

Qualitative Investigation on the Failure Experiences of Entrepreneurial Engineering Students

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Work in Progress: Qualitative Investigation on the Failure Experiences of Entrepreneurial Engineering Students

Abstract:

Entrepreneurial education has been rapidly expanding within universities over the past 15 years with colleges of engineering being amongst the most active participants in embedding entrepreneurship into curricular and cocurricular activities (Pittaway & Cope, 2007). Well-developed and theoretically grounded educational interventions have been shown to increase entrepreneurial skills and perception among students. (Pittaway & Cope, 2007; Matlay & Caray, 2007; Duval-Couetil & Wheadon, 2013; Duval-Couetil & Rheed-Roads, 2012). Organizations including the National Science Foundation through the Lean Launch Curriculum and I-Corps program, VentureWell through curriculum development grants and their E-Team program, and the Kern Family Foundation through the Kern Entrepreneurial Education Network (KEEN) have provided significant funding to embed and transform entrepreneurial teaching and practice into colleges of engineering (Matthew et al., 2017; Pistrui, Blessing & Mekemson, 2008; Smith et al. 2017). This activity combines with an added emphasis among engineering programs to develop an entrepreneurial mindset among their engineering students with the belief that this will lead to them being more productive and innovative whether their career path leads them into established industry (becoming “intrapreneurs”) or later as entrepreneurs.

While this trend toward developing more entrepreneurially minded engineering students is supported by global economic trends and a rapidly changing work environment, one factor has been largely overlooked in this process. Statistically, most entrepreneurial ventures fail, with disproportionately large value being created from a minority of entrepreneurial endeavors (Coats, 2019). Given this fact, until we find ways to drastically increase the success rate of entrepreneurial ventures, as we increase engineering students’ exposure to entrepreneurship, we are also increasing their exposure to failure very early in their careers. With this exposure, it is unknown whether sufficient preparation and education around project/venture failure is occurring to properly equip entrepreneurially minded engineering students to learn and grow from entrepreneurial failure.

In this work in progress study, current and former engineering students who formed entrepreneurial ventures and experienced either failure of the venture or significant failure during the venture are interviewed to better understand the influences that led to both adaptive and maladaptive responses to these failures. Participants have been selected from those that have received funding through the national VentureWell E-Team program. This program awards three levels of funding and provides mentorship, training, and networking for the teams. The study uses the framework developed by Henry, Shorter, Charkoudian, Heemstra, and Corwin (2019) in which they associate pre-failure dispositions related to fixed and growth mindset (Dweck, 2000, 2006) and mastery vs. performance disposition (Pintrich, 2000 a, b). Our work

will utilize this framework to guide the research, but more importantly will provide a unique context for analysis, specifically within engineering entrepreneurship, which will add to the body of work and expand the understanding of this pre-failure/post-failure disposition framework. In this work in progress, we review the background literature and design of the research study in addition to the initial results of our interviews with both pilot-study participants (used to help develop and refine the interview protocol) and the initial interview respondents.

Background

Entrepreneurship education includes content that can be classified into three categories of business basics, entrepreneurship basics, and entrepreneurial mindset (Kuratko & Morris, 2018). While the first two categories of content are largely skills and tools required for being an entrepreneur including setting up operations, understanding financial statements and lean startup processes, the category of entrepreneurial mindset includes many behavioral characteristics that are believed to be associated with entrepreneurial success such as passion, persistence and tenacity, optimism, and learning from failure. These entrepreneurial mindset behaviors have been espoused by colleges of engineering looking to enhance and differentiate their curriculum to help their students flourish in a rapidly changing society while building upon the technical foundation provided by the core engineering education. Within the context of entrepreneurship education, the concepts of learning from failure, failing fast, and failing forward have been championed as key attributes to entrepreneurially-minded individuals. Developing an attitude that failure is learning and leads to perseverance (Kuratko 2014; Kuratko & Morris, 2018), that tolerance of failure is a key entrepreneurial factor during the growth stage of a venture (Kuratko 2014), that persisting through and learning from failure are key to creating value (London et al. 2018), and that even when failure occurs the entrepreneur has an opportunity to learn from the experience to improve his or her chance of success in the next entrepreneurial endeavor (Minniti & Bygrave, 2001) are desired outcomes for those teaching entrepreneurship.

While entrepreneurship programs generally espouse and encourage learning through failure and resilience, presumably one of the attributes that colleges of engineering hope their students learn when participating in entrepreneurial programming, little is known about how students are being taught about and responding to the failures that they encounter as part of these programs. In fact, while failure is consistently referenced as central to various aspects in entrepreneurship education, there isn't an agreed upon definition of what failure even is to support the consistent reference to its educational value (Katona, Zappe & Tranquillo, 2020). Many of the definitions of failure are quite narrowly constrained in reference to business failure and more specifically bankruptcy of a venture (Shepherd & Haynie, 2011; Zacharakis, Meyer, & DeCastro, 1999). Shepherd (2003:318) defined failure such that, "Business failure occurs when a fall in revenues and/or a rise in expenses are of such a magnitude that the firm becomes insolvent and is unable to attract new debt or equity funding; consequently, it cannot continue to operate under the current ownership and management." Similar to Shepherd, failure has also been defined based

on “the market” where the test of failure is if revenues sufficiently exceed costs to make the business attractive to continue (Coelho and McClure 2005). Ucbasaran (2010) add to pure market-related definitions, such as those above, to also define failure as closing down a business because it failed to meet the *expectations* of the entrepreneur. Reuber and Fischer (1999) go further and eschew any business or financial metric from the definition but speak of failure in terms of “facing major setbacks,” which begins to be more relatable for a larger percentage of students experiencing university entrepreneurship curriculum and programming and is more broadly applicable in engineering education when thinking about levels of failure in a project or product development. When speaking about entrepreneurial failure in the university context, however, an even larger body of work speaks about failure without providing a concrete definition (Korach & Gargach, 2019; Li et al., 2019; Hirschfield, Huang-Saad & Libarkin, 2017; Jamison IV, D, 2017) or implicitly define it as the inability to properly accomplish a given task on the first try (Davis & Beyette Jr., 2017; Shooter & Orsborn, 2013).

Given the large range of contexts and definitions of failure, it is not surprising that educators need to consider that each of these contexts will have a different effect on and importance to students. These differences in effects result from students own emotions (Shephard, 2004) and the level of self-identity that the students place on the failure. As an example, it’s not surprising that students’ self-identity in a 30-minute entrepreneurially oriented in-class activity will be quite different than students’ self-identity in a business that they start through a university entrepreneurship center. Huerta (2018) begins to show how students self-identify with various entrepreneurial activities by profiling several students and their journey through curricular and co-curricular university entrepreneurship programming. With the explosive growth in entrepreneurship programming on college campuses, participation from engineering students, and the variety of depth to the entrepreneurial experience that is offered through these different programs (e.g. classes, weekend and/or year long competitions, summer accelerators, and venture launch support incubators to name a few), it is timely to begin to gain a better understanding of how learning from and response to failure is being taught/supported, and to better understand factors that influence student response to a failure event.

The Problem

It is unknown whether sufficient preparation and education around project/venture failure is occurring to properly equip entrepreneurially minded engineering students to learn and grow from entrepreneurial failure.

This problem statement guides the following Research Questions which are the subject of this proposal:

RQ1: What are the different types of entrepreneurial failures that students working on ventures experience?

RQ2: What are the different ways that students who experience entrepreneurial failure respond (i.e. identification of adaptive and maladaptive post-failure responses)?

RQ3: What are the different factors or events that lead students who experience entrepreneurial failure to exhibit adaptive or maladaptive responses (pre-failure dispositions)?

RQ4: What educational methods do student entrepreneurs report receiving to help them prepare for and respond to entrepreneurial failure?

Theoretical Framework

A qualitative approach to this study was chosen because qualitative research can provide more rich data particularly when trying to understand multi-faceted complexities or phenomenon (Smith, McElwee, McDonald, & Drakopoulou Dodd, 2013). Qualitative data on response to failure is being analyzed within the frameworks developed by Henry, Shorter, Charkoudian, Heemstra, and Corwin (2018) in which they associate pre-failure dispositions related to fixed and growth mindset (Dweck, 2000, 2006) and mastery vs. performance disposition (Pintrich, 2000 a, b). While the frameworks developed by Henry *et. al.* were not specifically developed for entrepreneurship education, they were developed for STEM education “to guide research aimed at understanding how STEM students develop challenge-engaging disposition and the ability to adaptively cope with failure.” This framework focusing on academic STEM failures for undergraduate students could be readily applied to failures of students in an engineering entrepreneurial context. Figure 1 shows the general framework to be applied from Henry *et al.* which is a combination of four distinct mini-model frameworks. The framework suggests that just as pre-failure disposition can be predicted based on mindset, goal orientation and fear of failure, post-failure attributions, responses and coping styles can also be predicted. It was constructed based on research at the K-12 levels of education and in educational fields distinct from STEM education. The construct suggests that for students to exhibit adaptive coping behavior post-failure, a pre-failure disposition of a growth mindset, and more specifically a “mastery approach” goal orientation is required which if true, would indicate that engineering entrepreneurship educators should have effective methods to foster these pre-failure dispositions in their students to impact their ability to learn from failure. With that said, Henry *et al.* acknowledge that the figure outlines most typical relationships, but that each distinct block actually represents a spectrum of pre-failure and post-failure orientations. Therefore, where a student is at in each spectrum and the context of the given problem may influence different relationships between the dispositions. Given this, our work will utilize this framework to guide the research, but more importantly will provide a unique context for analysis, specifically engineering entrepreneurship, which will add to the body of work and expand the understanding of this pre-failure/post-failure disposition framework.

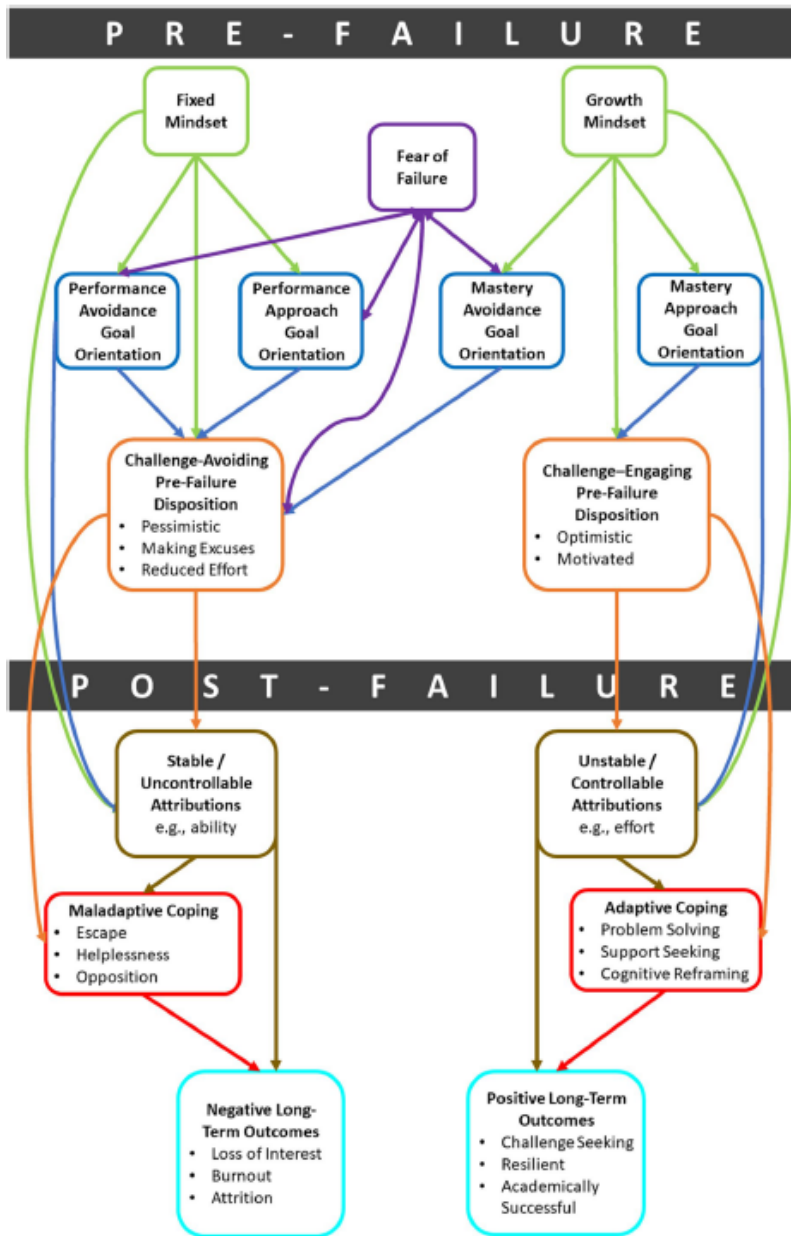


Figure 1: Henry *et al.* “Failure Mindset Coping Model” which shows the connection between different pre-failure dispositions and post-failure responses that will be used as the guiding framework for this research.

As highlighted above, while fixed and growth mindset serve as one basis for analysis, investigating pre-failure “approach” vs. “avoidance” dispositions combined with the “mastery” and “performance” dispositions (Elliot and Church, 1997; Elliot and McGregor, 2001) in examining the impact on post-failure response is equally important. Based on this construct, we will identify whether connections exist between these pre-failure dispositions and the post-failure responses. Adaptive responses such as problem solving, support seeking, and emotional regulation, among others, are clearly desired over maladaptive responses such as social

withdrawal, escape, helplessness, and rumination, among others (Skinner et al., 2003). If connections between pre-failure disposition and post-failure response are identified in this study, it may provide insight into pre-failure education and interventions that can be designed that would positively impact entrepreneurially minded engineering students.

Research Design

For this research, we are conducting a phenomenographical study of engineering students’ experiences with failure in an entrepreneurial context. As described by Marton (1986), the purpose of phenomenography is to understand the different ways that people experience something or think about something (Marton, 1986), in this case entrepreneurial failure. Using

analysis of semi-structured interviews, we are attempting to identify the “critical features” of failure that engineering students are aware of and how it relates to their pre-failure experiences and post-failure responses. Another way of conceptualizing the purpose of phenomenography is “to describe variation in experiences in a way that is useful and meaningful, providing insight into what would be required for individuals to move from less powerful to more powerful ways of understanding a phenomenon” (Bowden, 2005, p. 72).

Participants:

We are choosing to focus on engineering students who started technology-based companies either during or immediately after college and whose endeavors ceased operation without either selling the venture or achieving a traditional “exit” event. The focus is intended to identify engineering students who reached a level of maturity in their entrepreneurial project such that a threshold level of self-identity of the student was linked with that of their venture. The sample group that will be used for this study are current or former university engineering students who were a core member of a team that was awarded entrepreneurial team (E-Team) awards through VentureWell, a national engineering entrepreneurship university non-profit support organization. Through VentureWells’ E-Team program¹ students have the ability to garner up to \$5,000 and \$20,000 grants as part of the Phase I and Phase II programs, respectively. Using this group as a sample set has the following benefits.

- Draws from a national pool which eliminates unintended bias from working only with student entrepreneurs from the PI’s home institution.
- Ensures that the students received an amount of external funding sufficient for the team to work together on the project for greater than 6 months (and in most cases longer than that).
- While VentureWell’s program doesn’t restrict their funding to only engineering students, the projects are all technology based and the organizations’ efforts are directed primarily to engineering programs, which increases the likelihood that a core team member received an engineering education.

The study consists of qualitative interviews with core team members from VentureWell E-Teams. The goal for this study is to interview approximately 30 current or recently graduated engineering students. These students will be selected from the data provided from a survey that VentureWell administered in January, 2020. This survey was sent to all individuals who participated in one of the E-Team (Propel, Pioneer) or ASPIRE programs between 2014 and 2018 (616 individuals from 269 teams) to better understand their current activities (employment, engagement in the entrepreneurial ecosystem) and the status of the ventures they were working on when they participated in the program. Of the respondents, 68 individuals indicated that they are not currently working on the venture they were with for the E-Team program and of those, 38

¹ <https://venturewell.org/e-team-grant-program/>

indicated that the venture was not still active. We have begun outreach to these 38 individuals to see if they will participate in this study and are also analyzing the reasons why the other 30 individuals are not currently working on the venture to see if there are any indicators that these individuals may be candidates for the study. For example, if someone states that the venture is still operating but they left because the team was unable to continue working together they would be more likely to be included in our outreach than someone who indicates that the venture is still operating but they left because they had a great career opportunity they couldn't turn down. We are also currently evaluating whether to include participants from VentureWell's 2019 & 2020 cohorts which we did not have any information on when this study began.

Study Progress and Preliminary Results:

As of early March 2021 3 individuals were interviewed as part of a pilot study to test the interview protocol. These individuals were engineering alumni from institutions of the research team who had started companies through programming of the university, had either won or raised similar amounts of funding to what VentureWell provides through their E-Team program, and whose ventures had ceased operation. An initial interview protocol was established and two pilot interviews were conducted. After the first two pilot interviews the research team reviewed the responses, and the research questions and slightly modified the interview protocol in an attempt to address missing information related specifically to one of the research questions. After this, a final pilot interview was conducted and at that time the research team was satisfied with moving forward with participants from VentureWell's E-Teams programs.

Solicitations for participation were initially sent to 10 individuals (of the 38 described above) with an intentional attempt made with this initial 10 to obtain diversity in the participant pool. Specific variables that were taken into account were gender, race, field of study AND level of study (e.g. bachelors, masters, etc.), and geographic region. While it's still very early in the study, some themes are beginning to emerge both in the pilot interviews and the initial interviews with the participants. While all of the individuals noted that overall the experience of trying to start a venture was a positive experience that they learned a lot from, experiencing both failure of the venture and other moments of failure during their entrepreneurial journey was extremely difficult for the participants to navigate. It's clear from some of the themes noted below that these individuals didn't see the experience as a great learning experience at the time they were going through it and the results are mixed on their perception of the events in retrospect. These initial results indicate the need for continued work exploring this area to better inform entrepreneurial educators.

Themes and Perceptions Regarding Entrepreneurial Failure:

1. The participants reported feelings of shame, stress, frustration, embarrassment, and depression.

2. "I wish someone told me it's okay" to stop the venture or that the venture was failing.
3. "I wish I had someone helping me through it."
4. "Our university didn't provide any resources to help with this."

Next Steps & Future Work:

The study aims to have at least 30 participants with the majority of the interviews to take place during the first half of 2021. As indicated above, as of the beginning of March 2021 only 3 of the interviews have been completed. Based on the response rate of the originally defined study population, it's possible the researchers will have to expand the participant pool to include participants with similar profiles to those originally defined but not included in the first population definition.

Interviews will be transcribed and coded by at least two different researchers and then results compared. After coding is performed common themes will be explored to better understand participants perceptions of entrepreneurial failure, their responses to and reasons and/or influences on their responses to moments of failure, and their perception of support structures that could have helped them to more adaptively respond during those times. It is expected that these next results will be more thoroughly studied by fall 2021.

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Appendix 1: Semi-Structured Interview Protocol

The following semi-structured interview serves as a template for the interviews. It's not necessarily followed linearly, follow up questions are asked based on responses, and some questions are skipped based on if they have been addressed during the discussion from other questions.

Introductory Questions (for all participants)

1. Tell me a little about yourself. Where are you currently working and what type of work do you do? Where did you go to college? What degree were you working on while working on this entrepreneurial venture?
2. Tell me a little about the venture that you worked on with VentureWell. When did it start? What activities with VentureWell did you participate in? Describe how the venture started, how long you worked on it and in what capacity?
3. Tell me about the composition of the team that worked on the venture. How many people were on the team? What were their backgrounds?

For Those Survey Participants Who's Venture's Have Ceased Operation:

General questions on what happened (description of venture end/failure)

4. There isn't any right or wrong answer to this. Tell me about how you would define a failure or failures during the entrepreneurial process.

5. In thinking about responses to failure, some people, when they experience failure, become very frustrated and unmotivated, and don't want to take on other challenges. Other people, when they experience failure, view the failure as a learning opportunity and are still willing to take on other challenges right away. Which of these, or potentially which elements of each do you most relate to?
6. Tell me about what you perceived to be the biggest failure you experienced during your entrepreneurial journey.
7. Tell me about other experiences you had during your entrepreneurial journey that at the time they occurred you perceived to be failures?
8. Explain for me the similarities and differences you see between these different events?
9. Tell me specifically about the events and circumstances that led to your venture ceasing operation and how you perceived that at the time? (**This question is optional based on if it was addressed above**)
10. Has your perception of these moments of entrepreneurial failure changed at all over time? If so please describe how your perception has changed?

Psychological impacts of failure

11. Tell me about how you responded to some of the moments that you perceived to be failures?
 - a. How did you feel during these different moments of perceived failure?
 - b. Why do you think you felt this way?
12. When you think about the two types of people and responses we described earlier (becoming very frustrated and unmotivated, and don't want to take on other challenges or view the failure as a learning opportunity and are still willing to take on other challenges right away) which do you feel you were more like right after the failure happened?
13. Do you think you still feel that way, looking back at the failure now?
14. What are some factors that influenced how you responded in these moments?
15. Tell me about your experiences after the venture ceased operation? How and when did you notify others about the venture ceasing operation? How long did you take afterwards before you began pursuing other opportunities? Did you seek guidance, mentorship or help from other support structures during this time? Tell us

about any other information that was important to you while moving on from your entrepreneurial venture.

16. Even though your venture ceased operation do you view the experience of starting your venture positively or negatively and has that view changed over time? Explain your response.

We want to shift the discussion a little bit now to help you inform us on different support systems, training, etc. you may have gotten either before, during, or after these moments of perceived failures in your entrepreneurial journey. These could be things you learned or were taught long before you ever thought about starting your venture, things you learned or support you received during your venture, or interventions and support you received during or after these moments of failure.

17. Did you ever receive any information/training about how to handle failure before you started (or while you were starting) your venture (for example, in a course, program, etc.)? If so, please describe this.

18. What type of support would have better helped you respond when your venture ceased operation? If you could go back in time, what resources would have been most helpful either before or after your venture ceased operation?

19. When you experienced these different moments of failure, tell us about any support specifically from the university you were affiliated with that you didn't previously mention that was particularly helpful and how (i.e. instructor, advisor, office or entrepreneurship center, mentor, etc.)? This could be support provided either before or during the experiences you described.

20. What support could the university you were affiliated with have provided that would have been beneficial to you to help you through these moments of failure?

21. Are there any other things that were important about these experiences and how you worked through them that you think we should know?

22. Are you considering starting another venture or made any steps toward starting another venture?