

The Effects of Entrepreneurship Learning on the Engineering Identity of HBCU Students

Jerald Dumas

Hampton University

Abstract

As we face new challenges in the 21st century, a diverse engineering workforce and methodology are needed. The development of an engineering identity is important for the success of students pursuing careers and preparation to face such challenges. Various factors can affect engineering identity of students, and there is a gap in knowledge regarding the effects of entrepreneurship learning on engineering identity. This work in progress aims to better understand how entrepreneurship learning affects the enthusiasm and engineering identity of Historically Black Colleges and Universities (HBCU) students. Specifically, the study will examine undergraduate engineering students (of all levels) enrolled in an entrepreneurship workshop that is based from the NSF I-Corps program.

Keywords

engineering, entrepreneurship, education, innovation, business

Introduction

According to U.S. National Academy of Engineering (NAE), engineers will face several grand challenges in the 21st Century that include issues such as improving urban infrastructure, securing cyberspace, and making solar energy affordable. Such challenges will require a diverse workforce and diverse methodology. Historically Black Colleges and Universities (HBCU) have significantly contributed to diversifying the STEM workforce by producing 40% of bachelor's degrees awarded to African Americans in STEM fields¹. Further, there has been more emphasis on the importance of engineering students learning an entrepreneurial mindset^{2,3} in addition to their technical training such that they truly understand and address the unmet needs associated with the grand challenges that they will face. The infusion of entrepreneurial methodology has potential to affect the engineering identity of students.

Several studies have been conducted to ascertain factors that affect undergraduate engineering identity and its connection to student success and persistence in engineering^{4,5}. The development of an engineering identity is especially critical for HBCU engineering students as African American students have a higher attrition rate than other groups⁶. The introduction of entrepreneurship at an HBCU could address two critical concerns as the next generation of engineers are being trained: 1.) promoting a diverse workforce by strengthening student identity, and 2.) diversifying the training/methodology of this student group.

Two partner HBCUs have established an NSF I-Corps to increase the training of HBCU faculty and students in entrepreneurship methodology. NSF I-Corps is a program that prepares scientists

and engineers to move toward commercialization. In this study, African American engineering undergraduates are characterized in the context of their participation in a project-based entrepreneurship course. This course was inspired by the NSF I-Corps curriculum, which uses the work of Steve Blank^{7,8}. This paper examines the role of entrepreneurship education in the development of engineering identity and self-efficacy. The results from this on-going study would advance the knowledge gap describing the role of entrepreneurship learning and engineering identity.

Research Questions

The following questions are proposed in this study:

- 1.) What are the important factors of entrepreneurship learning that affects undergraduate students' engineering identity at a HBCU?
- 2.) What elements of engineering do students view as synergetic with entrepreneurship?

Methods

Course Layout. A one credit hour entrepreneurship pilot course was offered as an elective. This project-based course meets once weekly for 50 minutes and does not fulfill any degree requirements for the students. In the course, students learn about the business model canvas (www.businessmodelgeneration.com) with particular focus on value propositions, customer segments, and channels. Students are asked to think of a potential technology and develop their own business model canvas. Each student is required to conduct fifteen video or in person interviews of potential customer segments or subject experts to iterate hypotheses about their respective technologies. Course grading is based on the student's participation and the completion/analysis of their business canvas.

Participants. Twelve undergraduate students participated in this study and enrolled in the entrepreneurship course. Majors (see Table 1) included chemical, computer, electrical, and civil engineering. All student classifications are represented in the course.

Procedure. Students completed a pre-course survey (sample questions in Table 2). Survey questions were adapted from previous work (Godwin). The survey was administered via Google Docs. All questions were completed by the participants and were on a five point Likert scale.

Preliminary Results

Recognition of engineering and entrepreneurship was one factor that was assessed. A majority of the students (83.3%) reported (either strongly agreed or agreed) that their peers viewed them as engineers, while only 50% reported that their peers viewed them as entrepreneurs. In contrast, 66.6% of students reported that they have had experiences in which they were recognized as an engineer and 58.4% reported the same for entrepreneurship. As expected, engineering recognition was stronger than entrepreneurship recognition.

As a second factor, engineering and entrepreneurship interest was examined. All students reported that they enjoy learning about engineering. There was a slight drop in enthusiasm for

learning about entrepreneurship as 91.7% reported enjoyment for learning it. In similar trend, fulfillment in doing/practicing engineering and entrepreneurship was reported as 100% and 75% (strongly agree or disagree), respectively.

Finally, engineering and performance factors were examined. Half of the students reported that others ask them for help with engineering, and 41.7% reported the same for entrepreneurship. As a free response question, students were asked to describe skillsets that are necessary to become an engineer. “Critical thinking” and “problem solving” were the most common responses to this question.

Discussion and Future Work

The preliminary results from the pre-course survey show a gap in outside recognition between engineering and entrepreneurship for undergraduate engineering students. This gap is to be somewhat expected due to it being a pre-course survey (i.e., limited communication of gained knowledge). However, it is interesting that over half (58.4%) of students reported that their peers already view them as entrepreneurs, suggesting that students are already involved in innovative extracurricular activities (the final survey will probe this observation further). Interests for both engineering and entrepreneurship are high. This observation is to be expected for entrepreneurship as students elected to take the course; post survey results will provide more insight into this entrepreneurship interest. Since 58.3% of the class are underclassmen, measuring engineering interests after the fall semester after taking their STEM courses would be of great interest. One could expect that engineering interests would decline if the student experiences major challenges or setbacks and that the entrepreneurship interest would provide some stabilization of the current engineering identity and self-efficacy of the students.

The current dataset is limited in answering and supporting the expectations of this study. However, additional survey data will be generated at the end of the course to further study the proposed research questions. It is expected that as the students complete their projects that include interviews of customer segments and subject experts that the links between engineering identity and entrepreneurship will be further highlighted in their survey results. Specifically, the course surveys are aimed to uncover factors of entrepreneurship learning that affect engineering identity. Survey questions are targeted to assist in uncovering student-identified elements that are synergistic between engineering and entrepreneurship. Overall, one preliminary conclusion from the pre-survey suggests that engineering students already interested in entrepreneurship already have developed some degree of their engineering identity.

Acknowledgments

NSF I-Corps Award #1450443

References

1. Owens, Emiel; Shelton, Andrea; Bloom, Collette; and Cavil, Kenyatta, "The Significance of HBCUs to the Production of STEM Graduates: Answering the Call," Educational Foundations, ERIC, 2012, 15.
2. Korte, Russell. "Identifying as an Entrepreneur: A Social Identity Perspective of the Entrepreneurial Mindset," Advances in Engineering Education, ASEE Fall 2018.
3. Kriewall, Timothy and Mekemson, Kristen, "Instilling the Entrepreneurial Mindset into Engineering Undergraduates," The Journal of Engineering Entrepreneurship. Vol.1, No 1, July 2010, 5-19.
4. Godwin, Allison, "The Development of a Measure of Engineering Identity", ASEE's 123rd Annual Conference and Exposition. New Orleans, LA. June 26-29, 2016.
5. Meyers, Kerry; Ohland, Matthew; Pawley, Alice; Silliman, Stephen; and Smith, Karl, "Factors Relating to Engineering Identity, Global Journal of Engineering Education, Vol 14, No 1, 2012.
6. DePass, A. L and Chubin D. E., "Understanding interventions that broaden participation in research careers: growing the community", Vol (V1).
7. Blank, Steven. The Four Steps to the Epiphany. 2005
8. Blank, Steven and Bob Dorf. The Startup Owner's Manual. 2012.

Table 1. Classification of Gender

Classification		Sex	
Freshman	33.3%	Male	83.3%
Sophomore	25.0%	Female	16.7%
Junior	16.7%		
Senior	16.7%		
Other	8.3%		

Table 2. Sample questions from student survey

Sample Question	Statement
Q1eng	My peers see me as an engineer
Q2eng	I have had experiences in which I was recognized as an engineer
Q3eng	I enjoy learning about engineering
Q4eng	I find fulfillment in practicing entrepreneurship
Q5eng	Others ask me for help in engineering
Q1	My peers see me as an entrepreneur
Q2	I have had experiences in which I was recognized as an entrepreneur
Q3	I enjoy learning about entrepreneurship
Q4	I find fulfillment in practicing entrepreneurship
Q5	Others ask me for help on the subject of entrepreneurship

Jerald Dumas

Jerald Dumas, PhD is an Associate Professor and Chair of the Department of Chemical Engineering at Hampton University. His research focuses on the development of bioinspired polymeric materials for tissue engineering, disease detection, and equipment performance. Dr. Dumas graduated from Auburn University with a B.S. in chemical engineering and received his Ph.D. in chemical engineering from Vanderbilt University. He teaches upper level chemical engineering courses to majors, while serving as PI and Co-PI on several grants.