Work-in-Progress: Human Capital Formation as a Framework for Entrepreneurship and Venture Design Education

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Introduction

A strong case has been made for entrepreneurship education in higher education, and specifically in engineering education. Huang-Saad et al. [1] note the history of engineering entrepreneurship education, from the first entrepreneurship courses taught in the 1940s at Harvard Business School to the National Science Foundation's (NSF) I-Corps program launched in 2012 that seeks to provide NSF-funded researchers a pathway for bringing their research findings to market.

Outside of business schools, the growth of and interest in entrepreneurship education has been facilitated by Venture Well (formerly the National Collegiate Inventors and Innovators Alliance (NCIIA; [2]), the Kern Entrepreneurial Engineering Network (KEEN; [3]) established by the Kern Family Foundation, and Epicenter, the National Center for Engineering Pathways to Innovation, an NSF-funded center at Stanford University that aspired to advance entrepreneurship education and research on entrepreneurship education in engineering ([4]).

Entrepreneurship education usually falls under the purview of business schools, centering primarily on case studies and management skills. However, knowledge about the venture support system for innovation [5] as it relates to inventions and workforce development is critical to understanding the relationship between engineering and entrepreneurship education. Inventors require access to venture operations, incubators, accelerators, and legal resources as they look to bring their products to market and take them to scale. While the academic backgrounds of investors are varied, about one-third of venture capitalists have an undergraduate major in a STEM field [6]. However, the success of new ventures also requires entrepreneurial knowledge and skills in addition to the expertise found in technology transfer offices.

Entrepreneurship education prepares engineering students for the talent marketplace ([7]8]) and represents a promising strategy for job creation [5]. The origins of engineering entrepreneurship are shared with "traditional venture creation-focused entrepreneurship" (page 4) [1]. As a result, in this work-in-progress paper, we propose an expansion to entrepreneurship education in engineering: *Venture Education* or *Venture Design Education*. This framework concentrates on how engineering and other STEM disciplines communicate and engage with society through the formation of various forms of capital – cultural, process, financial, natural, intellectual and especially *human* capital.

Capital Formation and Entrepreneurship Education

The Kauffman Fellows Program is a two-year leadership development program for venture capital investors focusing on innovation that provides mentoring, networking, and teaching knowledge and skills. Originating from the Ewing Marion Kauffman Foundation in 1995, the Kauffman Fellows Program seeks to create a more equitable venture ecosystem [9] by emphasizing on capital formation, which it describes as "mapping, building access to, and mobilizing all of the different forms of capital on behalf of entrepreneurs" [10]. In the startup environment, the definition of capital is broader and more inclusive and capital formation is modeled on Abraham Maslow's hierarchy of needs (Figure 1).

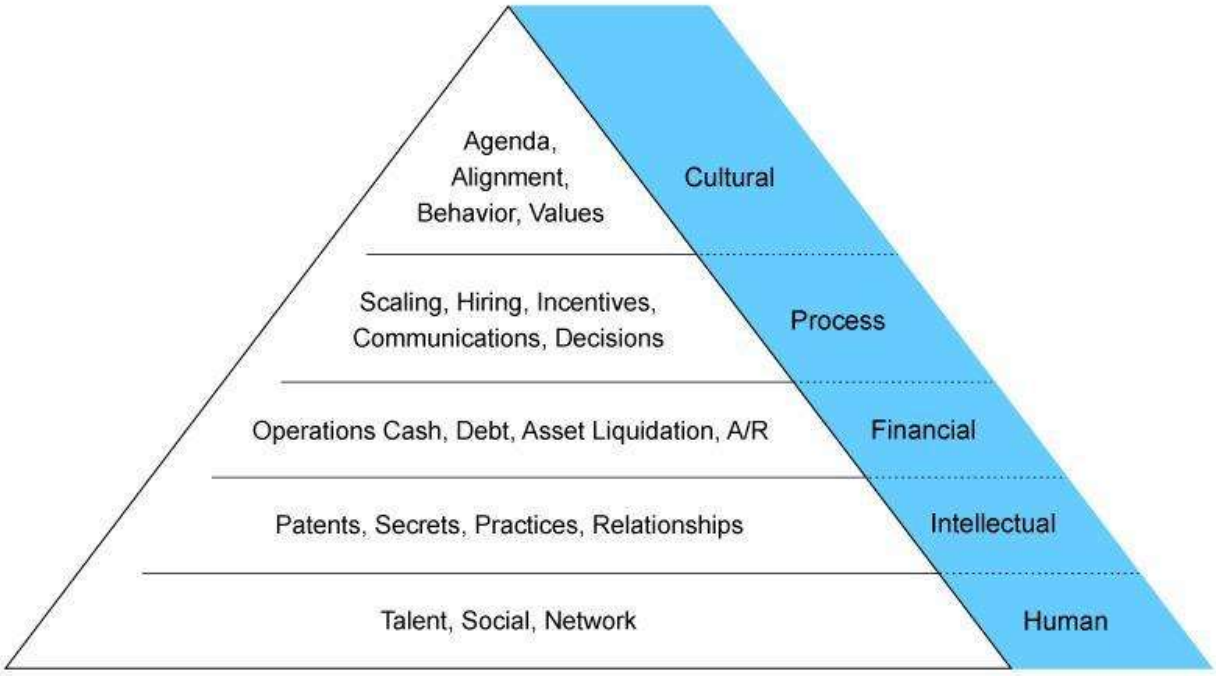


Figure 1. The Startup Capital Hierarchy of Needs: (At Least) Five Types of Capital for Success. [10]

Figure 1 lists a broad set of inputs required by entrepreneurs aspiring to innovate. Financial capital is what most often comes to mind. However, intellectual capital in the form of relationships cannot be underestimated. Process capital as it relates to infrastructure and scaling, and values and behaviors representing cultural capital and modeled by founders and leaders, are widely acknowledged as factors that can make or break a new venture. At the foundation of this pyramid is human capital, representing not just the founders, employees, and investors but also their collective knowledge, skills and abilities. While capital typically describes the resources (both financial and physical) that are used to produce goods and services, it can also refer to the *value* of these assets, which can be deployed to generate income or be invested in new projects.

Education can be viewed as a means to contribute to and develop human capital in the startup ecosystem by investing in and developing the competencies and capacities of individuals in order to improve their economic value and productivity. In both the educational and entrepreneurial ecosystems, the outcomes of increasing the quality of human capital are demonstrated by individuals who increase earning potential (their own and/or their organizations), enhance their ability to innovate and adapt to changing technologies and markets, and become more productive and engaged citizens. In higher education, this is accomplished through project- and problem-based pedagogies, and high-impact practices where students engage in internships, learning communities, service learning, and research. In sharp contrast to a traditional business school class, capital formation, as taught in ENGR 306, is characterized by experiential learning and continuous and embodied practices, not just a checklist or series of transactions. [11]

Piloting Human Capital Formation in Engineering Education

The Kauffman Fellows Program was established to satisfy Ewing Kauffman's desire to identify and develop emerging leaders in the design and building of organizations and in the financing of novel and untried technologies in order to strengthen the innovation ecosystem. An amplification of that effort looking to expose and engage graduate students in comparable activities, principles, and curricula started in 2017 at Stanford University in a course titled *Capital-Formation Design Theory in Practice* (ENGR 306). ENGR 306 is co-taught by Dr. Ade Mabogunje, a senior researcher in the Stanford Center for Design Research in partnership with Phil Wickham, founder and managing director of Sozo Ventures and former executive chairman and alum of the Kauffman Fellows Program. The design of ENGR 306 re-envisions the Kauffman Fellows curriculum by addressing the interests and needs of undergraduate and graduate students who wish to create new companies, transition organizations, solve a societal or educational problem, and/or learn more about the venture capital process and industry.

ENGR 306 focuses on innovation and innovators. While the following metaphor uses a formula to describe the factors within an organization that contribute to innovation, the role and experience of the innovator is implicit in each of these variables:

$$Innovation = f(product)(business\ model)(culture)$$

This representation highlights several of the key topics in this course, particularly optimizing the design of organizations and support-ecosystems by applying capital formation design to individual personal and professional journeys. The pedagogical model includes guest speakers (i.e., entrepreneurs, venture capitalists, and executive coaches), assessments, simulations and reflective exercises. The following descriptions illustrate how product, business model, and culture are operationalized and communicated in the course:

Product is represented by the diverse range of founders who often begin their presentations with their value proposition for their product or service, from an innovative cancer protection system aimed at consumers (Need, https://www.getneed.com/) to a credit card for the unbanked that is backed by assets that would often be traded in pawnshops (Pesto, https://www.getpesto.com/). Each speaker fields a wide range of questions from the students, and their responses eschew the typical elevator pitch and explore their motivation and challenges, as well as the lessons and doubts of their entrepreneurial journeys. From the perspective of the student, the wisdom offered by the speakers lies in how they responded to the challenges related to the various forms of capital formation.

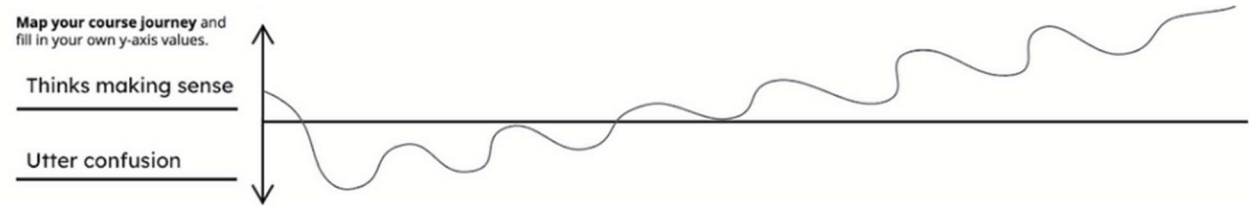
Business Model is addressed by introducing foundational concepts such as unit economics, interpreting cap tables, understanding term sheets, venture glossary terms [12]and legal issues. This has broad appeal for students looking to secure funding to bring a product to market.

Culture is a critical topic that engineering students initially approach with some skepticism. The fundamental importance of building a healthy culture is reiterated frequently throughout the course, from behavioral styles in the context of building trusted relationships in teams, conscious leadership (The Conscious Leadership Group), and mapping the organizational ecosystem [13]. The concept of behavioral fitness is also explored by using assessments such as exploring one's Upper Limit [14] and the SCARF Model [15]. These models provide a language for exploring each student's characteristics, talents and strengths, and the challenges and needs aspiring entrepreneurial leaders must confront, especially in relation to other individuals, such as within a founding team, potential funders and partners, and current and future stakeholders and collaborators.

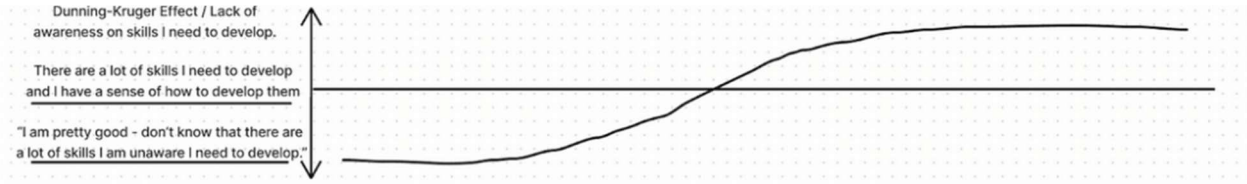
The outcome of **innovation** is further expanded upon through simulations and discussions about the innovation ecosystem [16], mapping and mobilizing the different forms of capital (human, intellectual, financial, process, and cultural), and the design of organizations and support systems through Product, Business Model, and Culture.

Implications and Future Work

Over the last two years, the teaching team solicited student feedback in order to better understand what they are taking away from the course. A journey-mapping approach allows us to track their journeys across the timeline of course experiences, activities, and topic modules to measure how meaningful each component of the class was for them (See Figure 2).



Student Example #1



Student Example #2

Figure 2. How two students mapped their experiences of ENGR 306 across the timeline of course events and modules

The word cloud in Figure 3 represents responses collected at the end of the class to the prompt: *What are 3 words or phrases you would use to describe this course?*.

Figure 3. Word cloud of how students would describe Capital-Formation Design Theory in Practice (ENGR ###)

Lastly, students were asked how they would describe this class to students considering taking this course.

- *This class will teach you about capital formation in a way you probably never had a chance to experience… You will learn a lot from the theory, but much more from the unique guest speakers and from yourself. The knowledge gained from this class will be useful in almost every aspect of your life. Question everything and try your best to fully engage with each class, studio session, the teaching team, and your classmates. This course has a very special type of people.*
- *ENGR 306 is a trip. I came into the class thinking it would be a relatively technical entrepreneurship course - cap tables, building financial capital, how to get VC funding, etc. but it was so much more. It definitely introduces some of these technical concepts but at its core, the class is about learning to be radically honest with yourself and becoming cognizant of who you are and how you approach leadership, entrepreneurship, and life in general. For me, the most valuable part of the class was the set of self analysis and introspection tools the teaching staff provided as well as the ability to hear a myriad of perspectives from entrepreneurs and VCs at various stages in their career.*

Student comments suggest there is something of value here, and as a teaching team, we aspire to identify and improve how we describe and characterize this curriculum and the framework for human capital formation so that it can be shared and disseminated with other educators as well as individuals outside of academia. For example, we are exploring how components of ENGR 306 can be adapted for high school students in the state of Washington interested in entrepreneurship in Career and Technical Education (CTE). Graduate students and postdoctoral fellows in medicine, sustainability and energy, and the sciences have also expressed interest in these topics as they consider potential opportunities to apply and accelerate their research insights and processes through industry, governmental, and non-profit pathways.

In our efforts to better understand the entrepreneurial ecosystem for engineering students and graduates, our experiences in ENGR 306 reiterate a parallel interest and a need for the development of educational modules focusing on venture and venture design within engineering. Our orientation to venture design in the entrepreneurial context is again prompted by the experience of the innovator in this definition: “The entrepreneur is essentially a person who anticipates a need, assembles and organizes the tools and skills necessary to satisfy this need. In doing so, he takes the risk that this need does not materialize or that the means it has established to satisfy are inadequate.” (p.152, translated from French, [17])

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