

# What Does it Mean to be Smart? A Narrative Approach to Exploring Complex Constructs

Emily Dringenberg  
Department of Engineering Education  
The Ohio State University  
Columbus, OH, USA  
dringenberg.1@osu.edu

Rachel Kajfez  
Department of Engineering Education  
The Ohio State University  
Columbus, OH, USA  
kajfez.2@osu.edu

**Abstract**— This Research Work in Progress paper focuses on the use of narrative methods to explore the complex and overlapping constructs of beliefs about smartness and identity in first-year engineering students. This effort is motivated, in part, by the perspective that the first year of engineering at the university level can be a source of hardship for many students. Not only are they navigating a new environment away from home, but they are also often experiencing new educational challenges that can push them to re-evaluate their identities with respect to smartness and becoming an engineer. We are interested in understanding how students construct and tell stories about their life experiences as learners and how these stories provide insight to their beliefs about smartness and their related identities as students or as engineers. Because these constructs are complex and overlapping, we conducted narrative-style interviews with students who self-identified as having an interesting story to tell about an educational struggle during their first year in an undergraduate engineering program. We are motivated to answer the following research questions: *In what ways do narrative style interviews provide insight into complex constructs related to beliefs about smartness and identity? How do first-year engineering students describe their educational experiences with respect to smartness and identity?* To scope our work, we frame beliefs about smartness through the use of Dweck's mindset theory, and for identity, we use Gee's identity lens coupled with Godwin's definition of engineering student identity. Due to the WIP nature of this research, we are still fully conceptualizing the potential impacts and implications of this work. At the time of presentation, we share our experience using narrative style interviews paired with preliminary findings related to the posed research questions.

**Keywords**—beliefs, identity, first year, smartness, narrative

## I. INTRODUCTION

Significant research has been conducted to understand the role of student characteristics on their academic persistence and success. These characteristics, such as identity, motivation, or beliefs, are often studied in isolation. However, in order to inform educational reform, a more nuanced understanding of how these constructs are interconnected in a person's lived experience is needed. These constructs are complex and overlapping, so it can be difficult to utilize extant research methods to capture them and connect them to educational experiences over time in a meaningful way. This work has been a first step towards understanding how the use of narrative

inquiry to collect stories from undergraduate engineering students can serve as a productive means to explore multiple complex constructs and the ways they integrate, rather than studying these constructs in isolation. This is important as we acknowledge the complexity of people as individuals constantly interacting with educational and societal structures and making on-going sense of their experiences, especially as it relates to smartness and identity formation. In addition, researchers have recently called out the limitations of framing research about engineering ability, which is intended to understand student success or promote inclusion, as limited to traits of the individual or to various socialization processes [1]. While this work does maintain the participants' stories as the unit of analysis, we are hopeful that the use of narrative can allow for more complex exploration of individuals and the educational systems in which they live and operate. While pursuing this methodological goal, we were also able to gain some preliminary insight into how first-year engineering students describe their educational experiences with respect to smartness and identity.

## II. BACKGROUND

In this work, we explore undergraduate engineering students' beliefs about smartness and identity as they emerge from narratives constructed about educational experiences. Our working hypothesis is that when one's smartness is challenged (i.e., a student receives a "bad" grade on a college test or completes academic work at a slower pace than near peers), this

influences their identity, including their beliefs about their own smartness and perhaps their identity as an engineer. This assumption is based on prior research, which has provided evidence that engineering is often equated with academic ability, especially in math and science [2] and perceived as a difficult field of study [3], engineering students identify early as engineers [4], and people's

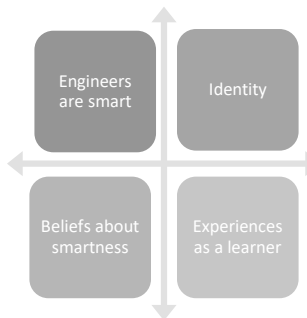


Fig. 1. Overview of related constructs of interest

decisions about how to behave are, in part, based on their identity [5]. Fig. 1 provides a view of these overlapping assumptions and our constructs of interest. These constructs are of particular interest because of a larger community effort to increase participation and retention in engineering. To scope our work, we utilize frameworks for beliefs about smartness and identity.

#### A. Beliefs About Smartness

Carol Dweck's theoretical framework for beliefs about the nature of ability, commonly referred to as growth mindset when the ability has to do with intelligence, has gained in popularity, especially in K-12 education. Due to the first author's prior experience in this research area, we intentionally use the word "smartness" here rather than "intelligence" or "ability" because the latter two have proved to be distinct ideas for students, whereas smartness is more general and likely to overlap with other constructs. Dweck's line of research provides empirical evidence that most individuals hold beliefs leaning in one of two ways: 1) a person's smartness is static and inherent (fixed mindset), or 2) a person's smartness is malleable (growth mindset) [6]. Researchers have provided evidence that a person's beliefs about the nature of smartness, or mindset, are distinct from other scales such as self-esteem, optimism, cognitive or motivational styles [7, 8]. To put it simply, do students believe that smartness is something you either do or do not have, or do they believe that smartness can be changed through effort? Researchers have linked these opposing beliefs to three key areas important to behavior in educational settings: motivation, views on effort, and responses to challenges [9]. Beliefs about smartness are dynamic, contextual, and often implicit, making them difficult to study directly. We have learned that while engineering students may not explicitly talk about the nature of smartness in interviews, the general idea of smartness is woven into their experiences [10]. Many actors in our educational systems construct clear cultural messages about who is cut out for engineering and who is not [1]. Dweck's theory allows us to frame our research around the underlying assumptions about smartness as fixed or malleable. We are interested in exploring narrative as a methodological framework with potential to capture the richness and complexity of students' beliefs about smartness, in themselves and others, formed through a lifetime of educational experiences. We are particularly interested in first-year students due to the required adjustment to a new educational setting when transitioning to college, which proves difficult for many students.

#### B. Engineering Identity

James Paul Gee's identity work provides a lens for understanding the kind of person someone is [11]. This analytical lens has been used in engineering education as a way to break down and interpret individuals' views of themselves to better understand the complex ways the self is shaped through experience [4, 12, 13]. For our work, we are particularly interested in the kind of student someone is in reference to experiencing a perceived struggle within engineering education and broader societal structures. Due to the qualitative and

exploratory nature of this work, we are currently using all four of Gee's views on identity (nature, institution, discourse, and affinity) to understand the student experience; however, because we are interested in educational and societal structures' impact on students' views of themselves, we are particularly interested in institution (i.e., a position) and discourse (i.e., a trait recognized in an individual) identities and their relationships with beliefs about ability.

We also draw on the role-identity research of Godwin [13], who built on the work of Hazari, et al. and Burke [14, 15], which conceptualizes a student's identity as including personal, social, and engineering identities. We postulate that a personal identity as smart (or not smart) coupled with a social identity created institutionally during a first-year engineering experience will impact a student's engineering identity.

### III. METHOD

This Work in Progress paper reports our current progress in our effort to conduct narrative-style interviews to explore how multiple complex constructs related to beliefs about smartness and identity might be understood in more comprehensive and socially situated ways. Narrative research has been conducted in many varied ways but consistently aims to capture people's stories, which reveal complex meanings that people assign to their lives [16]. This aligns with our goal of exploring multiple constructs at once in a more comprehensive way. Narratives are also recognized as an excellent way of understanding identity [17]. Within engineering education, Pawley [18, 19] has demonstrated the efficacy of narrative as a way to understand how underrepresented engineers interact with institutional structures as gendered and raced. Walker [20] utilized narrative to explore the role of gendered identities within engineering. Considering the utility of narrative to solicit nuanced data around people's lives, identities, and interactions with institutions, we believe this method is well-aligned with our goal of understanding how engineering students move through educational systems, transition into higher education, experience challenges, believe about smartness, and construct salient identities within engineering.

#### A. Researcher Reflexivity

This research was conducted by a team of four women: two are white faculty members in their early 30s and two are female undergraduate research assistants, one in her fourth year who identifies as white and one in her first year who identifies as Vietnamese. Both undergraduates had traditional pathways into engineering entering the university right after high school. The undergraduates conducted the interviews; the faculty members trained the undergraduates, conducted the literature review, are completing the analysis, and wrote the paper.

#### B. Participant Recruitment and Selection

Participants were recruited by email from a pool of approximately 200 undergraduate students who had previously expressed interest in participating in research interviews. All participants had completed a first-year engineering experience

the previous year at a large, research-intensive, Midwestern university. Twenty-three individuals completed the recruitment survey with responses to demographic questions, self-reported grades, and brief short answer questions including, “*Briefly describe yourself as a student (i.e., what kind of student are you?)*” and “*Briefly describe a time you struggled as a student. What happened and why? This could be something you struggled with recently or at any other point in your education.*” The researchers selected eight participants based on the short answers, prioritizing individuals who provided rich details in their stories that we believed had potential to allow insight into beliefs about smartness and identity. Of these eight selected participants, seven participated in an interview and received a \$25 Amazon gift card for their contributions. For this paper, we summarize stories from three participants; however, future presentations of this work will include information from all the participants’ interviews.

### C. Data Collection

Seven individuals scheduled and completed one-on-one interviews with trained undergraduate interviewers. The methodological decision to use undergraduate researchers rather than ourselves (faculty) was made in an attempt to lessen the power differential present during the interviews. Narratives are co-constructed by the participant and the interviewee in a given time and place [21], so utilizing undergraduate researchers was justified by a belief that the stories constructed as data for this project would be more natural between two students rather than between a student and a faculty member. Interviewers started each interview with an open-ended prompt, “*Tell me the story of how you got to this point in your education,*” and then asked probing questions to follow up on the stories that participants told.

### D. Data Analysis

To date, we have begun our initial analysis of the interviews. Currently, we are listening to the interviews to familiarize ourselves with the participants’ stories. Following the familiarization stage, we will start coding the interviews systematically to identify ways in which beliefs about ability and identity are woven into stories of students and their interactions with educational systems. The brief summaries we present here focus on a preliminary thematic analysis of narrative data, which reflects a common approach used by those engaging with narrative as a methodology for the first time [21]. We believe that a triple coding technique used in process evaluation where we would code the outcome, context, and reason may be valuable to this work [22]; however, we may adjust this approach based on our data. We also recognize the potential to draw on analytical steps employed by other researchers using narrative-style approach in engineering education [19].

## IV. PRELIMINARY FINDINGS

To date, we have conducted seven narrative-style interviews and have done a first listen to the interviews to identify the ways in which this methodology is suitable for our research questions

as well as any insights we gained about participants’ educational struggles, beliefs about smartness, or identities. When we began this work, we were unsure how the open-ended nature of the interviews would elicit information related to our constructs of interest. After conducting the interviews and listening to the ways that our participants tell their stories, we found that some resulting data are a productive first step towards our research goals, but that others fall short. Below we briefly summarize using pseudonyms the ways in which beliefs about ability or identity did surface during the open-ended, narrative-style interviews of three select participants. We close with takeaways related to these findings as well as our insight gained about the use of narrative for our research purpose.

### A. Participant 1: Yolanda

The first participant shared a story that we deemed quite interesting. She shared at length about her experiences participating in advanced courses during both high school and her first year in engineering (e.g. honors & advanced placement). Her ability to do well in classes was something she viewed as setting her apart as a smart person and she accepted this aspect of her identity, especially as it related to her social life, or her ability to make friends or be popular. She admitted to a tendency to look down on students who were unable to handle the workload that she could (social status related to smartness came through peer comparison). She communicated that her friend group from high school revolved largely around success in academics, which was framed as getting good grades or exam scores in advanced classes. She completed her introductory engineering coursework through dual credit while still in high school. While this unique experience was an example of how she saw herself as different and above average (and it made her parents proud), she was cautious about sharing this information with peers for fear that it might be socially isolating.

### B. Participant 2: Zach

Of the three participants reported here, Zach shared the least amount of detail about his life experiences as a student. His story centered on the transition from high school (which for his level of smartness, required little effort to achieve academically) to college. He failed a class during his first semester of college, and that caused him to recognize that he should ask for help, which was (and continues to be) difficult for him. Many of his descriptions of his experiences as a student were motivated by making academic progress (e.g. getting into a college major) and by the idea of being prepared and qualified for having a good career. A recognition that smartness may be contextual was present, but evidence of his identity or identity development during the transition to college was not obvious from our preliminary read of the data.

### C. Participant 3: Bill

Bill focused largely on his identity as a role model to his younger siblings during his interview. Smartness came up briefly when he described the competitive nature of engineering school and the trend of some engineering students to put down students in other majors; however, smartness was not a salient

theme in his story. He spoke about the significant role of his family, including many teachers and school administrators, in raising him to recognize the value of education and to think of himself as setting an example for his many younger siblings and cousins. Similar to Zach, Bill described his struggle as making the transition from high school, which was easy and did not require him to study, to college, which was a much faster pace with difficult exams. He also failed a course his first semester, but he learned to improve his study habits and ask for help, and he did well when he retook the course he initially failed. Bill shared that he viewed the institutional use of GPA as a poor way to represent a person's smartness—he thought motivation was more important. He described his own experience with being denied access to particular majors based on his GPA as feeling like doors were being unnecessarily closed on his pathway to becoming an engineer.

#### D. Preliminary Takeaways

We were not surprised that we had difficulty conducting the interviews in a way that felt true to the narrative tradition. For example, our interviewers were not always successful in soliciting rich, detailed stories rather than general summaries or views about past experiences. We believe this is partially due to the inexperience of our interviewers and the complex nature of beliefs about smartness and identity.

Based on our first listen to our participants' stories, smartness was portrayed with underlying tones of assuming smartness to be fixed. For example, Yolanda made it clear that she was smart in a certain way, but her brother was smarter. Smartness was communicated as something that is true about a person, not something that changes over time or with effort. We interpreted this as different than malleable ability in other areas, such as sports, where practice more obviously improves performance. This idea was also communicated in ways that aligned with a nature identity, something that someone is born as or with, and personal identity, a characteristic of the individual. People who were considered smart were seen as the ones in advanced coursework, which may relate to an institution identity and would have an impact on one's social identity.

Zach and Bill experienced high achievement in high school followed by failing a class during the first semester of college. They seemed to maintain a belief that their smartness was fixed (nature), and they interpreted that as: in college, sometimes you just need to adjust your behaviors (e.g., ask for help and study more). Our participants' stories did not include any discussion of questioning your own present capacity to do the work (i.e., smartness). Participants maintained a sense of static smartness and focused on simple behavior adjustments to meet the demands of college-level academic work. These adjustments did not mean you were not smart. They meant you had to change what you were doing, but your smartness was still intact as something true about you. It is possible that these experiences relate to discourse and social factors, but more information is needed to fully understand the impacts of changed behavior on identity.

#### V. NEXT STEPS

As previously stated, we are currently familiarizing ourselves with the interviews before we begin coding. Our familiarizing will include detailed reviews of the transcripts along with detailed memoing. In particular, we will use attribute coding [23] at this stage to document the characteristics and experiences of each participant.

Next, we will explore students' beliefs about smartness and identity. We will adjust to an in vivo and process coding approach for this stage of analysis [23]. This combined coding method will allow us to use the participants' words to guide our analysis and document their development through experiences. Throughout the process we will also evaluate whether or not narrative is the appropriate method for exploring these complex constructs in a connected way through team meetings and discussions.

At this time, we believe there is promise to this approach, but before we expand this work more fully, we need to complete additional steps in the research process to truly evaluate its applicability. Since we have only conducted and analyzed a small set of interviews, there are limitations to our work in terms of its transferability; however, we believe the initial results will guide us in future steps of this research.

#### ACKNOWLEDGMENT

We would like to thank our undergraduate researchers who conducted the interviews. We would also like to thank our participants for sharing their stories. Without our participants, this work would not be possible.

#### REFERENCES

- [1] S. Secules, A. Gupta, A. Elby, and C. Turpen, "Zooming out from the struggling individual student: An account of the cultural construction of engineering ability in an undergraduate programming class," *J. Eng. Educ.*, vol. 107, no. 1, pp. 56–86, 2018.
- [2] National Academy of Engineering, *Changing the conversation: messages for improving public understanding of engineering*. Washington, DC: National Academy Press, 2008.
- [3] E. Godfrey and L. Parker, "Mapping the cultural landscape in engineering education," *J. Eng. Educ.*, vol. 99, no. 1, pp. 5–22, 2010.
- [4] H. M. Matusovich, B. E. Barry, K. Meyers, and R. Louis, "A multi-institution comparison of students' development of an identity as an engineer," in *American Society for Engineering Education Annual Conference & Exposition*, Vancouver, BC, 2011.
- [5] J. G. March, *Primer on decision making: How decisions happen*. Simon and Schuster, 1994.
- [6] C. S. Dweck, *Mindset: The new psychology of success*. Random House LLC, 2006.
- [7] C. S. Dweck, C. Chiu, and Y. Hong, "Implicit theories and their role in judgments and reactions: A word from two perspectives," *Psychol. Inq.*, vol. 6, no. 4, pp. 267–285, 1995.
- [8] S. R. Levy, S. J. Stroessner, and C. S. Dweck, "Stereotype formation and endorsement: The role of implicit theories," *J. Pers. Soc. Psychol.*, vol. 74, no. 6, p. 1421, 1998.
- [9] L. S. Blackwell, K. H. Trzesniewski, and C. S. Dweck, "Implicit theories of intelligence predict achievement across an adolescent

- transition: A longitudinal study and an intervention,” *Child Dev.*, vol. 78, no. 1, pp. 246–263, 2007.
- [10] A. Adams, A. Betz, and E. Dringenberg, “Validation of an interview protocol to understand students’ beliefs about intelligence,” in *125th American Society for Engineering Education Annual Conference & Exposition*. Salt Lake City, UT, in press.
- [11] J. P. Gee, “Chapter 3: Identity as an analytic lens for research in education,” *Rev. Res. Educ.*, vol. 25, no. 1, pp. 99–125, 2000.
- [12] L. D. McNair, C. Newswander, D. Boden, and M. Borrego, “Student and faculty interdisciplinary identities in self-managed teams,” *J. Eng. Educ.*, vol. 100, no. 2, pp. 374–396, 2011.
- [13] A. Godwin, “The development of a measure of engineering identity,” in *ASEE Annual Conference & Exposition*, 2016.
- [14] Z. Hazari, G. Sonnert, P. M. Sadler, and M. Shanahan, “Connecting high school physics experiences, outcome expectations, physics identity, and physics career choice: A gender study,” *J. Res. Sci. Teach.*, vol. 47, no. 8, pp. 978–1003, 2010.
- [15] P. J. Burke, “Introduction,” in *Advances in identity theory and research*, P. J. Burke, T. J. Owens, R. T. Serpe, and P. A. Thoits, Eds. Kluwer, NY: Springer, 2003.
- [16] R. Josselson, “Narrative research: Constructing, deconstructing, and reconstructing story,” in *Five ways of doing qualitative analysis: Phenomenological psychology, grounded theory, discourse analysis, narrative research, and intuitive inquiry*, F. J. Wertz, K. Charmaz, L. M. McMulle, R. Josselson, R. Anderson, and E. McSpadden, Eds. The Guildford Press New York, NY, 2011, pp. 224–242.
- [17] S. E. Chase, “Narrative inquiry: Multiple lenses, approaches, voices,” in *Collecting and Interpreting Qualitative Materials*, 3rd ed., vol. 57, no. 3, N. K. Denzin and Y. S. Lincoln, Eds. Thousand Oaks, CA: SAGE Publications, 2007, pp. 651–679.
- [18] A. L. Pawley, ““Learning from small numbers” of underrepresented students’ stories: Discussing a method to learn about institutional structure through narrative,” in *Proceedings of the 2013 ASEE Annual Conference and Exposition*, Atlanta, GA, 2013.
- [19] A. L. Pawley, “From the mouths of students: Two illustrations of narrative analysis to understand engineering education’s ruling relations as gendered and raced,” in *121st American Society for Engineering Education Annual Conference & Exposition*, Indianapolis, IN, 2014.
- [20] M. Walker, “Engineering identities,” *Br. J. Sociol. Educ.*, vol. 22, no. 1, pp. 75–89, 2001.
- [21] C. K. Riessman, *Narrative methods for the human sciences*. Thousand Oaks, CA: SAGE Publications, 2008.
- [22] R. Pawson, and N. Tilley, *Realistic evaluation*. Thousand Oaks, CA: SAGE Publications, 1997.
- [23] J. Saldaña, *The coding manual for qualitative researchers*, 3rd ed. Thousand Oaks, CA: SAGE Publications, 2015.