

Investigating the development and manifestation of engineering students' conceptualization of well-being in engineering programs and careers

Kailey Head, University of Michigan

Kailey Head (she/her) is a Doctoral Student in Engineering Education Research Program at the University of Michigan. Kailey is also pursuing her MS in Mechanical Engineering from the University of Michigan. She received her BS in Mechanical Engineering from Michigan State University. Her research interests include student wellbeing, engineering design, and manufacturing curricula.

Ash Quadd, Rowan University

Ash Quadd (they/them) is a second-year Ph.D. Student at Rowan University in the Experiential Engineering Education Department, where they draw on their experiences as an agender queer person and advocate for research inspiration. Ash previously attended the University of Delaware, where they completed their B.S. in Chemical and Biomolecular Engineering and M.S. in Biopharmaceutical Science. After working in the biopharmaceutical industry, they decided to pursue a Ph.D. in engineering education to continue their advocacy work with the Queer community in engineering. Ash is currently a member of Dr. Justin Major's ASPIRE (Advancing Student Pathways through Inequality Research in Engineering) Lab, where they study how mental health affects undergraduate engineering students' career trajectories. In their dissertation work, Ash focuses on LGBTQIA+ experiences and identity negotiation in engineering. Across their efforts, they aim to use research to change engineering culture, making engineering more accessible to all marginalized populations, resulting in thriving rather than just surviving.

Maria Elisabetta Maione, Rowan University

Maria Maione is an Undergraduate Research Assistant in Engineering Education at Rowan University and a member of the ASPIRE research group. She is currently pursuing a Bachelor of Science in Electrical and Computer Engineering with a minor in Computer Science and is expected to graduate in 2028. She plans to continue her studies toward a Master's degree. Her research interests include assistive technology, with a focus on improving accessibility through engineering design. She is a National Science Foundation S-STEM Scholar, SMART Scholar with the Department of Defense, and serves as President of Rowan University's Society for Low-Income and First-Generation Engineers.

Isabel Miller, University of Michigan

Isabel Miller (she/her) is a Research Investigator at the University of Michigan in the Biomedical Engineering department. She received her PhD in Engineering Education Research at the University of Michigan in 2025. She received her BS and MS degrees in Bioengineering at the University of Illinois Urbana-Champaign. Her research interests include accessibility in engineering education and disability.

Dr. Karin Jensen, University of Michigan

Karin Jensen, Ph.D. (she/her) is an assistant professor in biomedical engineering and engineering education research at the University of Michigan. Her research interests include mental health and wellness, engineering student career pathways, and engagement of engineering faculty in engineering education research.

Dr. Justin Charles Major, Rowan University

Dr. Justin C. Major (they/them) is an Assistant Professor of Experiential Engineering Education at Rowan University where they leads ASPIRE Lab (Advancing Student Pathways through Inequality Research in Engineering). Justin's research focuses on low-income students, engineering belonging and marginalization mechanisms, adverse childhood experiences, and feminist approaches to EER, and connects these topics to broader understandings of student success in engineering. Justin completed their Ph.D. in Engineering Education ('22) and M.S. in Aeronautics and Astronautics ('21) at Purdue University, and two B.S. in Mechanical Engineering and Secondary Mathematics Education at the University of Nevada, Reno ('17).

Atop their education, Justin is a previous NSF Graduate Research Fellow and has won over a dozen awards for research, service, and activism related to marginalized communities, including the 2020 ASEE ERM Division Best Diversity Paper for their work on test anxiety. As a previous homeless and food-insecure student, Justin is eager to challenge and change engineering education to be a pathway for socioeconomic mobility and broader systemic improvement rather than an additional barrier.

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Introduction

This work-in-progress research paper describes engineering students' conceptualizations of well-being in relation to their career development. There are growing concerns over the mental health and well-being crisis due to its impacts on student wellness and the engineering workforce. Recent studies have found that more than 75% of college students experience moderate to severe psychological distress, with more than 60% meeting the criteria for one or more mental health diagnoses [1]. Untreated or under-treated mental health conditions are connected to lower academic performance [2] and contribute to students leaving degree programs due to stress [3]. These issues are prevalent in engineering, as undergraduate engineering students (UES) have described stress as necessary for success in engineering [4]. Additionally, this mentality is reinforced by engineering culture, in which even faculty feel underprepared and undersupported in conversations about mental health and well-being [5]. Given the influence of mental health on UES development, this is an area we must understand to support the next generation of engineers.

Existing literature on mental health in UES has focused on connections to engineering identity and perceptions of inclusion in engineering programs [6], the prevalence of mental health conditions in different engineering disciplines [7], help-seeking behaviors [8], the impact of the COVID-19 pandemic [9], and the prevalence of mental health conditions and treatment in engineering when compared to other fields [10]. This literature contributes to our understanding of UES mental health and their experiences in engineering education. However, there is a lack of research on UES's conceptualizations of well-being overall and in connection to their career decisions. Given how engineering culture and mental health experiences may influence UES's perceptions of the future, this subject remains a critical area for further research.

Our NSF-funded project #24000607/2400608 is studying the currently underexplored areas of how UES conceptualize mental health and well-being and how these conceptualizations impact their career planning. During our five-year project, we are interviewing UES from two public universities in the Middle Atlantic and East North Central U.S. about their mental health and well-being, and having them create supporting concept maps as visual representations. While students of all years are included in year one data collection, first-year students will be followed throughout their undergraduate education and into their careers. This paper presents preliminary results from the year one data collection, addressing our first research question: *How do UES conceptualize well-being as it relates to engineering learning and professional practice?*

Theoretical Framework

We use three frameworks to understand UES's experiences and address our research question. The primary framework is social cognitive career theory (SCCT), which describes how individuals make decisions and plan their future careers based on past and current experiences, interests, and contextual influences [11]. As part of our framework, we have integrated Engineering Thriving and Engineering Culture into SCCT as contextual influences that affect UES's career and well-being decision-making process. Engineering Thriving is described as the processes by which UES creates a state of "optimal functioning" in engineering [pp. 20, 2], where individuals excel in engineering while feeling well [12]. Engineering Culture, originally

developed from Schein's [13] cultural framework by Godfrey and Parker [14], describes six dimensions of engineering culture comprising the values, understandings, and assumptions shared by the engineering community. By integrating Engineering Thriving and Engineering Culture into SCCT, we can understand how engineering's unique culture around mental health may influence students' career decisions.

Methods

Following IRB approval from both institutions, student demographic information and interest in participating were collected in an initial survey, from which the population was stratified. Participants were selected to increase the diversity of the sample in background and experience. Priority was also given to first-year students, as they represent the majority of our research study, and to account for attrition rates over the five-year research period. Ultimately, our team interviewed 27 first-year students, 10 second-year students, 10 third-year students, and nine fourth-year students. The research team invited selected participants from the interest survey to participate in a 60 to 90-minute interview. The interviews follow a semi-structured format, during which participants discuss their background, personal and professional goals, motivations, experiences with mental health and well-being, and wellness resources they are aware of and/or have engaged with. These interviews were conducted either in person or over secure video conferencing by a member of the research team. The audio recordings were then transcribed using Rev, and identifiable information was redacted. All participants selected a pseudonym to represent them while protecting their identity.

During the interviews, participants were asked to create a concept map on the topic of wellness and update it throughout the interview. Concept mapping is described as a tool for charting a path towards new understanding, with the concept map itself as an artifact to aid the examination of beliefs [15]. These concept maps were cataloged for analysis and paired with the corresponding participant interview to aid interpretation and sense-making of the information.

The first pass of coding used an inductive coding scheme, with three coders independently coding separate transcripts with regular check-ins until saturation was reached, at which no new codes were generated [16]. Subsequently, the group collaborated to cluster and consolidate similar codes into a unified codebook using Miro as a virtual whiteboard. Code definitions and use cases were added to the codebook. Using the unified codebook, the group updated previously coded interviews to ensure consistency and began coding the remaining year one interviews.

Analysis is still underway with a focus on coding the transcribed interviews. The following results are based on a subset of interviews for which coding has been completed, along with interviewer observations. The research team is currently exploring methods for analyzing the concept maps; therefore, no results regarding them will be presented. However, the group has observed them to be a useful tool for creating holistic representations of participants' understanding of well-being and will include them in the project's future work.

Preliminary Results

We identified three themes during the initial analysis: (1) people are central to students' mental health, (2) UES conceptualize the elements of their well-being as interconnected, and (3) engineering places a burden on UES's mental health and well-being in education, but may have a positive effect post-graduation. In this paper, we examine these themes and their relationship to our research question.

One emergent theme identified across interviews was the centrality of people to students' mental health. Participants described family members, friends, roommates, and people of academic background as influencers of their mental health. These relationships were described as having a positive or negative impact on their health. For example, one participant explained how different relationships, including family, friends, and teachers, supported various aspects of their well-being. Friends helped relieve pressures and make them happier, family provided academic and daily support, and teachers and coaches supported their physical health.

I talk about wellness is after the discussion is separate into three components like family, friends, and my teacher, and each of them gives me different aspect of supporting my wellness. So for instance, friends are particularly in the aspects of dealing with my pressures like relieving my pressures and making my more happy, and family is for academic support or daily life support and especially my mom. And for teacher, with my coach, is for physical health and sparing extracurricular time, something like that. (Charlie)

Charlie's description reflects how relationships shape student well-being. Similar to other participants, Charlie explained how people supported different aspects of their well-being, including mental, academic, and physical health. Other participants similarly described relying on multiple relationships to manage the demands of engineering education. This reliance highlights how students' social relationships can shape their well-being, particularly their mental health.

Another emerging theme in the participants' responses is the interconnection of the types of well-being. Most of the participants identified mental and physical well-being by name and often described them as interconnected. When one fails, another is affected. Practices, skills, or events that support one will benefit the other. Crystal, a fourth-year student, described the connection between mental, physical, and financial well-being while creating her concept map:

Kind of tying in. If you don't have good mental health, you don't have good physical health. And if you don't have financial stability, you can't afford to get the physical help that you need. Wellness. I guess the next one is kind of like, I'm going to put self-care. Because either way, wellness at some point depends on your person and what you do to help it. (Crystal)

For Crystal, her mental and physical well-being was tied to her financial well-being, a connection she drew from her experiences as a low-income student. She further described how her financial well-being, over career interests, was a deciding factor in her job choice later in the interview. Interconnections among the elements of well-being were often represented in participants' concept maps, in which they drew ties between shared elements (e.g., friends affecting both mental and physical health) or direct connections between elements. Given engineering's impact on mental health, this theme suggests that as mental well-being is affected, other aspects of students' well-being will be affected as well.

The final emerging theme is that engineering education places a burden on students' well-being. Participants from every year mentioned that engineering was a challenging major, either due to the high time commitment, challenging coursework, or relearning how to navigate education

(i.e., learning how to fail or study effectively). When asked how this affected their well-being, participants gave mixed responses. Many mentioned that pursuing a challenging major improved their self-image and mental health. However, they would also discuss that the challenges of engineering made it easier for them to neglect their well-being. Billy, a first-year engineer, described his mindset that led him to put aside his mental health:

Being an engineering student, I think it comes with a lot of pressure because there's so much work and there's so much difficulty in classes in school in general. So, it led me to think less about my mental stability and more of it would be better if I focus on school rather than my mental health, which probably isn't a great mindset, but sometimes I feel like it's necessary to prioritize certain things. (Billy)

Billy went on to describe that this mindset led to him isolating from friends and family to focus on school, and his mental health started to degrade with time. Other participants shared this sentiment, and as they progress through their programs, it only gets harder. However, many also expressed a different view on professional practice. Many discussed looking forward to a career that would allow them to pursue their personal goals and provide financial stability. They anticipated that they would no longer face the burdens of engineering education, establish a work-life balance, and could focus on their mental and overall well-being. In engineering education and professional practice, participants had distinct conceptualizations of their well-being across stages.

Discussion and Future Work

The integration of the Engineering Thriving framework into Social Cognitive Career Theory provides a robust basis for interpreting the data and emerging themes. Studies in Career Counseling have found that well-being informs career decisions and planning [17, 18]. Our initial findings suggest networks inform UES learning and, in turn, their goals and outcome expectations regarding both their career choices and wellness. Other studies have found that social networks are particularly meaningful for women and underrepresented minorities [19,20]. The participants' initial conceptualizations provide a baseline for students as they progress to identify change in career aspirations and expectations. UES, regardless of their standing in their engineering careers, acknowledge a baseline of the engineering culture and the struggles in engineering, which align with findings from other studies on engineering culture [4,14]. We anticipate this becoming more prevalent and including personal anecdotes as students progress through the engineering landscape. In the ongoing longitudinal interviews with first-year students, we anticipate that the creation of new knowledge as students progress through their university education will shape their career goals and preparatory actions. We also foresee the threshold for thriving that students describe in their conceptualization of wellness changing over the course of their careers as their goals and current experiences evolve.

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