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Work-in-Progress: Meme-ing Engineering: Exploring Student Perceptions of Engineering Culture through Memes

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Abstract

This work-in-progress paper examines student perceptions of the undergraduate engineering subculture through memes, which are visual artifacts that provide a unique lens into the shared experiences, values, and norms associated with the undergraduate engineering community. Despite efforts to diversify the engineering workforce, representation of minoritized groups has remained largely unchanged. While research has underscored the role of engineering culture in fostering belonging and professional identity among students, its complexity – encompassing diverse and sometimes contradictory norms, values, and power dynamics – make it elusive and its components challenging to articulate. We address this challenge by conducting a content analysis of over 400 memes submitted by engineering students in a foundational undergraduate engineering course at a large land-grant university in the Mountain West. Preliminary findings highlight themes such as perceptions of rigor, stereotypes, and shared struggles that will be used to inform future interview protocols for further exploring meme interpretation and transferability. Ultimately, these findings will articulate cultural components that serve as leverage points for promoting inclusion in engineering for students from all groups.

Introduction

Despite significant efforts to diversify the engineering workforce, the number of students belonging to minoritized groups in engineering have remained relatively constant over the last several years [1]. While many groups have seen a steady yet slow increase in numbers (i.e., women), others have reported declines in enrollment (i.e., Latinx students) [1]. At the same time, research has emphasized the important role of engineering culture in promoting a sense of belonging among students and fostering their professional identities (e.g., [2], [3]. Given the complexity of culture, which encompasses diverse and sometimes contradictory elements such as norms, values, and power relations, memes can offer a particularly useful tool for examining the undergraduate engineering subculture as experienced by students [4].

In this work-in-progress paper, we present preliminary findings from our study conducted as part of a National Science Foundation-funded Summer Research Experience for Undergraduates during the Summer 2024 term. In this study, we examined student perceptions of undergraduate engineering subculture as communicated through memes. Memes, as culturally relevant and often humorous artifacts, offer a unique lens into the shared experiences, values, and norms within the engineering community. The flexibility of memes as a medium allows them to promote a sense of community through shared meanings related to identity, inclusion, language, and cultural symbols [4]. To guide this study, we asked the following research questions: (1) What are the perceptions of students regarding the engineering programs at their university? and (2) How is engineering culture reflected in the meme content that undergraduate students choose to create and share? To address these questions, we conducted a qualitative content analysis of over 400 memes submitted by engineering students in a foundational undergraduate engineering

course at a large land-grant university in the Mountain West. Analysis procedures were guided by principles found in discourse analysis [5] to identify recurring themes, language, and symbols that reflected student perceptions of engineering culture.

The Significance of Memes in the Study of Culture

Memes have been shown to be a powerful tool for promoting community through shared meanings derived from identity, inclusion, culture, language, political landscape and more due to the flexibility of the medium [6], [7], [8]. The power of memes lies in their ability to condense rich and nuanced perceptions and sentiments about a context within a single communicative unit [4], [9]. Several scholars in education have found that the utilization of memes and humor while teaching lead to higher levels of student engagement in the classroom, strengthened student-teacher relationships, and improved academic performance [10], [11], [12]. Within engineering education, memes have not been extensively examined as a viable form of data collection; however, because of the social nature of memes, we believe that memes may serve as a unique, engaging, and accurate option for capturing the honest perspectives of students regarding their engineering programs. At the same time, memes may also provide fruitful opportunities for engineering students to cope with common programmatic and social challenges as identified by their peers [13], which may lead to increased belonging and retention in engineering programs.

Theoretical Framework

Our inquiry is grounded in a component of discourse analysis referred to as speech acts. Speech acts are utterances – including written communication – in which an individual not only conveys information, but also performs an action (i.e., doing something with words) [14], [15]. Examples of common speech acts include but are not limited to making a promise, making a joke, and advocating for oneself or others [5], [14], [16]. In her theoretical examination of the role of memes in online communities, Grundlingh [5] argues that the functions of memes (i.e., what they do and how they are used) correspond to those identified in speech act theory [14], [15]. Informed by Grundlingth's work, we use speech acts in the present study to connect meme content to actions that ultimately promote or hinder the inclusion of students from minoritized and underrepresented groups. This framework challenged the research team to think beyond the words and images presented within a meme and encouraged us to consider broader implications of students' interactions with them.

Research Methods

To address the research questions, a content analysis was conducted on 436 memes submitted by undergraduate engineering students in a foundational engineering mechanics course across seven semesters spanning three and half years. Students in the course were offered the option to respond to the prompt, shown in Figure 1, as part of an extra credit assignment presented as a class discussion board hosted in the course's Canvas site. Students were encouraged to post memes as well as like and comment on the memes posted by their peers.

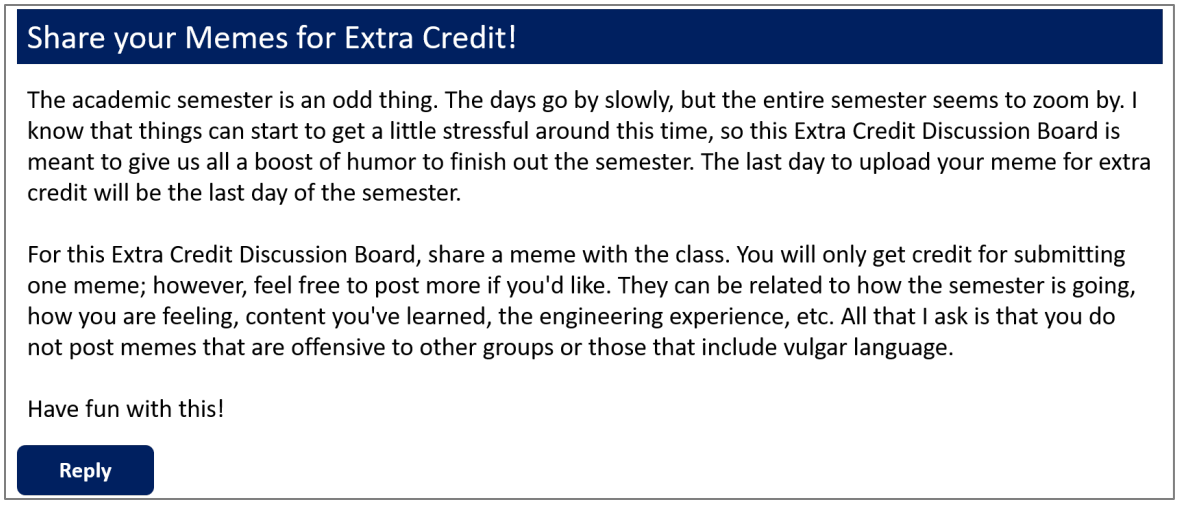


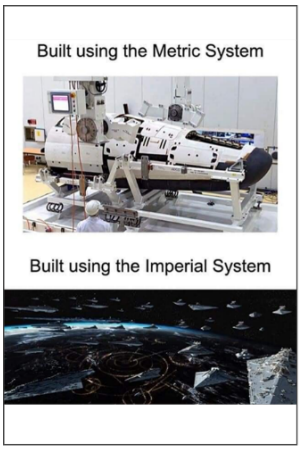
Figure 1: Extra credit opportunity prompt as presented to students via the course Canvas site

All course sections were taught by the same instructor and class sizes ranged from 37 to 105 students. Table 1 provides a summary of the number of memes submitted by students each semester. Duplicate memes were deleted, resulting in a cleaned data set of 336 distinct memes for analysis. To protect the anonymity of student submissions, the instructor downloaded the image files to a secure university-hosted Box folder and ensured that all identifying information was removed from image content and/or file names. All image files were renamed using a common naming scheme (i.e., SemesterYear_MemeNumber). Because this was offered as an extra credit assignment, some students submitted more than one meme while others did not submit a meme, which likely introduces self-selection bias to collected data toward students who may be struggling with heightened mental health, academic, or other concerns [17], thus amplifying negative aspects of undergraduate engineering subculture. Such limitations may be addressed in the future work described in later sections of this paper.

Table 1: Summary of collected memes and student enrollment by course semester and year

Semester/Yr	SP2021	FA2021	SP2022	FA2022	SP2023	FA2023	SP2024	Totals
Enrollment	64	37	98	49	105	56	88	558
# Memes	64	34	72	41	100	43	82	436

We conducted our analysis using a combination of inductive and deductive approaches that occurred over several phases. In Phase 1, the first and second author each reviewed the memes for a single semester (i.e., each author selected a semester to explore) to familiarize themselves with the data and begin identifying common themes related to meme content/topic and construction. In Phase 2, the first and second author each examined a subsample (n=5) of the same group of memes using Shifman's Model of Meme Analysis [8]. During this phase, the first and second author developed structured coding notes that captured the connection between meme components and engineering culture using Shifman's three meme dimensions of content, form, and stance [8]. Definitions of these components and an example of how they were used to summarize broad concepts communicated in the meme are shown in Figure 2.



Meme Dimension	Definition	Coding Notes from Analysis
Content	Refers to the ideas and ideologies captured in the text.	This meme speaks to the engineer's perception of how using the metric system leads to scientific breakthroughs in technology. They compare this message to the imperial system that is more fantastical in nature, while not inherently less scientific. In academia, the metric system is utilized more to express units of measurements over the imperial system.
Form	Refers to the composition of the messaging	This meme is composed of two images of spaceships and two messages about what unit of measurement was used to build the spaceships. The first spaceship is situated in a real-world setting, while the fleet of spaceships in the second image is situated in a science fiction setting.
Stance	Refers to the identity of speakers, the tone of speech, and embedded communicative function.	This meme was submitted by an engineering student. This meme is communicated through a comparison and contrast of what happens when you use two different measurement systems.

Figure 2: Application of Shifman's Model of Meme Analysis [8]

This ensured that coding consistently included the exploration of more abstract concepts and meanings that constituted the overall action being performed in the meme by the creator/sharer as it related to engineering culture. Throughout the analysis process, the entire research team held weekly meetings to review coding iterations and emergent findings. These meetings were held until consensus regarding dimension and topic interpretation and code application were reached. Once the initial codebook was established, the first and second author applied them to the remainder of the dataset.

Initial Findings

Overall, our initial findings began to tell a story about how students perceive their engineering program at their university and highlighted the ways students chose to represent those perceptions within the memes they created and/or shared with their peers. The majority of memes related to school or work, shown in Figure 3. This was expected based on the prompt provided to students for data collection and provided a starting point to being parsing nuances across topics.

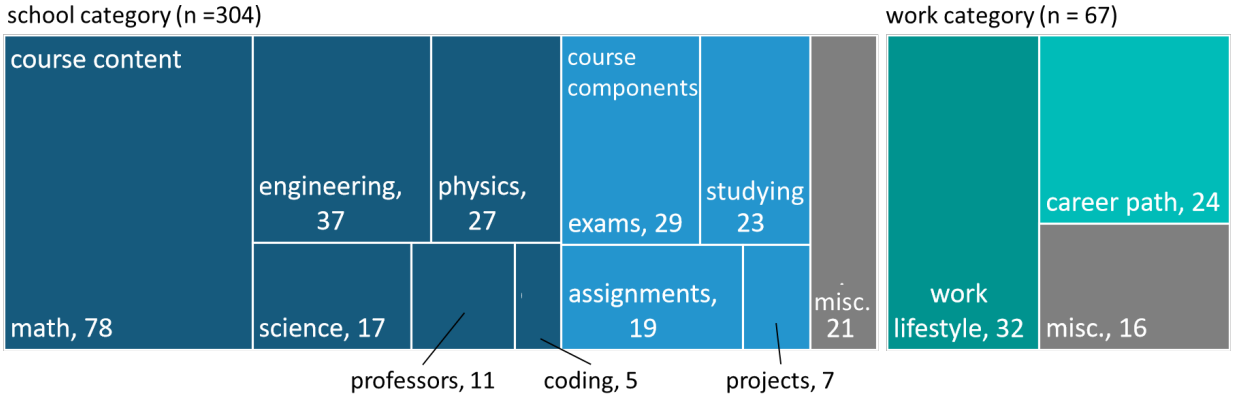


Figure 3: Breakdown of school and work categories with code counts

The School category included memes having a direct reference to any aspect of school (both related and unrelated to engineering). Codes within this category included course components (e.g., assignments, exams, projects, and studying), course content (e.g., content specific to engineering courses, professors), and student lifestyle (i.e., aspects of student life related to the technical and social characteristics of their engineering program). The Work category included memes that provided commentary on or related to students' perceptions of life after graduation and in the workforce. This category included codes related to students' anticipated and specific career paths (e.g., referring to a specific engineering discipline or industry) and work lifestyle (i.e., social and technical aspects of one's life as a working engineer/professional).

Common themes communicated through student memes included perceptions of academic rigor, broad social stereotypes typically ascribed to engineering students, and shared struggles experienced by undergraduate engineering students while participating in their programs. One common example of a shared struggle communicated by students was not having enough time – enough time to sleep, enough time to socialize, and enough time to complete their coursework – as highlighted in the meme examples shown in Figure 4.

Figure 4: Submitted memes depicting a lack of time as communicated through The Office television show (left) and Disney's The Lion King (right).

The meme on the left includes a character named Dwight Schrute (played by Rainn Wilson) from the television show, The Office. In the meme, Dwight introduces the reader (assumed to be an engineering student) to three options: (1) getting enough sleep, (2) getting high grades, and (3) having a social life. At first, he instructs the reader to choose two out of the three equally-important options; however, in aligning with the nature of the Dwight's character on the show, he abruptly changes his proposition by instructing the reader that they must choose only one option, implying that there is only enough time for one thing as an engineering student, which is getting good grades. Similarly, the meme on the right shows a scene from the animated Disney movie The Lion King in which King Mufasa is looking over his kingdom with his son, Simba, who he is training to be future king. When considering the context presented in the movie and its translation into the engineering context, Mufasa is interpreted as a professor or experienced

engineer who is training the next generation of engineers to take their place, which includes hard lessons related to free time. It is implied here, that because engineering content is so challenging and/or time consuming, engineers do not have the luxury of experiencing free time. This theme aligns with established observations of engineering student culture throughout the literature (e.g., [18]).

Conclusions and Future Work

The work we present in this paper is still in its early phases. Because memes are still emerging as sources of data and procedures to analyze them are still generally ill-defined, we dedicated a significant amount effort toward exploring this approach to research, especially in deciphering how various meme components could be parsed out and communicated in a usable and meaningful way. To date, we have established an initial codebook that identifies general trends in meme topics and the frames, or sociocultural contexts, in which those trends are communicated.

In gaining a better understand the complex, multifaceted nature of the cultural forces that shape engineering education, we can identify more nuanced strategies for promoting the cultural inclusion of students from all groups. While many students in our study expressed experienced stressors, some memes also indicated feelings of optimism and introduced a comedic aspect of these experiences. Instances of increased belonging were identified in which the memes served as points of relatability and shared struggle. These memes may point toward students' hopes for the future, though sometimes that future may seem distant and unknown.

Future work includes two significant steps to further examine the topics introduced in this paper. First, we will continue our efforts to map content, frame, and stance [8] across memes to make meaning of the generated codes and their relationships with one another. Second, we will leverage the findings from our initial and continued analyses to create an interview protocol that will be used in later phases of the research to gain deeper insights into meme consumption, interpretation, and transferability across university contexts. At the same time, we want to use this approach as a form of member checking to enhance the quality of this research. The first author has a background in STEM education, with a focus on mathematics, and the other three authors have backgrounds in mechanical engineering (the second author) and civil engineering (the third and fourth authors). Conducting interviews with students, to gain their real-time interpretations of memes, will allow us to not only check our own understanding of the memes, but to further expand the ways in which these memes may be interpreted and leveraged to promote community and belonging in engineering education.

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