How Do Engineering Faculty, Staff, and Administrators Define Engineering Thriving? An Investigation of Key Themes

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***Abstract*—In this work-in-progress research paper, we explore key themes and patterns prevalent in definitions of thriving for undergraduate engineering students. Although there is growing research and acknowledgment of the breadth and complexity of thriving in engineering, the field has limited conceptual clarity regarding its range of definitions. Data for this research was collected from 47 engineering faculty and staff who are considered long-term members of the engineering education system who also play a vital role in creating environments conducive to thriving and forming relationships with students that facilitate thriving. Participants were asked to define engineering student thriving in an open-ended survey, where their responses were analyzed using thematic analysis. 29 codes emerged from the data, 18 of which align with prior research. 10 new codes emerged, relating to positive emotions (such as happy, excited, and passionate), learning (love of learning, growing, understanding and deep learning), wellbeing, identity, belongingness, and professional experiences. These findings highlight positive aspects of engineering thriving beyond the absence or reduction of suffering and hardship. Implications of these findings include developing measures with multi-dimensional focus and emphasizing the role of emotional support and identity development in engineering students.**

Keywords— thriving, engineering, students, well-being

I. Introduction

Within the last five years, research on thriving for undergraduate engineering students has grown in attention and importance in the engineering education research community [1]–[4]. Prior research has generally defined engineering thriving as a multidimensional process by which undergraduate engineering students develop factors that allow them to function optimally in engineering programs [5], [6]. While simple, this generalized definition does not capture the range and nuances in definitions of thriving among long-term stakeholders in this community. Investigating the range of definitions of engineering thriving yields important insights into its multidimensional and complex nature.

This study builds upon prior research by examining themes that emerge from the range of engineering faculty and staff's definitions of engineering thriving. This study addresses the growing need to understand the perspectives of individuals who have the most influence in shaping the culture of engineering departments. For this study, we identify high-influence individuals in the engineering education system as engineering faculty and staff. They are long-term members of the engineering education system and play a vital role in creating environments conducive to thriving and forming relationships with students that facilitate thriving.

Developed within an interpretivist paradigm, the research question guiding this study is: "what are the key themes in how engineering faculty and staff define thriving for engineering students?" Findings of this research provide themes and patterns derived from the definitions of thriving from engineering faculty and staff. This investigation advances the field's language and understanding of the positive aspects of thriving in engineering departments beyond the reduction of suffering and hardship. This investigation also highlights important focus areas for future work on engineering thriving, such as emotional support, identity development, and sense of belongingness.

II. Methods

A. Research Philosophy and Design

The purpose of this study is to determine and analyze key themes in engineering faculty and staff's definitions of engineering thriving. Data in this study was collected as part of a larger research project to develop a model of engineering thriving [5]. Data reported in this paper has not been previously analyzed or published, as they do not

directly contribute to model development. However, this data provides insights into the epistemological beliefs of these same participants whose feedback developed the model of engineering thriving.

B. Participants

Participants consisted of 47 engineering faculty, instructors, administrators, academic advisors, and staff who have satisfied three eligibility criteria: 1) worked at or were associated with an undergraduate engineering program at an academic institution, such as a university or college; 2) taught, supported, advised, mentored, served in an administrative role, and/or otherwise worked directly with undergraduate engineering students; and 3) a minimum of three years of experience engaging in the first two criteria. Participants were selected based on convenience and snowball sampling as part of a larger project [5] concerned with developing a model of engineering thriving.

C. Procedure

Participants were asked to define thriving for students in an electronic survey on Qualtrics. Responses were analyzed from the first survey item, "How do you define thriving for undergraduate engineering students (not engineers in professional workplaces)?" This item was rated on an open-ended response scale, allowing for a general understanding of how participants define thriving. Data was analyzed using Braun and Clarke's guidelines in conducting thematic analysis [7] to identify emergent codes, patterns, and themes in participants' definitions of engineering thriving.

D. Data Analysis

An open-ended test protocol allowed for flexibility and diversity in responses, as participants were given the space to respond freely. Responses were analyzed using a thematic analysis, with both inductive and deductive coding, following Braun and Clarke's six phases of thematic analysis [7]. First, participant's responses were read closely multiple times by the second author for data familiarization [7]. Then, responses were coded by content to identify patterns and themes consistent with broader categories of engineering thriving established from prior research as part of the multidimensional model of engineering thriving, i.e. Internal Thriving Competencies and External Thriving Outcomes. These broad themes are found to be important components to engineering student thriving [5]. These initial codes were categorized to represent patterns in reference to factors of engineering thriving found in prior research [5]. This stage was completed twice, where the second time, trends consistent with themes outside of these competencies were reviewed, named, and categorized to broader categories of thriving. New codes were inductively created that were not previously established. Finally, all patterns were reviewed and consolidated to reflect broader categories of engineering thriving; i.e. Internal Thriving Competencies and External Thriving Outcomes, which consider both novel codes and those referenced in prior research. Each code was named, defined, and provided an example in consideration to each code (see **Appendix A**).

E. Trustworthiness

Lincoln and Guba's criteria [8], [9] for trustworthiness were followed in the data analysis process. To protect from biases, all personally identifiable information and university affiliations were removed from the data prior to analysis. *Credibility* and *transparency* were established through investigator triangulation, in which the authors analyzed the data, reviewed findings, and discussed discrepancies. Furthermore, environmental triangulation was embedded in the process of collecting data from participants from multiple engineering contexts (such as roles, departments, and universities). The participants' multiple contexts and backgrounds contribute to the *transferability* of findings to multiple engineering departments in the United States. For evidence of *dependability*, the researchers practiced bracketing by keeping records at each stage of data analysis, including raw data, decisions made, and the final steps in the coding structure. Engaging in the practice of bracketing resulted in the researchers reflexively analyzing major decisions, especially during discrepancies in interpreting data.

III. RESULTS

The first content codes presented in this paper are derived from deductive coding using a list of internal thriving competencies and external thriving outcomes developed in prior research [5] and inductive coding when codes emerged that were not captured in prior research. Internal thriving competencies are considered intrinsic experiences, consisting of behavioral, cognitive, intrapersonal, and social components [5]. External thriving outcomes are considered the results and impacts of the use of the internal thriving competencies under favorable contexts, situations, and systemic factors [5]. Of these initial content codes, 22 of these codes represented internal thriving competencies and 7 codes represented external thriving outcomes.

During the analysis, 10 new codes emerged:

1. Happy
2. Passionate
3. Well-Being
4. Excitement
5. Growing/ Developing
6. Engineering Identity
7. Sense of Belonging
8. Love of Learning
9. Understanding and Deep Learning
10. Professional Experiences

Identify applicable funding agency here. If none, delete this text box.

Examples of each of these additional codes of feeling "Happy" and "Passionate" are represented in **Appendix A**.

Next, these 29 codes were organized to represent reoccurring patterns and to account for similar definitions. Of the 22 codes that comprised internal thriving competencies, 9 of them were adapted. Out of the seven codes for external thriving outcomes, two were adapted. Codes were adapted from the established list of competencies in [5] to better fit the definitions given from participants' definitions. For example, "Professional Opportunities" was adapted to "Professional Experience," where participants placed heavy emphasis on involvement in experience, rather than the ability to have this experience (**Appendix A**). Codes were also combined to account for similar participant definitions. In the following example, the established codes for "Curiosity" and "Interest" were combined because participants often used these terms together in their definitions.

> *Thriving also means that they can identify their interests and feel empowered to engage with curiosity, wonder, reflection, and exploration.*

These codes were then organized into seven subcategories of engineering thriving, represented as patterns in the codes. Of the twelve subcategories established in prior research [5], seven patterns emerged from the codes in this analysis. These patterns include: Behavioral, Cognitive, Social, Intrapersonal, Community and Relationships, Health and Well-Being, and Academic and Professional. These seven patterns were consolidated to the two broader themes: "Internal Experiences" and "External outcomes."

We found most participants considered thriving to be primarily internal experiences that are interrelated. For example, multiple participants defined thriving using a long list of interrelated intrinsic factors, as demonstrated with the following quotes from two participants:

> *A combination of self-awareness, resilience and motivation that supports their ability to pursue their own goals.*

> *Thriving undergraduate engineering students enjoy going to many of their classes, are comfortable speaking to faculty outside of class time, are happy with their choice of major, and are excited about what their next step might be post-graduation.*

These examples highlight that individual codes, such as self-awareness, resilience, motivation, and happiness, are often conceptualized and discussed in tandem rather than independently. Interrelated codes were more commonly used to describe internal experiences rather than external outcomes.

IV. Discussion

With regard to research on thriving in the context of undergraduate engineering students, our findings support: 1) focusing on positive aspects of engineering thriving rather than solely on the absence or reduction of suffering and hardship; 2) developing measures with multi-dimensional focus; and 3) emphasizing the role of emotions and identity development.

A key finding from our study was that participants in our sample tended to define engineering thriving in ways that emphasized the presence of positive internal experiences and desirable outcomes, rather than solely the absence of suffering and hardship. These findings contributes different, and complementary perspectives to existing literature on supporting engineering student well-being, which largely focuses on reducing stress, anxiety, and depression [10], [11]. Our findings provide strong support that definitions of thriving in engineering are more associated with positive experiences and outcomes than the mere absence of stress, anxiety, or depression. Thus, a fundamental requirement for thriving engineering students is to create the systems and conditions that support meaningful growth as opposed to solely navigating the culture of "suffering and shared hardship" in engineering [12]. Faculty and staff ought to understand and create positive environments conducive to student thriving, instead of solely resolving deficits, problems, and barriers.

Second, the interrelatedness of thriving factors suggests that future assessments and measures of thriving should include multi-dimensional foci. Separate assessments of individual factors are generally more popular among research studies due to scope and limited resources. However, our findings suggest the importance of working toward holistic understandings and assessments of thriving in engineering students. One participant mentioned the Gallup-Purdue Index as an example for shifting toward multi-dimensional perspectives of thriving that can support students holistically. Yet, when it comes to actual practice, one participant shared "we administrators and faculty do a terrible job at mentoring students... to take care of themselves holistically." A unique implication of these findings is that engineering faculty, staff, and administrators who are dedicated to supporting thriving engineering students can feel unprepared to provide the holistic mentorship that they envision for students. One strategy to shift toward more holistic support could include broadening success metrics in engineering beyond primarily academic factors (such as grade point average or course grades) [6]. Strategies such as motivational interviewing could also be adapted for undergraduate engineering student settings as a mechanism to support holistic positive behavior change [13].

Finally, most new codes focused on emotions and identity, highlighting their importance for engineering students. Prior studies have shown that emotions play a critical role in engineering students' academic trajectories, learning, and persistence [14]. Many faculty and staff in our sample valued strong emotional bonds with students, a sentiment shared by engineering students in prior research [14]. This value aligns with research suggesting that students' social connections with faculty and staff directly affect students' emotions, engagement, and satisfaction, especially when they experience anger or anxiety [14], [15]. Furthermore, faculty and staff can support students' engineering identity development by recognizing more successes in the classroom beyond finding the single correct answer to a close-ended problem [16]. One participant highlighted the importance of helping students "[build] a personal engineering identity that meshes well with their interests and goals." Thus, engineering faculty and staff can inquire about students' interests and goals to pull in relevant engineering examples in their teaching, advising, and/or mentorship. Building strong personal connections is especially important because engineering students, especially women, who identify strongly as engineers tend to feel more belongingness and motivation to persist through strong negative emotions [17]. Thus, engineering faculty and staff who care about supporting student thriving can actively invest in getting to know students personally, checking in on them emotionally, and connecting their interests and goals with engineering.

V. Conclusions, Limitations, and Future Work

This study explored definitions of thriving in engineering through the perspectives of engineering faculty, staff, and administrators that actively work to support more engineering student thriving. Our data shows that thriving in engineering was defined mostly in terms of students' experiences and interpretations of themselves and their environment (such as "Self-awareness" and "Curiosity") and positive behaviors (such as "Goals" and "Self-care"). These results support a multidimensional conceptualization of thriving for engineering students that focuses on behaviors that support academic success as well as personal well-being.

This study does not include the perspectives of engineering students, a key limitation that warrants further research. Future studies can include perspectives of engineering students as key stakeholders in engineering education and explore whether their perspectives align with those of engineering faculty, staff, and administrators. Including student perspectives is critical to understanding thriving for engineering students and grounding research in this area to actual experiences of those being studied [18]. For example, an interesting question to explore could be "to which extent are the perspectives of faculty, staff, and administrators presented in this paper consistent with the perspectives of actual engineering students?" Findings can lead to applied research projects to create interventions to target multiple dimensions of engineering and investigate their impact on the engineering education system. Overall, this exploration into definitions of thriving in engineering offers various implications for engineering faculty, staff, and students working hard to improve their educational environment.

Acknowledgments

The authors would like to thank Dr. Brad Kinsey, Dr. Michael Thompson, and Dr. Michael Briggs for helpful discussions, insights, and/or feedback on drafts of this paper. This material is based upon work supported by the National Science Foundation (OIA-#1757371). This work is also supported by a National Science Foundation Postdoctoral Engineering Fellowship (EEC-#2127509). Any opinions, findings, and conclusions, or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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APPENDIX A. ORGANIZATION OF THEMATIC ANALYSIS WITH DESCRIPTION OF CODES

Themes (Third Level)	Patterns (Second Level)	Codes (First Level)	Description	Examples
Internal Experiences	Behavioral	Time Management	Able to effectively manage and allocate time in their lives; this includes prioritizing education along with devoting time to leisure interests.	"Manage time to complete course, lab, and project work." "Manage their time effectively."
		Stress Management	Have a reasonable amount of stress that is managed and does not affect productivity or well-being.	"Progress towards their degree with a reasonable (self-defined) level of stress." "Not becoming overwhelmed." "Some appropriate stress and difficulty but not with a level of stress that impairs general functioning."
		Goals	Having a goal that has meaning to the individual, whether it be an academic goal (ex. GPA) or intrinsic goal (accomplishing a skill they worked towards) and working to achieve the goal.	"Having a goal and making progress towards it." "Being able to progress towards professional and personal ends that they find intrinsic meaning."
		Responsibility	Has agency and ownership of their work and growth, and does not blame success or failure on others.	"Take responsibility for their learning and personal growth." "Ownership of their education and engagement with it."
		Navigating Educational Opportunities	Student takes available opportunities to further education.	"Being proactive and making the most of the opportunities available to students." "Students that are not just "getting through" their education but taking on a variety of the opportunities provided to them to grow and learn."
	Cognitive	Learning/ Love of Learning	Students who know how to learn, and love learning. Students that see an opportunity to learn and enjoy it rather than learn to satisfy requirements.	"A desire for learning." "Students motivated by curiosity and love of learning." "Undergraduate experiences joy in learning."
		Technical Knowledge/ Skills	Students have strong technical knowledge and skills.	"Undergraduate engineering students must develop their technical knowledge while they also cultivate their professional skills and identity." "Can prioritize their technical skills in a way that lead them to enjoy engineering rather than simply getting through it."

Intrapersonal	Meaning/ Purpose/ Holistic Intelligence	Finds personal meaning in engineering, sees individual purpose in their profession, and develops holistically.	“Being able to progress towards professional and personal ends that they find intrinsic meaning.” “Develops holistically in a way that is life-giving.” “Purpose Well-Being: Liking what you do each day and being motivated to achieve your goals.”
	Curiosity/ Interest	Curious, inquisitive, and interested in the subject for the content. Goes beyond the minimum.	“Thriving also means that they can identify their interests and feel empowered to engage with curiosity, wonder, reflection, and exploration.” “Students motivated by curiosity ...”
	Growing/ Developing	Views education as a way to grow. Continues to find ways to grow and develop not only as a student but as a person.	“Growing in their identity as beginning engineers while also growing as people.” “Developing confidence in personal growth and career development.”
	Self-Awareness/ Sense of Empowerment	Understands themselves and how they fit in the engineering system. Feels capable of succeeding themselves.	“A combination of self-awareness, resilience and motivation that supports their ability to pursue their own goals.” “Students seem themselves as unique individuals with valid "dreams" for themselves and they are empowered to achieve those dreams.”
	Comfort with Uncertainty, Complexity, and Challenge	Comfortable with challenges and complex problems. Takes uncertainty and complexity as a way to grow rather than become discouraged.	“Ability to deal with uncertainty, ability to deal with complexity.” “(Students) who are able to accept the challenge and rigor of the STEM courses required for the First Year Engineering Program- and rise to the challenge without complaining and quitting.” “Challenged but making progress.”
	Confidence	Has confidence and comfort in personal abilities.	“They are confident and self directed.” “Feeling comfortable and confident with friends and interests outside of school.” “Having a sense of confidence that their effort in school will bring a reward and that they feel they are succeeding in school.”
	Motivation	Intrinsically motivated to be successful as an engineer.	“A combination of self-awareness, resilience and motivation that supports their ability to pursue their own goals.” “Self-motivation and passion.” “Motivated, engaged, excited, eager, goes above and beyond.”
	Adaptable	Has the ability to change ways of thinking and learns from others.	“Changing attitudes and behaviors to reach goal.” “Students who are adaptable, quick to learn, and resilient.”

		Resilience	Views failure and challenge as a way to grow. Keeps working in the face of obstacles. Learns from mistakes and applies the knowledge to future practices.	"Recover and continue work after failure or disappointing results." "Getting stuck, asking questions, and moving through misunderstandings." "Resilience to failure."
		Engineering Identity	Forms a self-concept of becoming an engineer that aligns with interests and goals.	"… forming a self concept of being an engineer." 'Comfortably identifying with engineering and engaging in building a personal engineering identity that meshes well with their interests and goals."
		Excitement	Student is excited about a future working as an engineer.	"They also see where engineering might take them and they look forward to whatever is waiting for them after school." "(Students are) excited about what their next step might be post-graduation."
		Happy	Is happy with their choice to become an engineer.	"They overall enjoy what they are doing." "(Students) are happy with their choice of major." "They are generally enthusiastic about what they are learning." "Students enjoy going to many of their classes."
		Passionate	Pursues passion for learning and the engineering profession.	"Passionate about learning." "Passion for the subject." "Capable of identifying their passions and articulating ways to intentionally pursue these passions."
	Social	Teamwork	Works well with others.	"Able to work in teams."
		Professional Skills	Gaining and using skills related to engineering that will be beneficial to future professional experience.	"Undergraduate engineering students must develop their technical knowledge while they also cultivate their professional skills and identity." "Students who develop their personal and professional skills in a way that promotes learning deeply while also maintaining physical and mental health."
External Outcomes	Community and Relationships	Strong and Stable Supportive Networks/ Friendships/ Personal Relationships	Having a support system to lean on when needed and groups of friends or family that are positive additions to students' lives.	"They (can) reach out to established support systems (family, friends, professionals) and are able to get perspective and move forward." "(Students are) engaging with a group of supportive and positively engaged peers." "Social Well-Being: Having strong and supportive relationships and love in your life."

	Sense of Belonging	Welcomed in their environment.	"Feeling like the department or university is a welcoming place." "Strong sense of belonging and engagement with the educational ecosystem."
Health and Well-Being	School/Life Balance	Balances personal life and academic requirements. Satisfies academic requirements while also engaging in personal activities.	"(Students are) able to balance academic work with other developmental tasks, such as socializing with friends and meeting people..." "Balance; well-rounded; time for academics as well as extracurriculars."
	Well-Being	Positive growth in every aspect of their life, happy, healthy, positive growth and development.	"Students who believe they have a balanced life." "They also experience excellent physical, emotional and mental well-being." "Physical Well-Being: Having good health and enough energy to get things done on a daily basis." "Academic growth while experiencing positive well-being."
	Extracurricular Activities	Has extracurricular activities that provide the individual stress relief or happiness. Does not necessarily have to be unrelated to engineering (thriving students find engineering extracurriculars fun).	"Thriving students are actively engaged in their studies and also participate in extracurricular activities (in engineering or outside)." "Engaged in class and extra-curricular activities (not necessarily all engineering related)." "Involved in at least one extracurricular activity that they enjoy (and preferably one that is professionally-focused, not necessarily the same one)."
Academic and Professional	Understanding and Deep Learning	Success in academic courses as well as having a deep understanding of course material.	"(Student) is successful in completing coursework and related engineering activities." "Meeting both personal and graduation-related performance expectations." "Deep learning of engineering concepts in concert with developing sensibilities of what it means to be a productive member of society."
	Professional Experiences	Involved/ will be involved in professional experiences.	"Has/Will have degree-related work experience prior to graduation." "Involved in an internship or other professional experience at some point."