An Effort to Instill Entrepreneurial Mindset Through Teaching Modules in Undergraduate Civil Engineering Courses

S. Immanuel Selvaraj, Ph.D., P.E.
Assistant Professor of Civil Engineering
Department of Mechanical and Civil Engineering
University of Evansville, Evansville, IN 47722
Phone: 812-488-2085; Email: ss476@evansville.edu

Abstract

Entrepreneurship and innovation are two essential skill sets that engineering graduates entering the modern competitive and global workplace are expected to possess in order to be successful. With growing interest in entrepreneurship in higher education, faculty members are finding an increased need to instill an "entrepreneurial mindset" in students. The entrepreneurial education was considered as a sole domain of business schools. This trend is changing and there is interest among engineering faculties to teach students about entrepreneurship in engineering. Establishing new companies or products through the entrepreneurial mindset would generate job opportunities for many people. So it is of paramount importance for engineering educators to teach the future engineers about how to be entrepreneurially minded and innovative in their area of specialization. With this in mind, to instill the entrepreneurial mindset in undergraduate civil engineering students, two modules on entrepreneurship were developed and taught by the author in separate courses. To assess the understanding and effect on these modules, a pre and post case assessment was conducted in both courses. This paper explains the teaching modules and presents the pre-and post-case assessment results to underscore the impact of these modules.

Introduction

As per the dictionary definition, an entrepreneur is a person who organizes, operates, and assumes the risk for a business venture[(1)]. While some folks may be convinced that entrepreneurs are simply born to do business, the fact is that the characteristics of entrepreneurial minded people can be learned and implemented to increase the likelihood of success[(2)]. An entrepreneurial mindset no longer means you are a business owner; it is more of a lifestyle. Having an entrepreneurial mindset affects the way entrepreneurs make decisions and look at opportunities. An entrepreneurial mind does not come easily for everyone. Some must work to develop an entrepreneurial mindset[(3)]. An entrepreneurial mindset begins with an enterprising attitude[(4)].

To maintain the nation's economic competitiveness, reduce unemployment and improve the quality of life for people around the world, engineering educators are trying to change the way engineering is taught in the classroom. Establishing new companies or products through the entrepreneurial mindset would generate job opportunities for many people. So it is very important for engineering educators to teach the future engineers about how to be entrepreneurially minded in their area of specialization. To accomplish this mission, the author

developed two modules and taught them to the same set of students, one during their first semester on campus and the other during their junior semester to identify the change in the mindset of students towards entrepreneurship. The first module was developed and taught in the Introduction to Engineering class in fall 2011. The second module was developed and taught in fall 2013 in the junior level construction management course. The following sections explain the modules and their outcomes.

Module Description and Details: Entrepreneurial Mindset Module I

New product creation through innovation increases revenue for companies. Establishing new companies through entrepreneurship mindset generates job opportunities for many people. With this in mind, in an effort to instill the entrepreneurial mindset and innovation into civil engineering freshmen, it was decided to introduce a module on entrepreneurship and innovation in civil engineering introductory level freshmen civil engineering class. Twenty eight students were enrolled in this course. A lecture was organized which was focused on explaining entrepreneurship through the eyes of the engineer, design for stakeholder perspectives. An interesting interdisciplinary project completed by the University of Evansville engineering students in May, 2011 under the KEEN initiative was also discussed in this module. The students were asked to read the "Entrepreneurial Engineering" by Goldberg and as one of their assignments to learn more about entrepreneurship.

To assess the understanding on this subject, a pre-case assessment was conducted prior to the lecture and a post-case assessment was conducted after the lecture to identify the mindset change in students towards innovation and entrepreneurship in civil engineering. The response was received from twenty two students (79% response rate). The Table 1 shows the assessment form used in this course.

Table 1. Pre and Post Case Assessment Form Used in ENGR 101 Course

Statement #	Please rate your level of agreement with each statement	Rating Level (1-Strongly disagree, 10-Strongly agree)									
		1	2	3	4	5	6	7	8	9	10
1	I understand the basic steps necessary to translate an idea into a company or product.										
2	It is important for a technical person to have a deep understanding of the end customers' needs										
3	I have a basic understanding of how capital is raised to support an entrepreneur with commercializing an idea										
4	A technical person needs to know very little about marketing, finance and management of people										
5	I am motivated to design and market solutions for unmet needs in the world marketplace										
6	There is a strong correlation between outstanding written and oral communication skills and success even for technically oriented people										
7	I believe problems are really opportunities										
8	Risk taking hinders achievement										
9	I am aware of opportunities for entrepreneurship and innovation in civil engineering										

Figure 1 shows the results of the pre and post case assessments. It can be clearly seen from the figure below that the students showed significant improvements in statements 1, 2, 3 and 9 compared to others. It is to be noted that changing mindset is a long-term process and teaching or emphasizing the entrepreneurial concepts starting from the freshmen level courses may influence the engineering students to think more about entrepreneurship in their thought process and design.

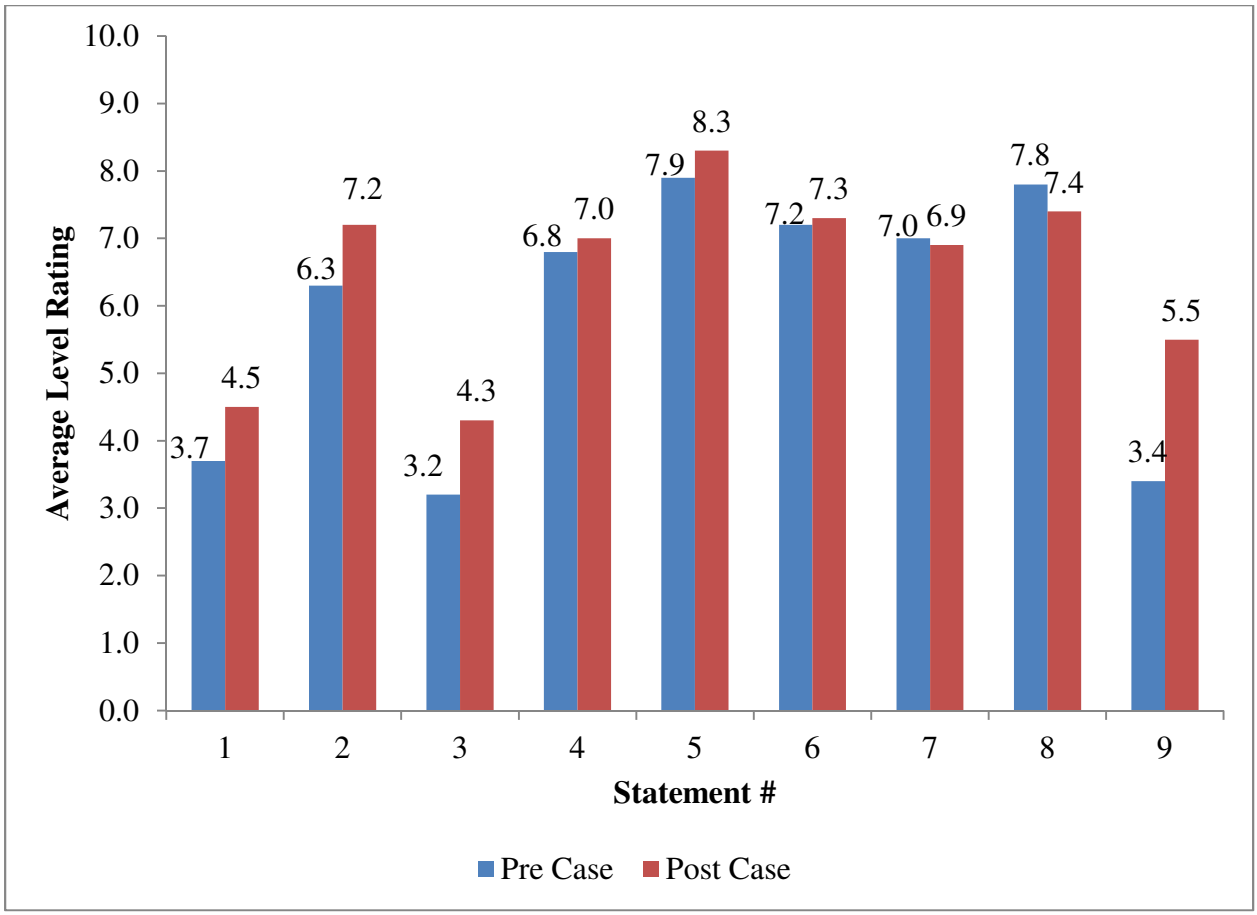

Figure 1: Assessment Results for the ENGR 101 Entrepreneurship Module

Module Description and Details: Entrepreneurial Mindset Module II

To instill the entrepreneurial mindset in civil engineering students, the second module on construction entrepreneurship was introduced in one of the civil engineering junior level classes (CE 324 Construction Management). The course was taught in fall 2013 to a total of seventeen students. This class consisted primarily of students who took the Introduction to Engineering class in fall 2011 and few transfer students.

By definition a construction entrepreneur is an individual who starts new ventures in the construction industry. A construction entrepreneur may develop new architectural methods and construction practices, seek interested clients, and gather funds to hire workers and purchase materials. A green construction entrepreneur is also a construction professional who focuses on creating environmentally friendly structures. This kind of entrepreneur may install utilities that run on alternative energy sources, such as solar power or wind. These methods of construction also may produce less waste and use biodegradable materials[(5)].

As a part of this module, a lecture on construction and green construction entrepreneurship by the President of Insolterra Concepts, an innovative design and construction company owned and operated by an entrepreneur was delivered to students. Another lecture on becoming an entrepreneur through innovative design concepts was also given. The students were encouraged

to research and address about entrepreneurship and innovation in their construction management paper.

To assess the understanding on construction entrepreneurship, a pre-case assessment was conducted prior to these lectures and a post-case assessment was conducted to identify the mindset change in students towards construction entrepreneurship after the module delivery. The following questionnaire (Table 2) was given to the students before and after the module was taught.

Table 2. Pre and Post Case Assessment Form Used in CE 324 Course

Statement #	Please rate your level of agreement with each statement	Rating Level (1-Strongly disagree, 10-Strongly agree)									
		1	2	3	4	5	6	7	8	9	10
1	I understand the basic steps necessary to translate an idea into a company or product.										
2	It is important for a technical person to have a deep understanding of end customers' needs.										
3	I have basic understanding of how capital is raised to support an entrepreneur with an intention to develop a company.										
4	A construction entrepreneur needs to have a good understanding of marketing, finance and management of people.										
5	I am motivated to design and market solutions for needs in the construction industry.										
6	I consider myself to be a person with an entrepreneurial mind.										
7	I am seriously considering being a construction entrepreneur/owner as my professional goal/career.										

Figure 2 shows the results of the pre and post case assessments. The response was received from sixteen students (94% response rate). It can be clearly seen from the figure that the students showed improvements in all statements. The author is hopeful that repeatedly teaching more about the entrepreneurial concepts will have a significant impact on the students' mindset.

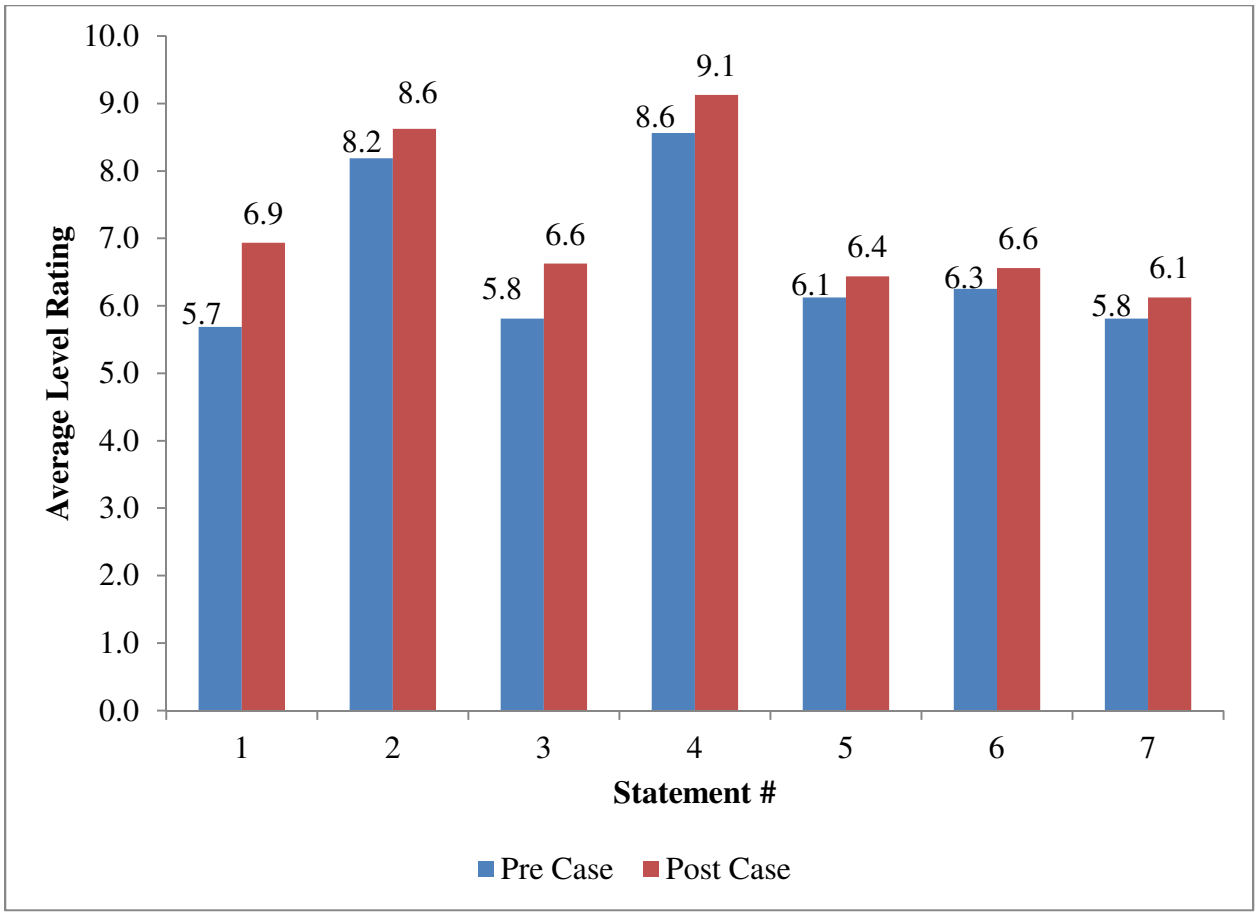

Figure 2. Assessment Results for the CE 324 Entrepreneurship in Construction Module

The first five statements were similar or the same between the two modules and it can be seen from the assessment data that the students have positively changed their opinion on these statements.

Conclusion

The author strongly believes that changing the mindset of students on entrepreneurship will take time and effort. With this in mind, these modules will be taught again and their effectiveness will be assessed and compared with this initial set of data. After more data is gathered, detailed statistical analysis will be performed and published. The author is planning to introduce more modules on entrepreneurship to the same set of students in other classes to see if improvements are met in the entrepreneurial mindset of students.

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Brief Biographical and Contact Information

Dr. Immanuel Selvaraj is an assistant professor of civil engineering in the Department of Mechanical and Civil Engineering at the University of Evansville and a professionally licensed civil engineer. Dr. Selvaraj holds a PhD degree from Auburn University, Auburn, AL. His contact email address is ss476@evansville.edu