studies of this nature. Richardson explains,

When we write social science, we are using our authority and privileges to tell about the people we study. No matter how we stage the text, we – as authors – are doing the staging. As we speak about the people we study, we also speak for them. As we inscribe their lives, we bestow meaning and promulgate values [7, p. 12].

In our previous work using narrative research methods, we have attempted to construct and share stories in a way that kept the participant's voice intact, such that we could privilege the voices of the often voiceless [8]–[10]. While this enables us to share stories in the participant's voice, it does not allow us to share more than two or three stories of participants in traditional dissemination venues. For instance, length restrictions of conference proceedings and journal articles often limit our ability to truly honor the participants' voice. In this manuscript, we therefore explore the use of I-poems [11] as a novel means of drawing out the complexity of our participants' experiences, sharing their voices with consumers of our research projects, and sharing more diverse stories within a single manuscript.

Given our interest in exploring I-poems for understanding and sharing the unique voices of our participants, we surveyed the literature and evidence surrounding this approach. Edwards and Weller conducted a thematic analysis and produced I-poems from the analysis of Anne, a white, British young woman who was interviewed three times, when she was 11, 15, and 17 [12]. In the broader study, the authors were interested in change and continuity in a young person's identity over time. In particular, they discussed how these different analytic methods changed the perceived relationship between the researcher and participant. According to Edwards and Weller, in the thematic analysis, they concluded the researcher felt they were "gazing at" the participant. However, the creation of I-poems challenged this distance by moving the researcher to feel they were

"standing alongside" the participant [12, p. 206]. What's more is that these two types of analyses accentuated different aspects of the interviews. For example, the thematic analysis resulted in a discussion of Anne and her changing relationship with her older sister. Conversely, the I-poem analysis focused on Anne's personal experiences as a little sister and how her sense of herself changed and became more ambivalent as she got older.

In this paper, we are engaging with the analytic strategy of I-poems as a way to draw out the richness of our participants' stories and focus on how they discuss identity. By focusing our efforts on the first-person voice of the participant, we may better understand how our participant talks about themselves and how their identity evolves over time [13]. While there is not one correct way to create I-poems, they are typically based on the second step in the Listening Guide, and involve excerpting "I" statements of the interviewee from an excerpt in the interview to construct a poem [13].

III. PURPOSE AND RESEARCH QUESTION

The purpose of this paper is to play with various ways of representing participant voice in order to best draw out the richness of our data. The research question guiding this study is: How well do I-poems and thematic analysis help us uncover complex and nuanced understandings of the identities of engineering students and makers who are from URGs?

IV. METHODOLOGY

A. Context of the research

In this broader research project, we are interested in the experiences of engineering students from URGs who are engaging in makerspaces. To date, we have conducted site visits and collected data at seven institutions throughout the US. These research sites are university-affiliated makerspaces. We selected makerspaces at diverse institution types (e.g., high research universities, prestigious liberal arts colleges, minority serving institutions (MSIs)) in efforts to observe a variety of makerspaces and to situate us to interview students from diverse backgrounds. We were interested in students diverse in race, ethnicity, gender, engineering discipline and classification (1st year, 2nd year, etc.). In particular, in this broader, multi-faceted study we are interested in uncovering the personal identity stories of engineering students who engage in makerspaces and whether there are gender, race, or ethnicity differences in these stories. We are also interested in developing an understanding of the culture of these makerspaces through these personal identity stories.

B. Data Collection

For this work in progress paper, we are going to explore the creation of I-poems from passages taken verbatim from interview transcripts and consider aspects of identity that could emerge from this analytic approach. We are also going to compare these I-poem results to results based on a thematic analysis. We have selected one excerpt from one interview (of 67 interviews with engineering students/ makers). We selected this excerpt, because this excerpt is representative of many of the other excerpts in the larger data set and will be helpful in testing out this new analysis method.

C. Data Analysis

For the I-poem analysis, we constructed I-poems from Betty's interview transcript. For data reduction, we followed the method outlined in the second step of the listening guide [13]. We underlined the "I" statements, including I, the verb, and any other words that we deemed important. We then arranged these "I" statements in the same order that they appeared in the transcript. We also considered other statements and contextual elements that were needed to understand the story within the poem. In our case, these included other pronouns such as "he" or "guy." We then separated lines of the poem into stanzas. Within Betty's interview transcription, we generated seven I-poems. We then reduced this number of I-poems to one for this paper, where we explore the methodological implications of an I-poem analysis and how this contrasts with a thematic analysis.

For the thematic analysis, data was first coded using structural coding [14]. We generated 10 codes that related to our project's research questions. Codes included, for example, "pedagogical experiences that shape identity," "road of trials in engineering," and "stories of values, knowledge, skills, practices, and norms in engineering classrooms." For more details about this step in our analysis, see [15].

During this process, we wrote analytic memos reflecting on the analysis and how the two modes of analysis compared and contrasted. These analytic memos were read and re-read and were used as a basis for the discussion section of this paper, where we discuss the differences between the two modes of analysis. We were not attempting to identify the "best" way of analysis, but to think deeply about the implications of different analytic approaches to this data set.

For this paper, we present the I-poem and a discussion of the I-poem, ending with a thematic analysis and discussion. In the discussion section, we share lessons that emerged from this preliminary analysis.

V. FINDINGS

Betty is a fourth year, Black undergraduate student in Mechanical Engineering at a Private, not-for-profit institution. The institution is a doctoral university with high research activity according to the Carnegie Classification. Also, according to the Carnegie Classification, the undergraduate profile is four-year, full-time, more selective, and lower transfer-in [16].

A. I-poem Analysis and Discussion

I was in there,
I had a project

I was filing my project,
I was doing some finishing on the wood,
I'm filing

I know how to file,
I had to
I had a class before,
I was filing wrong
I did it and it was beautiful!

I know how to file.
I'm filing upstairs, big file, perfect strokes
guy is hovering behind me and it's just like, tsk tsk tsk tsk tsk.

I'm like, I don't know what he's doing
'cause I'm like, I'm filing,
I'm just like
he's just like no, no

I think he's like, doing something else,
he like touches me,
"Um, excuse me, excuse me, um ... you're doing that wrong."
"I'm sorry?"

I was like, "Oh no, It's like..."
He starts doing it
He's like mangling the side of my piece

I was like, "Oh no, this ..."
I'm like,
"I think I got this."
He's like, "Okay."

I don't know.
I was just like, so now
I'm like that piece is mangled
I have to fix it.

This I-poem highlights the complexity inherent in Betty's story. Through viewing this data as a poem, the contradictions between the statements of "I know how to file" and the male in the space questioning her abilities "tsk tsk" begin to emerge. We also begin to see clearly the repeated phrases that Betty uses when telling her story. She repeats "I know how to file" and "I'm filing." In the poem she also moves between the current story and present tense into past tense, where she is establishing her knowledge of filing.

The poem helps us begin to understand Betty's identity, which is a combination of values, knowledge, and skills taking place within a community of practice. In the beginning of the poem, Betty is confident in her filing skills. As the I-poem continues, we are introduced to the "guy" who hovers behind her and questions her filing abilities. She communicates to him that she "thinks" she has got this and then he moves away. The I-poem accentuates a tension between Betty's confidence in her skills and knowledge around filing, and how these skills and knowledge are not recognized by others within the space. While this could be considered an event that happens once, when this I-poem is combined with Betty's other I-poems, we get a sense that her skills and knowledge are often not recognized within the larger community. This begins to give us a sense of the power differentials present in the makerspace, with Betty being a less empowered individual than the white, male student. Under these less than ideal circumstances, Betty can, at best, form an identity as a peripheral member of the group. Given our conception of identity, Betty's actions and beliefs in the space fulfill her personal sense of self. However, without influential others recognizing her personal knowledge practices and skills as

valuable to the larger engineering community, her ability to form a professional identity is complicated.

We could also broaden our analysis to look across multiple I-poems found in Betty's story. Through looking across these I-poems we will begin to see patterns of expression in her voice that emerge. In this poem, we observed the confident voice and the exasperated voice. Looking across other I-poems, we would see other expressions of voice begin to emerge, such as the oppressed voice, the spokesperson for others voice, the imposter voice, and the unconfident voice. Through these emerging senses of herself, we could begin to understand the evolution of her identity from the time that she picked a college to her experiences as a 4th year Mechanical Engineering student and maker. Through this analysis of her evolving voice, we can also begin to see her voice becoming more confident and empowered through the narration of her story. We can also begin to see the role of making in her story and in her sense of self.

B. Thematic Analysis and Discussion

To provide a different analytic approach to the analysis of this passage, we will describe codes that were applied to this passage during the first pass of data analysis for this larger project.

Pedagogical experiences that shape identity: This excerpt, "I had a class before, I was filing wrong, my ... the shop manager pulled me aside, gave me the smallest file imaginable and told me to file this mangily piece of wood into a cube, and it took me hours and I did it and it was beautiful!" was coded as pedagogical experiences that shape identity. The description of this code is experiences and learning environments that influence a person's professional or personal identity formation (within university space). This excerpt could be used as an illustration of an experience that happened in a makerspace that then influenced Betty's identity as someone who can use a file to create.

Stories of bias/ prejudice/ stereotype: Much of this passage was coded as "stories of bias/ prejudice/ stereotype." An excerpt from this larger coded passage is, "But, some of the others using the space don't necessarily treat you equally, so I was in there, I had a project and I was filing my project." The description of this code is experiences of being marginalized through identity or affiliation with at least one of these groups: woman, racial/ethnic minority, low socioeconomic status, person of disability, first generation student, LGBTQ status, transfer student. This passage highlights trials that are faced by this student, which are, at least in part, due to her being a Black, female student, as she engages in the makerspace.

These coded excerpts would be aggregated with other excerpts from Betty's interview and the remaining 65 interviews. Through multiple coding passes, we would likely have a set of themes that would emerge from this data with a few of these themes focused on the identity development of undergraduate engineering students and makers who are from URGs. These themes would be broad and written in the third person with supporting quotes from the participants. At most, we would include a short quote from Betty's interview in a final publication. Her stories would certainly impact the themes that were developed, but would not be included in detail in any dissemination of this work.

VI. DISCUSSION

After exploring these two types of analysis in parallel, we are left wondering if one is more superior to the other. We believe the answer to that is, "it depends." There are certainly many differences in the two approaches that emerged from this analysis. One difference between the two approaches is the depth of understanding of identity. The I-poems provide more depth to the ways that the participant talks about themselves, and, in some cases, how they talk about themselves in relation to others. This depth enables us to uncover more complex and nuanced understandings of the identities of these students. However, there is a tradeoff in having more depth, there will inherently be less breadth.

Another difference that emerged is the resonance that each method has with the consumers of the research. In many cases, I-poems would likely resonate more with the audience. Because they are in the voice of the participant, the reader may feel they are "standing alongside" the participant [12]. A thematic analysis sets the reader further away from the transcript data and induces a feeling of "gazing at" the participant. This distance would not enable them to hear the voice of the participant.

Finally, these methods have implications for uncovering instances of power within the makerspaces. In the I-poem analysis, longer excerpts of the participant's voice are provided. This helps ease some of the power differential between the researcher and the researched (i.e., the participant) by presenting the findings in a way that honors their voices. Conversely, in the thematic analysis, the primary voice in the findings section is that of the researcher, thus increasing the power differential by honoring the researcher's voice over that of the participant. Admittedly, the researcher is in a more dominant position than the participants in all of our studies [7]. However, the I-poem analytic method shows potential for lessening that differential. There are other possible ways of honoring a participant's voice that are not considered in this manuscript. One example is to invite the participant to be a co-author on the papers that emerge from the work. This does, however, bring about other concerns. One such concern is that the identity of the participant is revealed and, depending on the focus of the paper, this may be something that one would not want to reveal about themselves in such a public forum. In addition, it may be difficult to have the participant meaningfully contribute to a paper as, in many cases, they are not trained as researchers.

VII. CONCLUSION

In conclusion, this paper presents an analytic mode that shows promise for developing an understanding of the identity of engineering students. In this paper, we are not claiming that I-poems are better than thematic analysis. Instead, we exemplify their particular analytic differences when examining the identity development of engineering students through interview transcripts. While thematic analysis will help us understand, more generally, the identities of engineering students, I-poem analysis promises to provide a more complex and nuanced understanding of the participants' identities while lessening the power differential present in academic manuscripts between the researcher and the researched.

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