

Rowan University

Rowan Digital Works

Henry M. Rowan College of Engineering Faculty
Scholarship

Henry M. Rowan College of Engineering

7-26-2021

Student Perceptions of an Entrepreneurial Mindset and Its Relevance to Engineering Careers

Alexandra Mary Jackson

Samantha Resnick

Rebecca Hansson

Cheryl Bodnar

Rowan University, bodnar@rowan.edu

Follow this and additional works at: https://rdw.rowan.edu/engineering_facpub



Part of the [Engineering Education Commons](#)

Recommended Citation

Jackson, A. M., & Resnick, S., & Hansson, R., & Bodnar, C. A. (2021, July), Student Perceptions of an Entrepreneurial Mindset and Its Relevance to Engineering Careers Paper presented at 2021 ASEE Virtual Annual Conference Content Access, Virtual Conference. <https://peer.asee.org/37751>

This Conference Paper is brought to you for free and open access by the Henry M. Rowan College of Engineering at Rowan Digital Works. It has been accepted for inclusion in Henry M. Rowan College of Engineering Faculty Scholarship by an authorized administrator of Rowan Digital Works.

Student Perceptions of an Entrepreneurial Mindset and Its Relevance to Engineering Careers

Ms. Alexandra Mary Jackson, Rowan University

Alexandra Jackson is a senior Electrical and Computer Engineering student with a minor in Mathematics at Rowan University. She began research in Rowan's Experiential Engineering Education (ExEEd) department in the Fall of 2019, and has developed interests in entrepreneurial mindset and student development. Besides research, Alexandra is involved as a Resident Assistant and is the Treasurer of Rowan's chapter of the College Diabetes Network. Upon graduation, she plans to enter into Rowan University's PhD program for Engineering with a specialization in engineering education. Alexandra aspires to continue in the research field and hopes to work for a university as a research professor and advisor.

Samantha Resnick, Rowan University

Samantha Resnick is a senior Chemical Engineering student at Rowan University. She began research in the Experiential Education (ExEEd) department in Spring 2020 as part of her Junior Engineering Clinic. Besides research, Samantha is an Engineering Learning Community Mentor, where she helps first year engineering students adjust to college and provides academic tutoring. Upon graduation, she plans to attend graduate school to further her studies in Chemical Engineering. Samantha aspires to work in the cosmetics industry creating products.

Ms. Rebecca Hansson, Rowan University

I am involved in an engineering clinic at my school that is working on a paper for this.

Dr. Cheryl A. Bodnar, Rowan University

Dr. Bodnar is an Associate Professor in the Experiential Engineering Education Department at Rowan University. Her research interests relate to the incorporation of active learning techniques such as game-based learning in undergraduate classes as well as integration of innovation and entrepreneurship into the engineering curriculum. In particular, she is interested in the impact that these tools can have on student perception of the classroom environment, motivation and learning outcomes. She was selected to participate in the National Academy of Engineering (NAE) Frontiers of Engineering Education Symposium in 2013, awarded the American Society for Engineering Education Educational Research Methods Faculty Apprentice Award in 2014 and the Raymond W. Fahien Award for Outstanding Teaching Effectiveness and Educational Scholarship presented by American Society for Engineering Education (ASEE) Chemical Engineering Division in 2017.

Abstract

Development of an entrepreneurial mindset (EM) has been a focus that has gained traction within engineering over the last decade. Thus, undergraduate engineering curricula have been modified to address EM development. Curriculum modifications can include assigning hands-on projects with entrepreneurial elements, devoting entire courses to developing students' entrepreneurial skills while working with real world companies, and even creating degree programs with entrepreneurship in engineering as the focus.

Literature on EM has shown that there is a variety of methods for defining EM depending on the stakeholder. However, there has been limited research on how students understand and define EM, which is a vital step in helping students understand the role an EM can have for their future careers. This research study explores students' perception of EM through interviews with engineering undergraduates across multiple class years and majors. We sought to answer the following research questions: (1) *How do engineering students' definitions of EM differ from literature definitions?* and (2) *How do engineering students believe EM will be useful to their career?* Students were interviewed using a semi-structured protocol to get a clearer understanding of how they define EM. The interview protocol included questions focused on what students think EM means, how it has affected them, and how it might continue to affect them in the future. These interviews were then transcribed and thematically analyzed to determine the attributes of an EM that are common in students' definitions of EM. The analysis of the interviews identified trends that could then be compared to the existing literature definitions of entrepreneurial mindset. The work done through this study provides value to the community by providing an understanding for engineering students' perceptions of EM and how this may differ from that of other stakeholders. It will also shed light on whether engineering students' find value in developing an EM as part of their undergraduate studies, including whether they see it as an important asset to their future career.

Introduction

The entrepreneurial mindset (EM) is a concept, which has been widely studied over the past decade [1]-[3]. The concept comes from the idea that in the world today people need to adopt entrepreneurial skills to better advance and develop society [4], [5]. EM has been integrated into various classrooms starting from grammar school and ranging up to college level courses, [4]-[6]. Integration of EM early on was focused on the idea that young students need to have exposure to EM to improve their career readiness [5].

The push for EM to be a focus in undergraduate engineering courses and programs started after a call from the National Academy of Engineering in 2005 [7]. Although engineering students develop many skills during their time as undergraduates, it has been determined that engineers with entrepreneurial skills are vital to a developing society [8], [9]. For this reason, the technical

skills, although important to possess, should also be accompanied by development of how to think outside the box and become involved on an entrepreneurial level [10].

There does not seem to be one clear and accepted definition for EM in the literature. As said in Zupan et al. [4], the most widely accepted definition is from McGrath and MacMillan [11, p. 15], which is "a growth-oriented perspective through which individuals promote flexibility, creativity, continuous innovation, and renewal", although many other definitions have been presented since then [12]. These various definitions often depend on their source, such as researchers in different fields, faculty involved with teaching EM courses, and entrepreneurs themselves [12]-[14]. However, there is a large gap in literature when it comes to how students understand and define EM, especially engineering students. In order to make an impact on student understanding of certain topics, it is vital that their perspectives are understood and taken into consideration [15]. When the voices of students are heard, professors and teachers can use that to design their courses and projects in such a way that the students will be able to glean value of the topics being discussed [16].

Exploring how students understand the EM interventions they have had throughout their college experience will be extremely beneficial in refining the teaching of EM. In this study, engineering students' perceptions of EM are explored, taking into consideration the value that students place on EM and their feelings toward its importance in their futures. This study will help faculty to be able to implement EM into their courses with a better understanding of their students' perspective, which will allow them to modify their interventions accordingly to ensure that students are effectively grasping the concept of EM and how it can benefit them in their future careers.

Literature Review

The following section addresses background research related to EM's definition within the entrepreneurship field. We first discuss the concept of growth mindset and how it is often linked to EM, exemplifying its accepted definition. We then discuss the various definitions of EM as reported by entrepreneurs, faculty, and students, and provide comparisons between them. The reported literature shows limited work that addresses how students define this complex construct and provides evidence for the need for the proposed study to address the identified gap.

Growth Mindset vs. EM

One mindset that is mentioned often in EM studies is the growth mindset [17], [18], due to its focus on change and students' desire to learn new things [19]. Unlike EM, growth mindset has an accepted definition, based on Carol Dweck's book called "Mindset: The New Psychology of Success", which is referenced in most studies that discuss growth mindset [20]-[22]. In this book, growth mindset is described as being "based on the belief that your basic qualities are things you can cultivate through your efforts. Although people may differ in every which way—in their

initial talents and aptitudes, interests, or temperaments—everyone can change and grow through application and experience" [19, p. 8].

Individuals with a growth mindset believe that their skills can be further developed from what they already are [23], [24]. These people can develop their skills through effort, having positive teaching and learning experiences, having the desire to learn, and having good strategies to approaching difficulties [23]. As Davis points out, those who currently have a fixed mindset can work towards developing a growth mindset by embracing imperfections, seeking approval within oneself rather than from others, and appreciating the process more than the end result [25].

It has been noted in the literature that it is beneficial for anyone to possess a growth mindset, however EM and growth mindset are not the same thing [26]. Definitions of EM are often focused on characteristics and attributes, which can be developed through an entrepreneurs' growth mindset [18]. For example, individuals may use a growth mindset to allow them to develop entrepreneurial qualities such as creativeness and inventiveness [17].

Discrepancies in EM Definitions

Literature demonstrates that there is no single agreed upon definition of EM. In Naumann, they gathered the definitions of EM from eight studies on the subject [12]. Some studies defined EM as a way of thinking, while others focused on the attributes and abilities associated with EM. EM was found to be a way to reframe uncertainty into positivity, an ability to adapt to changes and situations, alertness to opportunity, or a set of specific skills. Naumann also notes the skills that are often associated with EM, including cognitive thinking, goal setting, quick decision-making, alertness, social ability, natural intelligence, flexibility, and adaptability [12].

Stakeholders related to EM have been shown to define this construct in different manners. In this section, we will look at how three specific stakeholders: entrepreneurs, faculty members, and students define this construct and what differences exist, if any, amongst their definitions.

In a study done by Kuratko et al. on previous literature that studied entrepreneurs, the entrepreneurial mindset consists of three main aspects: cognitive, behavioral, and emotional [3]. In terms of entrepreneurship, cognition relates to making new connections that allow entrepreneurs to invent new products or ideas, and the general knowledge they use to assess situations. The behavioral aspect of EM involves how an entrepreneur will present an opportunity or display their leadership abilities driven by their prior knowledge. Finally, the emotional aspect deals with how those with an EM handle times of uncertainty, stress, and risk based on their previous experience in these areas. These aspects are showcased through entrepreneur interviews conducted in Nastor's study, where they observe how entrepreneurs define EM [14]. In Nastor's results, entrepreneurs describe EM using qualities such as decisiveness, accountability, resilience, humility, and confidence. Decisiveness can be mapped to

the cognitive aspect of EM, as it involves coming to a conclusion based on prior knowledge and connections. Accountability and resilience align with the behavioral aspect of EM, as these qualities involve displaying who the entrepreneur is as a person because of their cognitive ability. Humility and confidence align with the emotional aspect, as these qualities are often nurtured from personal experience and are built from how one has dealt with risk and/or uncertainty [14].

Understanding how faculty define EM is also important, as they have an important role in embedding these concepts within the classroom. As part of Bosman and Fernhaber' study, two engineering/entrepreneurship professors describe how EM can be taught by faculty: EM is defined as "the inclination to discover, evaluate, and exploit opportunities" [1, p. 13]. This definition was come to through experience by these two individuals in addition to their deep dive into literature that defines "entrepreneurship", "mindset", and EM. There have also been interviews and surveys, conducted by Zappe et al., among university faculty involved with teaching entrepreneurship to engineering students [13]. As part of the process of building this survey, the researchers interviewed 26 entrepreneurship instructors about their perceptions on teaching entrepreneurship. They used the data from these interviews to create a survey that was sent to 37 university faculty members, and included multiple choice (with options to select multiple answers) and open ended responses. The faculty that took this survey believed that EM is based more on personality than skill and identified two main attributes of EM, which are drive and risk tolerance. This paper also brings to light the fact that faculty beliefs on EM influence how curricula are structured and what content is taught in regards to EM [13]. In a study conducted by faculty at Rowan University and Wake Forest University, 26 faculty members of universities in the United States that have knowledge in the engineering entrepreneurship field were asked to create concept maps based on their perceptions of EM. The purpose of collecting this information is to provide a way for faculty members to track the development of their students' EM. After analyzing the 26 concept maps and creating one master concept map, it was found that EM is composed of character traits, attitudes, and behaviors, such as thinking outside of the box, being open minded, being a risk taker, and critical thinking [27].

The final stakeholder that is important to consider are students. There have been limited studies on students' definitions of EM in the engineering context, though a few studies have addressed business student perspectives on entrepreneurial qualities. Some common attributes of entrepreneurs given by undergraduate business students in the School of Economics at the University of Turku in Finland are courage, social skills, supporting others, serving society, and making an effort to attain common goals [28].

A study on freshman engineering students showed that students believed that to be successful on the entrepreneurial side of design projects they had to be more creative and use problem solving [8]. In another study done at a Canadian university, engineering students were given the

opportunity to take an engineering entrepreneurship course [29]. The students were given an open-ended survey that asked questions such as why they chose to take the course and what they think the qualities of an entrepreneur are. After taking the course, engineering students identified that the attributes that are most defining of engineering entrepreneurship are creative/innovative, good work ethic, self-motivated, organized, strong people skills, desire to succeed, insightful, critical/analytical/practical, leadership, independent, good communication, experience, and perseverance [29]. Themes of creativity, social skills, and problem solving skills are seen across all student definitions discussed above.

Based upon this literature survey, it is clear that small discrepancies exist in EM definitions depending on the stakeholder group. Entrepreneurs seem to focus on the aspects of the human mind: cognitive, in terms of making connections to better create as well as assess situations, behavioral, in the sense of how one will use their prior knowledge to drive their leadership abilities and emotional, such as how one will deal with times of high stress or uncertainty. As discussed before, Nastor lists how entrepreneurs defined EM as decisiveness (cognitive), accountability and resilience (behavioral), and finally humility and confidence (emotional) [14]. In a similar way, students and faculty tend to define EM based upon one's personality, which can go hand in hand with entrepreneurs' behavioral definition of EM. Faculty seem to define EM as someone with a desire to grow (drive) as well as someone who understands the risks of every situation [13]. In Laalo and Heinonen, students discussed how an EM involves someone who is supportive, courageous, social focused, and caring [28]. The commonality between faculty and business students is that they both highlight the importance of social skills in an EM and give the social aspect of an EM as being one of its defining attributes, which points to the notion that an EM can be nurtured through education. All three stakeholders seem to describe that EM is strongly associated with one's personality traits however; entrepreneurs seem to focus more on the psychological definition. In the end, the three groups may have slightly different opinions on what an EM is but they all agree on the fact that it is something that can be nurtured through education and growth.

Research Questions

As was noted from the literature review above, little research has been done on engineering student definitions of EM although they offer an important perspective to understand. As such, this study seeks to answer the following questions: (1) *How do engineering students' definitions of EM differ from literature definitions?* and (2) *How do engineering students believe EM will be useful to their career?*

Methods

This section outlines the procedures followed in data collection and analysis as part of this qualitative study.

Study Design

This study consisted of 14 interviewees encompassing a wide variety of engineering disciplines and class levels. Due to the qualitative nature of the study, a smaller sample size is reasonable as it is common to draw meaningful conclusions with samples as small as twelve [30]. There were 2 first year students, 1 sophomore, 3 juniors, and 8 seniors who participated in the interview process, of which eight students were male and six were female. All six of the engineering disciplines present within the College of Engineering where the study took place were accounted for within the interview participants, with 3 Electrical and Computer engineering students, 2 Civil Engineering students, 1 Chemical Engineering student, 3 Mechanical Engineering students, 4 Biomedical Engineering students, and 1 Engineering Entrepreneurship student.

Data Collection

Students at a Northeastern University were contacted via email to request their participation in an entrepreneurial mindset video testimonial. Additional recruitment for the video testimonial was done through researcher connections and networks. Students that agreed to participate in the video testimonial were subsequently asked if they would be interested in participating in the research study that was being conducted on the video testimonials. Students were then provided with an informed consent form to complete if they wanted to participate in the research study and were asked to provide audio consent at the start of the video testimonial. Proper human subjects' approval was obtained prior to initiation of the study.

The interviews conducted were semi-structured and 20-35 minutes in length. Questions were derived from background literature to appropriately shape the scope of questions necessary to capture students' perception of EM (included in Appendix). As part of the video testimonial, interviewees were asked how they would define EM, and then asked to describe some attributes they feel someone with an EM might possess. They were then provided with a literature-based definition of EM and asked questions based on the accepted literature definition and how EM might relate to their previous experiences and their future goals. The interview protocol was first tested amongst the research group to identify any issues of weakness or where further clarification was needed prior to conducting the video interviews. All interviews were conducted through Zoom and then transcribed by a third party for analysis. As part of the de-identification process of the participants, random numbers between 1 and 1,000 were assigned to each transcript.

Data Analysis

Transcriptions were coded using thematic analysis, which assigns a general theme to a phrase or idea that is present within the transcription [31]. This type of coding allowed for patterns to be captured within student responses that encompassed the way this population of students understands EM. Coding for research question 1 was performed upon the questions regarding the student definition of EM prior to providing students with a literature-derived definition. These

questions were "What would you say is the definition of an entrepreneurial mindset" and "What do you think are the most important attributes associated with an entrepreneurial mindset?"

The process used for gathering data to answer the first research question involved each researcher separately reading transcripts to identify themes present within the data set. All researchers then met to discuss these themes and generate overarching categories that were representative of the themes identified. The final categories and their definitions were used in the development of a final codebook as shown in Table 1.

Table 1. Thematic Codes and Definitions for Answering *How do engineering students' definitions of EM differ from literature definitions?*

Code	Definition	Example
Business Skills	The set of skills an entrepreneur possesses within the business field, such as, efficiency, budgeting and spending, decision making, marketing, resource management, and knowledge of the production process.	"It's like, can you think about the production process? Can you think about marketing to clientele? That sort of thing."
Character Traits	Qualities possessed by someone, such as motivation, charisma, curiosity, empathy, and self-awareness.	"They need to easily relate to a bunch of different people in order to try and more effectively get their product out to more pe- as many people as possible. And, yeah, they just have to, overall, just be a good people person."
Communication	The ability to work well in a team, network with others, be open-minded in their processes, bridge the gap between business and engineering knowledge, and remain customer focused.	"I think that as an engineer, you're kind of balancing that, like, the science behind, like, a- a technology, but you also need to be able to translate, like, that information to someone who might not know."
Creativity	The ability to think outside the box, create original ideas, and turn imagination and ideas into reality.	"The most important attributes, um, definitely being able to think outside the box um, someone with an entrepreneur, with a good entrepreneurial mindset has to know their resources."

Innovation	The ability to see the bigger picture and improve upon existing products and processes to better society and move towards a more efficient future.	"When you start thinking with an entrepreneurial mindset, um, you need to start thinking, all right, in the real world, how is this going to be useful?"
Problem Solving	The act of having an obstacle to overcome and using prior knowledge as well as a set of skills to find the solution or improve upon something.	"You're constantly trying to solve different problems in effective and unique ways that maybe other people can't really see."
Responsibility	The ability to show leadership and manage money and time effectively and efficiently.	"There are super complex and expensive ways to do it and there's also, like, the most cost effective and safe way to do it."
Technical Knowledge	The knowledge gained through lab work and research within the technical field of engineering that helps develop more societally beneficial products.	"Um, I feel like the only main difference there really has to do with, um, the technical skills that engineers possess... You have to think of like more of technological things too, but our mindset has to have that business aspect to be able to combine the two properly."

Upon the creation of this codebook, three transcripts were chosen at random for each researcher to code independently as a measure to ensure reliability in the data analysis process. When the three transcripts were coded, the researchers met to reconcile their codes and discuss the effectiveness of the codebook in capturing the student definitions. Once the codebook was determined to be effective, each researcher coded the other eleven transcripts individually and then the researchers met to discuss any discrepancies.

The same process was followed for the second research question, in which students provided answers to the question "Do you think an entrepreneurial mindset is important to success in your future career? Why or why not?" This question was asked after the researchers provided a literature based definition to the students, which was: *An entrepreneurial mindset is often defined as an individual that is curious, has the ability to overcome challenges, makes the most of opportunities, adapts to situations, persists through failure, and manages risk.* Through the thematic coding of this question, five codes were found as described in Table 2.

Table 2. Thematic Codes and Definitions for Answering Do you think an entrepreneurial mindset is important to success in your future career? Why or why not?"

Code	Definition	Example
Foundational skills	EM provides business and professional skills such as communication, networking, and marketing that are crucial building blocks to many careers.	"I think that [EM] will help you identify problems in a project or a situation easier. And, um, I also think it'll just help to think outside the box, and really help performance in a project and time and cost."
Way of thinking	Having an EM provides individuals with a way of thinking that allows them to learn from their mistakes, be more motivated, and be willing to take risks.	"It just really improves how you like view like even like work in general, you know what I mean, like if you take everything as like a challenge and how you're going to overcome it you're going to be a lot more successful than someone who takes everything as easy and then it doesn't work and then they're like, well, what do I do now?"
Creating Value	EM thinking can lead to valuable products being produced that benefit and advance society through creative and innovative ideas, which meet the needs of customers.	"All technology, especially in engineering is always improving, getting more accurate, but also more complex. And you kind of have to keep up with the ever changing atmosphere of whatever technology you're working with."
Career Opportunities	EM provides opportunities to advance and identify more career options through being effective as an employee for the company.	"And it makes it easier to be, like, to be social and find more, uh, networks to find, you know, jobs or interviews 'cause it helps you learn how to work with others and, like, especially people who, like, you don't work well with or who you never worked with before"
Personal growth	Being able to create the best version of yourself through self-reflection, marketing yourself efficiently, and being able to recognize and improve upon flaws.	"You're going to apply to a lot of jobs. It might take a while for something to stick, and you can't just say, "No, no, nobody wants me." You gotta, you gotta keep going. You gotta keep putting yourself out there, and eventually someone will say, "Yeah, we want you.""

Research Quality Considerations

Research quality was a crucial part of this qualitative study, in which multiple measures were taken during both making and analyzing the data to ensure its reliability. The constructs within the research quality framework by Walther et al. were referred to as shown in Table 3 [32].

Table 3. Research Quality Constructs from Walther et al. [32]

Construct	Description	Making the Data	Analyzing the Data
Theoretical Validation	Focuses on the study's relevance to social reality and the existing theories being discussed	<ul style="list-style-type: none">-Literature in the area of EM integration within engineering was reviewed-Literature based EM definitions were reviewed	<ul style="list-style-type: none">-Data was referred back to literature throughout the analysis process-EM definitions from interviewees were cross referenced with existing definitions
Procedural Validation	Ensures that strategies incorporated effectively address the theoretical framework that validates the study	<ul style="list-style-type: none">-Test interviews were conducted between three researchers to ensure the interview protocol's effectiveness- Students had questions that were focused on how to define EM as part of the interview protocol	<ul style="list-style-type: none">-Transcripts were coded and reconciled by three different researchers-Audit trail captured changes to the analysis procedures as they were made
Communicative Validation	Ensures that the results produced by the study will be relevant to the community in focus	<ul style="list-style-type: none">-One researcher took notes during interviews while another asked the questions-Interviewees were able to elaborate on each question they were asked	<ul style="list-style-type: none">-Researchers met consistently to discuss discrepancies in coding process and finalize coded transcripts-Code book was agreed upon by all researchers before being used and any discrepancies in coding procedure were discussed by all researchers
Pragmatic Validation	Focuses on the knowledge generated by the study and whether or not it is meaningful to the investigations taking place	<ul style="list-style-type: none">-Data was gathered from students within an engineering program, which was the population of interest	<ul style="list-style-type: none">-Researchers searched the results for underlying themes regarding definitions of entrepreneurial mindset which would be relevant to the engineering entrepreneurship community

Process Reliability	Ensures that the process followed during collection and analysis produced dependable data	-Meeting notes were kept in a separate document that was referenced to determine the topics discussed -An audit trail was created that captured all changes and additions to procedures -Audio files were transcribed by a third party	-Researchers kept their coded files and coding notes separate for reference -Researchers discussed each coded transcript to reconcile any discrepancies -Audit trail captured changes to the analysis procedures as they were made
---------------------	---	--	--

Results & Discussion

This section will present and discuss the results found from the coding process of the fourteen interview transcripts. Research Question 1 is addressed first, going over the eight codes, which described student definitions of EM. Research Question 2 is then addressed, presenting the five codes describing students' perceptions of the importance of EM.

Research Question 1

The first research question; *How do engineering students' definitions of EM differ from literature definitions?* involved determining how students defined EM and comparing that to existing literature based definitions. The thematic coding results showed that all of the students agreed that Innovation and Business Skills, coded 29 and 27 times respectively, are the two most important aspects of an entrepreneurial mindset. Innovation was coded in 12 out of the 14 transcripts, and Business Skills was coded in 11 out of the 14 transcripts. The next most frequent code was Problem Solving, which was coded 15 times and appeared in 9 transcripts. The occurrence for each of the eight codes is shown in Table 4. The student definitions of EM are also represented in the word cloud shown in Figure 1.

Table 4. Research Question 1 Thematic Code Occurrence

Thematic Code	Times Coded	Percentage
Business Skills	27	23.7%
Character traits	10	8.8%
Communication	9	7.9%
Creativity	8	7.0%
Innovation	29	25.4%

Thematic Code	Times Coded	Percentage
Problem Solving	15	13.2%
Responsibility	6	5.2%
Technical Knowledge	10	8.8%



Figure 1. Word Cloud Representing Student Definitions of EM

Across all of the most frequent codes discussed by the student interviewees, it seems that the students were focused on skills and outcomes. Students commonly discussed improving practices and products, learning budgeting and marketing skills, and making decisions to reach effective solutions. For example, this excerpt from Participant 803 exemplified Innovation; *"I think my definition of entrepreneurial mindset is, um, like working at something and thinking about how it can be improved upon, like constantly searching for improvement. If that makes sense. Like, um how we, and how it can benefit society in particular."* And this example from Participant 1,000 was coded under both Business Skills and Problem Solving, with the bolded part of the quote highlighting the business skills aspect; *"Entrepreneurial mindset is **thinking about, like, a product not just in terms of the, the function of the product, but thinking about how you would sell it, how other people would view it, because there's, there's one thing to, to, like, make something that solves a problem, but you also need to think about how you communicate how that's solving a problem.**"*

The most frequent codes of Innovation and Business Skills in this study were also noted in previous studies involving student definitions of entrepreneurship and EM [8], [29]. In Hsiao's study on engineering students who decided to take an entrepreneurial engineering course, the

most frequent trait that came up in their survey responses was Innovation. Students in this study were also focused on business, with many students discussing the importance of using resources, managing ideas to start a business, and profiting from an idea [29]. These same ideas were often coded under Business Skills in this study, as highlighted in this quote from Participant 48; *"Someone with a good entrepreneurial mindset has to know their resources. They have to be able to use the resources that they already have and expand off of them."* and this quote from Participant 39; *"I'm going to learn something and then figure out how I can apply it, how I can make it something effective that I would maybe be able to sell to a company or offer to people who need it."* Slightly lower on the list of recognized traits in Hsiao's study was problem solving and critical thinking skills [29], which was the third most frequently coded in this study and appeared in 9 out of the 14 transcripts, as depicted in this quote by Participant 769 *"Well, they most certainly gonna be a, uh, critical thinker, not just necessarily creatively, but like critically getting down to the bottom of like, what are these problems? And really being able to analyze situations effectively."* In Dabbagh and Menascé's work, students also recognized the importance of business management and problem solving skills upon the completion of entrepreneurship related projects [8].

Students in Hsiao's study also noted traits such as organization, people skills, leadership, and communication [29], which were some of the less frequent codes in the interviews performed. Participant 705 was focused on people skills in their interview, saying; *"They gotta be really charismatic. They gotta be polite. Um, you don't want them to be too pushy, because then that's gonna just make the client upset,"* and Participant 48 highlighted the importance of good communication; *"Communication is absolutely a big part of it. Um, yeah, you have to, you have to be able to communicate your idea or t's not gonna go anywhere."* Participant 92 discussed leadership and organization; *"So someone with a entrepreneurial mindset, you know, I think someone who's very organized, someone who's like very on top of what they're doing. Um, being able to kind of be a leader, as well. Kind of being able to, you know, manage both themselves as well as other people who need help."* Although these traits were not as widely discussed in these interviews or widely noted by students in [29], many students still exemplified their importance. Students have previously been shown to think similarly in terms of academic related opinions and expectations [33], which could explain the similar findings across the few studies relating to student definitions of EM and entrepreneurship.

Entrepreneurs highlighted the most important attributes of EM as leadership, general knowledge, confidence, risk assessment, decisiveness, making connections, and resilience [3], [14]. Although many of the traits exemplified by entrepreneurs were brought up in a few student interviews, they were not widely discussed. General knowledge was coded as Technical Knowledge in this study, which appeared in 5 out of the 14 transcripts. As stated by Participant 42 *"I feel like the only main difference [between engineering and business EM] has to do with, the technical skills that engineers possess. It's a different skill set we have to provide rather than business people, really just thinking more on the marketing aspect of it. You have to think of like more of technological things too, but our mindset has to have that business aspect to be able to combine the two properly."* Very few students mentioned leadership, and Participant 987 was the only to mention risk assessment: *"They know how to take risks, mitigate risks, um, even parts of leadership, um, are important to the entrepreneurial mindset."* Decisiveness was sometimes

discussed as part of Problem Solving and Business Skills, for example Participant 47 said; "*I think for chemical engineers...from what I've kind of gathered is, when you have a process...you can have, like, an infinite number of ways of doing the same thing. So you have the one reaction you do and there are super complex and expensive ways to do it and there's also the most cost effective and safe way to do it. So, like, with the skills you learn as a ChemE you have to learn to kinda [figure out], what's the best way to design and solve this problem?*" Making connections was another frequently discussed code within entrepreneurs' definitions, but mentioned only a few times throughout student interviews, for example, Participant 42 stated; "*Entrepreneurial mindset is really just creating a new form of mental habits that will allow you to see the bigger picture of things to make connections and values through what your work is.*" However, it seems that some of the more frequent codes such as Innovation and Business Skills were not highlighted by entrepreneurs in previous studies. This could be due to students' lack of experience in the field and the fact that students are only learning about entrepreneurial mindset in the classroom, as opposed to entrepreneurs who have real world experience with the benefits of EM.

Faculty in Zappe et al.'s study said that they believe that personality is more important than skill in developing an EM, and were heavily focused on risk taking and motivation [13]. Bodnar et al.'s results also exemplified personality in their findings such as open mindedness, courage, charisma, and empathy [27]. Students in this study tended to highlight skills and behaviors within their definitions rather than personality traits, though some students discussed people skills, leadership, and risk taking, as mentioned previously. This leads to the assumption that faculty and students think differently about an entrepreneurial mindset. This was supported by Reeves et al., where they coded faculty interviews and student open-ended survey responses, which showed that entrepreneurial faculty often have a broader definition of entrepreneurship, while students enrolled in an Entrepreneurship and Innovation minor were more focused on the aspect of starting a business [34]. These discrepancies between students and the faculty instructed to aid in developing their mindsets can lead to the assumption that students may not understand EM in the way that experts have described. Some of the student interviewees showed uncertainty in their definitions, for example, after describing some general business skills that may go into EM, Participant 606 followed with "*I know they have that major, entrepreneurial engineering, and that's what I always thought it was, but I never fully understood it.*" This further validates the idea that students may have a general lack of understanding regarding the most important attributes of EM.

Studies have shown that EM based projects and courses have made a significant impact on student EM development [6], [9], [35]-[41], but the results presented here show that the students may not actually be in touch with the mindset they are developing. As discussed, some interviewees named many of the characteristics and attributes that have also been named by experts, but had an overwhelming focus in the area of outcome, product development, and business skills that were not as stressed in literature by entrepreneurial experts or faculty.

Research Question 2

The second research question *How do engineering students believe EM will be useful to their career?*, focused on student interviewees' discussions regarding their futures and how they feel EM may be beneficial. The coding results for this question had much less disparity than the first research question as the code with the highest percentage was coded 15 times, and the lowest was coded 8 times. This result indicates that students could observe multiple ways in which EM would provide value to their future careers. Two of the codes appeared in 9 transcripts, one code appeared in 8, and two codes appeared in 7, once again showing less disparity and that engineering students as a whole had similar impressions of how EM would be useful to them in their future career. These results are depicted in Table 5 and in the word cloud in Figure 2.

Table 5. Research Question 2 Thematic Coding Results

Code	Times Coded	Percentage
Foundational Skills	15	25.9%
Way of Thinking	8	13.8%
Creating Value	10	17.2%
Career Opportunities	12	20.7%
Personal Growth	13	22.4%

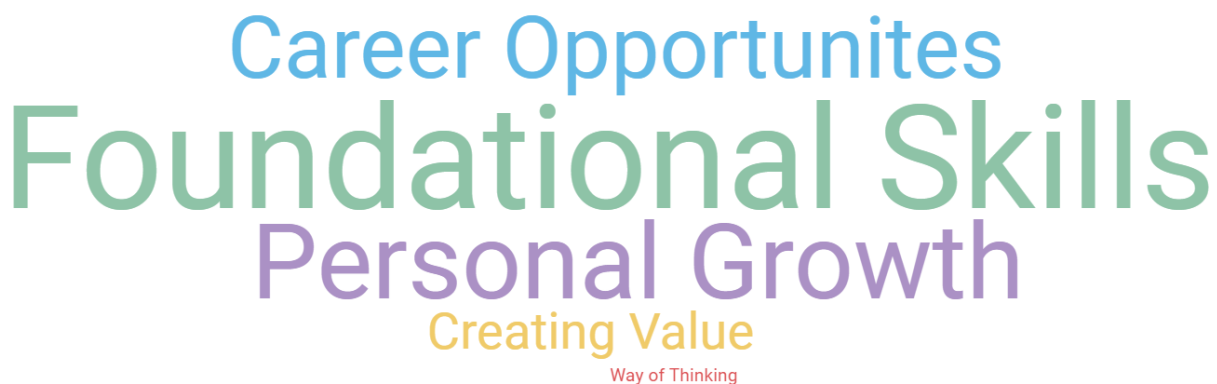


Figure 2: Word Cloud Representing How Students Believe EM Will Be Useful in Their Careers

Many of the students discussed relevant foundational skills associated with EM, as described in both their EM definition and the literature based EM definition provided by the researchers, and their career benefits as part of their response. For example, students discussed the role of communication as shown by Participant 47 saying: "[EM is] important to have because you're not gonna always be interacting with people who, like, are engineers. You might be interacting with, like, a business team or, um, different- different types of people who might not have that knowledge behind you." They also included discussion about the advantage of EM Ways of

Thinking in their career as shown by the response from Participant 705, *"Obviously there's a lot of risk, there's a lot more risk involved once you graduate. So you gotta be able to handle all that risk...There's gonna be a lot of obstacles you need to overcome in order to see success. That's how you become successful. And so yes, I would say it is important to have an entrepreneurial mindset going forward."* In Rodriguez and Lieber's study, it was found that after entrepreneurial interventions, students' comfort with risk increased along with their communication skills and opportunity recognition skills [5]. This result, in combination with what the students shared in this study, demonstrate how entrepreneurial interventions are one means for better preparing students, in their opinion, to meet the needs of their future careers.

Students in other entrepreneurship studies also believe EM is important to their careers [5], [29], [42]. In Pihie and Sani's work, students were asked to give their thoughts on their ability to use EM effectively in their future career after taking a course that included entrepreneurship in the curriculum. These students were confident in their ability to use EM and identified motivation, ambition, ability to identify and take career opportunities, and creativity as important skills to this success [42]. These benefits associated with having an EM align with the majority of the themes identified in this research. Specifically, Participant 1,000 emphasized the importance of creativity and advancing society, which falls under the Creating Value code, in this excerpt *"I think definitely creativity is, is super important, because that's how, you know, new things come about, and that's how, like, you'll, you'll find, you know, new solutions to new problems, and rather than just doing, like, the same old thing that everyone else is doing. And that's how you could potentially, like, break out into the industry."* The motivation and being able to identify and take career opportunities aspect is shown through the Way of Thinking and Career Opportunities codes. Participant 705 touched on this when they said *"it's looking like I'm going into transportation engineering. I'm definitely gonna need to be able to, uh, keep trying, if places keep saying "No, you know, we're not really hiring" or, "Oh, we don't, we don't really need someone with your qualifications." I'd have to just keep going. Making the most out of these opportunities that Rowan is providing to help me look for a job while I still can is definitely a big one."*

In Rodriguez, and Lieber's study, they similarly found that students who were subject to entrepreneurial intervention in their college courses demonstrated gains in knowledge of and strengthening of their EM, as well as increased confidence that they will be successful in their future career [5]. Most students in this study agreed that an EM will help them in their future career and will propel them forward in their field, similar to what was observed in the Career Opportunities code. This is exemplified by Participant 55 in this excerpt *"I think yes, while having it is very important, it can put you above somebody else... I think it definitely will put you a step ahead of everybody else that doesn't have that."*

According to Kövesi, and Csizmadia, who conducted interviews with engineering employers, recruitment for engineering jobs was traditionally focused on the technical knowledge possessed upon graduation, but has shifted to include a much wider range of skills and attributes [43]. Participant 42 emphasized the importance of a conjunction of both technical and non-technical skills in this excerpt *"If you don't have like that entrepreneurial mindset, like that business mindset, all you're really going to have is your technical skills. And I don't really think just*

having technical skills is going to get you to where you want to be. Like, you have to be able to think like a business person really, and be able to get where you want to be." In terms of the professional skills expected in industry, communication and sociability are often ranked highly by employers [43]-[45]. A few students brought up communication and teamwork as part of the Foundational Skills code, indicating that having an EM provides these necessary skills. This can be seen when participant 800 said: *"[An EM] makes it easier to be social and find more networks... 'cause it helps you learn how to work with others and, like, especially people who you don't work well with or who you never worked with before. It helps you learn how to, like, work with those types of people and find new ways for communicating and which method works for this team or works for this project."* Participant 987 also emphasized the importance of these Foundational Skills: *"They're not always looking for the engineer that just is going to sit there and put in tons of work. Obviously they are looking for those types of people, but they're also looking for someone who can understand what those people are doing, and then, communicate with those who have absolutely no idea what's going on."*

When hiring undergraduates, employers are also looking for specific personality characteristics that indicate their willingness to grow within themselves [43], [44]. This relates closely with the Personal Growth code, in which students addressed how EM helps them to grow and adapt in order to be their best selves. As said by Participant 39, *"If you're willing to test out what you're comfortable with or not, and if you're willing to put yourself out there and do what it takes to make yourself the best version you can be, then I think you'll be successful. And I think that's applying the entrepreneur mindset to yourself instead of to a project like you usually would, but I think that would make you successful."* Kövesi, and Csizmadia also discussed the importance of certain attitudes such as motivation, ambition, and enthusiasm [43], which were emphasized within the Way of Thinking code. Participant 48 addressed that one's mindset is powerful in this excerpt: *"Without motivation, you're not going to go anywhere. You're, you're going to stay where you are. Like if I had no motivation to become an engineer I wouldn't be going through all these hard classes. I wouldn't be paying all this money for school. I probably would still be just working like my fast food job for the rest of my life. So without motivation, you can't go anywhere. You can't move up in the world."*

Industry also expects that their employees will have the capability to design products that are beneficial for the company and the public [43]-[45]. Though designing requires many of the foundational skills discussed often by the student interviewees, it also requires a sense of Creating Value for the changing society, which was a code mentioned in over half of the transcripts. Participant 42 said: *"I think you need an engineer that cares about what the people want and what's going to be beneficial to the world, like to create better things that will help everyone."*

Based on this information, the students in this study seem to overwhelmingly believe that EM is beneficial, even crucial, to their future engineering careers. This aligns with existing research that many of the attributes and skills developed from having an EM are expected in graduated engineers in the workforce. Therefore, integration of EM education in engineering curricula is a powerful tool for ensuring the development of skills that are expected for engineers upon their graduation.

Limitations

Although the results present valuable information on the comparisons of student and literature definitions of EM and student perspectives on the benefits of EM to their future careers, there were some limitations. The original aim for the number of participants was at least 20, and this study only had 14. The COVID-19 pandemic presented significant limitations that may have affected student responses, such as interviewing students through Zoom rather than in person, as well as the students not being physically in the classrooms - this is especially significant for first and second year students. In addition, this study was conducted only at one university, and there was not equal representation of all engineering disciplines within the interview participants, which could have influenced the results.

Conclusion

Students' definition of the entrepreneurial mindset varied, with many descriptions focused on developing the skills to start a business, improve society, and create innovative solutions to engineering problems. These results are similar to other studies conducted on students' definition of EM, although the information in this study was collected through interviews, and the literature studies gathered their data from survey prompts and questionnaires. Overall, students were more likely to mention skills and behaviors in their definitions, which slightly differed from the literature derived through studying experts in the field.

The literature on entrepreneurial mindset definitions by entrepreneurs and faculty was centered on the idea that EM is not only about skill. Entrepreneurs stressed the importance of confidence, leadership, and risk taking in addition to strong decision-making ability and prior knowledge, which few students addressed in their interviews. Faculty were also focused on risk taking, motivation, and other character traits, saying that personality is more important than skill in the development of an EM. The student interviewees were not as consistent with this focus, though few did mention some character traits such as charisma, curiosity, and empathy during their interviews.

Although the student interviewees noticed many important attributes and characteristics of someone with an EM that were mentioned by experts in the field and agreed that an EM is beneficial for professional engineers, there were explicit differences in the definitions between students and faculty. These discrepancies may indicate that students do not fully understand the concept of EM in the way that faculty believe they are teaching the concept, as faculty have been shown to have broader definitions of EM. For this reason, faculty may have to revise their teaching styles to further stress the importance of personal growth and attributes of those with an EM rather than just skills that are necessary for starting a business or making products.

In terms of students' beliefs about the importance of EM, they were widely accepting of many aspects of EM being crucial in their future success as engineers. The students' thoughts on the significant characteristics, skills, and attitudes that would be beneficial in their careers overwhelmingly aligned with industry expectations of engineering graduates, indicating that EM education is needed for engineering students to be better prepared for their future careers.

Acknowledgements

The authors would like to acknowledge funding provided from a Kern Family Foundation Rising Star Grant Award for the work conducted as part of this study.

References

- [1] L. Bosman, and S. Fernhaber, "Defining the Entrepreneurial Mindset," in *Teaching the Entrepreneurial Mindset to Engineers*, 2018. Cham: Springer International Publishing, pp. 7-14. https://doi.org/10.1007/978-3-319-61412-0_2.
- [2] D. Ridley, B. Davis, and I. Korovyakovskaya, "Entrepreneurial Mindset and the University Curriculum," in *Higher Education Theory and Practice*, 2018, vol. 10, no. 7, pp. 241-264. doi:10.9737/hist.2018.658
- [3] D. F. Kuratko, G. Fisher, and D. B. Audretsch, "Unraveling the entrepreneurial mindset," in *Small Bus Economics*, 2020. <https://doi.org/10.1007/s11187-020-00372-6>.
- [4] B. Zupan, F. Cankar, and S. Setnikar, "The development of an entrepreneurial mindset in primary education," in *European Journal of Education*, 2018, vol. 53, no. 3, pp. 427–439. <https://doi-org.ezproxy.rowan.edu/10.1111/ejed.12293>
- [5] S. Rodriguez, and H. Lieber, "Relationship Between Entrepreneurship Education, Entrepreneurial Mindset, and Career Readiness in Secondary Students," in *Journal of Experiential Education*, 2020, vol. 43, no. 3, pp. 277–298. <https://doi-org.ezproxy.rowan.edu/10.1177/1053825920919462>
- [6] M. V. Huerta, J. London, and A. McKenna, "Engineering deans' perspectives on the value of entrepreneurial thinking in engineering education," in *ASEE Annual Conference and Exposition*, Conference Proceedings, Salt Lake City, Utah, 2018.
- [7] National Academy of Engineering, "The Engineer of 2020: Visions of Engineering in the New Century," in *The National Academies Press*, Washington DC, 2005. <http://www.nap.edu/catalog/10999.html>.
- [8] N. Dabbagh, and D. A. Menascé, "Student Perceptions of Engineering Entrepreneurship: An exploratory study," in *Journal of Engineering Education*, 2005, vol. 95, no. 2, pp. 153-163.
- [9] S. Brunhaver, J. Bekki, A. Carberry, J. London, and A. McKenna, "Development of the Engineering Student Entrepreneurial Mindset Assessment (ESEMA)," in *Advances in Engineering Education*, 2018, vol. 7 no. 1.
- [10] T. Byers, T. Seelig, S. Sheppard, and P. Weilerstein, P, "Entrepreneurship: Its Role in Engineering Education," in *The Bridge*, 2013, vol. 43, no. 2, pp. 35–40.
- [11] R. McGrath, and I. MacMillan, "The entrepreneurial mindset." in *Harvard Business School Press*, 2000.
- [12] C. Naumann, "Entrepreneurial Mindset : a Synthetic Literature Review," in *Entrepreneurial Business and Economics Review*, 2017, vol. 5, pp. 149-172.
- [13] S. Zappe, K. Hochstedt, E. Kisenwether, and A. Shartrand, "Teaching to innovate: Beliefs

- and perceptions of instructors who teach entrepreneurship to engineering students," in *International Journal of Engineering Education*, 2013, vol. 29, no. 1, pp. 45-62.
- [14] J. Nastor. "How to Develop an Entrepreneurial Mindset."
<https://hacktheentrepreneur.com/entrepreneurial-mindset/>
- [15] A. Cook-Sather, "Authorizing Students' Perspectives: Toward Trust, Dialogue, and Change in Education," in *Educational Researcher*, 2002, vol. 31, no. 4, pp. 3–14.
<https://doi.org/10.3102/0013189X0310040>
- [16] M. Steen. "Why Teachers Should Value Students' Voices in the Classroom." *Resilient Educator*.
<https://resilienteducator.com/classroom-resources/embracing-student-voices/>
- [17] K. Reid, and D. M. Ferguson, "Enhancing the entrepreneurial mindset of freshman Engineers," in *ASEE Annual Conference & Exposition*, Vancouver, British Columbia, 2011. <http://doi.org/10.1109/fie.2011.6142734>.
- [18] S. Zappe, "Avoiding Construct Confusion: An Attribute Focused Approach to Assessing Entrepreneurial Mindset," in *Advances in Engineering Education*, 2018, vol. 7, no. 1.
- [19] C. Dweck, "Mindset: The new psychology of success." in *New York: Random House*, 2006
- [20] "What is a growth mindset?" About Growth Mindset.
<https://www.mindsetkit.org/topics/about-growth-mindset/what-is-growth-mindset>
- [21] S. Mackie, and J. Rives. "Revisiting the growth mindset definition - we are a mixture of Both."
<https://www.growthmindsetinstitute.org/2018/03/08/growth-and-fixed-mindset-definition>
- [22] "What Does It Mean to Have a Growth Mindset?" Big Think Edge.
<https://www.bighinkedge.com/what-does-it-mean-to-have-a-growth-mindset/>
- [23] C. Dweck. "What Having a "Growth Mindset" Actually Means."
<https://hbr.org/2016/01/what-having-a-growth-mindset-actually-means>
- [24] D. Agar. "Fixed mindset versus growth mindset and why it matters." *The Medicine Hat News*.
<https://medicinehatnews.com/life/local-life/2019/02/08/viva-vitality-fixed-mindset-versus-growth-mindset-and-why-it-matters/>
- [25] T. Davis. "15 Ways to Build a Growth Mindset."
<https://www.psychologytoday.com/us/blog/click-here-happiness/201904/15-ways-build-growth-mindset>.
- [26] D. Schwarz. "Why Entrepreneurs Must Develop a Growth Mindset (and How to Do It)."
<https://www.sitepoint.com/why-entrepreneurs-must-develop-a-growth-mindset-and-how-to-do-it/>.
- [27] C. Bodnar, S. Jadeja, and E. Barrella, "Creating a Master "Entrepreneurial Mindset" Concept Map," in *ASEE Virtual Annual Conference Content Access Proceedings*, 2020. doi:10.18260/1-2--34345.
- [28] H. Laalo, and J. Heinonen, "Governing the entrepreneurial mindset: Business students' constructions of entrepreneurial subjectivity," in *European Educational Research Journal*, 2016, vol. 15, no. 6, pp. 696–713. <https://doi.org/10.1177/1474904116662288>.

- [29] A. Hsiao, "Developing An Entrepreneurial Mindset In Engineering Students," in *Proceedings of the Canadian Engineering Education Association (CEEA)*, 2013. doi:10.24908/pceea.v0i0.4832
- [30] J. Ritchie, J. Lewis, G. Elam, R. Tennant, N. Rahim, "Designing and Selecting Samples" in *Qualitative Research Practice: A Guide for Social Science Students & Researcher*, J. Ritchie, J. Lewis, C. McNaughton Nicholls, R. Ormston, Eds., Los Angeles, CA, USA: Sage, 2014, 118-119.
- [31] M. B. Miles, A. M. Huberman, and J. Saldaña, "Qualitative data analysis: A methods sourcebook," Los Angeles: SAGE, 2020.
- [32] J. Walther, N. Sochacka, and N. N. Kellam, "Quality in interpretive engineering education research: reflections on an example study," in *Journal of Engineering Education*, 2013, vol. 102, pp. 626–659, <http://dx.doi.org/10.1002/Jee.20029>.
- [33] M. Koslow, and J. Ellen, "First -year college students and faculty: A comparison of Expectations for success," in *Dissertation Abstracts International*, 2010, vol. 71, pp. 0-176.
https://ecommons.luc.edu/cgi/viewcontent.cgi?article=1117&context=luc_diss.
- [34] P. Reeves, S. Zappe, E. Kisenwether, D. Follmer, and J. Menold, "Comparisons of Faculty and Student Definitions of Entrepreneurship," in *The Journal of Engineering Entrepreneurship*, 2015, vol. 6. 10.7814/jeenv6n2p2.
- [35] N. F. Ghazi, M. S. Tavakoli, and M. "Developing Entrepreneurial Mindset in Industrial Engineering Classes: A Case Study," in *ASEE Annual Conference & Exposition*, New Orleans, Louisiana, 2016. 10.18260/p.26756.
- [36] S. R. Kirkpatrick, A. Watt, and A. Bernal, "Developing an Entrepreneurial Mindset in Engineers: An Application of the Three C's (Creativity, Curiosity, and Connections) in a Collaborative Summer Mega- Course," in *ASEE Annual Conference & Exposition*, New Orleans, Louisiana, 2016. 10.18260/p.26745.
- [37] N. O. Erdil, R. S. Harichandran, J. Nocito-Gobel, M. Carnasciali, and C. Li, "Integrating e-Learning Modules into Engineering Courses to Develop an Entrepreneurial Mindset in Students," in *ASEE Annual Conference & Exposition*, New Orleans, Louisiana, 2016. 10.18260/p.25800.
- [38] H. Park, "Fostering and Establishing an Engineering Entrepreneurial Mindset through Freshman Engineering Discovery Courses Integrated with an Entrepreneurially Minded Learning (EML) Pedagogic Approach," in *First Year Engineering Experience (FYEE) Conference*, Daytona Beach, Florida, 2017.
- [39] C. Wang, "Teaching Entrepreneurial Mindset in a First-Year Introduction to Engineering Course," in *ASEE Annual Conference and Exposition*, Columbus, Ohio, 2017.
- [40] R. Desing, K. M. Kecskemety, R. L. Kajfez, D. M. Grzybowski, and M. F. Cox, "A Multi-institution Investigation into Faculty Approaches for Incorporating the Entrepreneurial Mind-set in First-year Engineering Classrooms," in *ASEE Annual Conference & Exposition*, Tampa, Florida, 2019. <https://peer.asee.org/31972>.

- [41] H. Morano, S. Henson, and M. L. Cole, "Work in Progress: A Mixed-method Longitudinal Study to Assess Mindset Development in an Entrepreneurial Engineering Curriculum," in *ASEE Virtual Annual Conference Content Access*, Virtual Online, 2020.
<https://peer.asee.org/35596>.
- [42] Z. Pihie, and A. Sani, "Exploring the entrepreneurial mindset of students: Implication for improvement of entrepreneurial learning at university," in *Journal of International Social Research*, 2009, vol. 2, no.8, pp.1-6.
- [43] K. Kövesi, and P. Csizmadia, "Industry perception of new engineering graduates: the gap between requirements and reality," in *44 th SEFI Conference*, Tampere, Finland, 2016.
- [44] A. Davies, D. Fidler, and M. Gorbis, "Future Work Skills 2020," in *Institute for the Future for the University of Phoenix Research Institute*, 2011, pp. 1- 13, Available at:
<http://www.iftf.org/futureworkskills/>.
- [45] J. D. Lang, S. Cruse, F. D. McVey, and J. McMasters, "Industry Expectations of New Engineers: A Survey to Assist Curriculum Designers," in *Journal of Engineering Education*, 1999, vol. 88, pp. 43-51. <https://doi.org/10.1002/j.2168-9830.1999.tb00410.x>

Appendix: Interview Protocol

1. What would you say is the definition of an entrepreneurial mindset?
2. What do you think are the most important attributes associated with an entrepreneurial mindset?

An entrepreneurial mindset is often defined as an individual that is curious, has the ability to overcome challenges, makes the most of opportunities, adapts to situations, persists through failure, and manages risk.

3. Would you consider yourself to have an entrepreneurial mindset given this additional information? Why or why not?
4. Share a story about a course or extracurricular experience that you believe has helped shape your entrepreneurial mindset. What attributes of entrepreneurial mindset do you feel were developed during this experience?
5. Do you think that an entrepreneurial mindset is important to success in your future career? Why or why not?