

Assessment of a New University-Wide Entrepreneurship and Innovation Minor

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Abstract:

The paper describes the new Entrepreneurship and Innovation minor at Penn State. The unique inter-college minor consists of several clusters that center on entrepreneurship and innovation in relation to different majors, industries, and contexts. An assessment plan was developed in conjunction with the minor and initial results will be reported. The overall goal of the assessment is to track the students' progress, knowledge, skill development, and attitudinal changes as the students proceed through the minor and begin their careers. As the first step in this process, students from the core classes of the minor were asked to complete a survey near the beginning and end of the semester to capture their attitudes toward entrepreneurship and innovation. A vast majority of the students who completed the survey were enrolled in their first entrepreneurially focused class. As a result, the survey responses provide a unique opportunity to examine students' initial thoughts about entrepreneurship and innovation, which will serve as a baseline for future assessments.

Introduction

Entrepreneurs have a considerable impact on local economic development¹. Consequently, the recent economic downturn has resulted in a movement to refocus on developing entrepreneurs and innovators². As a part of this trend, a growing number of colleges and universities are focusing on creating or improving entrepreneurial course and program offerings³. While many of these programs are embedded within engineering or business colleges, others are offered university-wide with students from all majors able to enroll.

Recently, students at Penn State have begun enrolling in the new university wide Entrepreneurship and Innovation Minor. The minor, which previously existed only within the College of Engineering, has expanded to include concentration areas, called clusters, in Technology-Based Entrepreneurship, Social Entrepreneurship, New Media, Food and Bio-innovation, and New Ventures. The five clusters are housed in four different colleges and additional clusters will be added in the near future to focus on entrepreneurship and innovation in other disciplines, contexts and customer segments.

The purpose of this paper is 1) to describe the changes to the minor and the new format, 2) to discuss preliminary assessment of the minor, and 3) to discuss implications for engineering students with the new minor. The paper may be of interest to faculty who direct similar entrepreneurship programs that are either housed within the College of Engineering or those that are university wide.

Description of Minor

The minor discussed in this paper is offered at the university-level. Penn State is a large mid-Atlantic public institution with multiple campuses. The entrepreneurship minor was originally established in the College of Engineering in 2001. The original purpose of the minor was to encourage entrepreneurial thinking and engagement regardless of academic background. Generally, all students took the same basic coursework, with twelve required credits and six elective credits. The required coursework only contained one class difference for engineers versus non-engineers, but as enrollment increased and diversified, instructors found it difficult to mentor students who were interested in working on projects that were outside of their area of expertise such as agriculture and social sciences.

Consequently in 2013, the faculty led a transition of the minor, making it available university-wide and creating the five clusters listed above. Hopefully, the new structure will allow the university and the faculty to better serve the needs of all of the students enrolled in engineering and other participating programs. To complete the minor, all students must earn nine credits in three core courses and at least nine credits in cluster-based courses, which provide more in depth coverage within the specific content area that interests the student. The first six credits of core coursework are earned in two classes that focus on teaching and developing the entrepreneurial mindset and entrepreneurial leadership. Students then complete their cluster-based coursework followed by earning the final three core course credits in the capstone class, which focuses on new venture creation.

The cluster-based course sequences were designed by faculty members in their respective colleges to address issues directly relevant to entrepreneurship and innovation in their fields of expertise. Some of the clusters have fixed course requirements, while others are more flexible and allow students to choose from several classes in order to earn the necessary number of credits. Students from any college or major can enroll in any cluster, which could potentially lead to interesting interdisciplinary collaborations.

Cluster Descriptions

The Food and Bio-Innovation cluster is based in the College of Agriculture. Students interested in this cluster will be exposed to some of the challenges encountered during the process of producing food and energy. Topics and projects in this cluster relate to bolstering or managing food supply, developing or improving renewable energy and materials, and increasing human and animal health through food or agriculture. Given vast differences within the agricultural and food production industries, students have the ability to select coursework in this cluster that specifically targets the aspect of the industry that interests them the most.

The New Media cluster is based in the College of Communications. The internet, social media, and other communication technologies have rapidly changed the way that people interact and access information. As a result, students interested in this cluster will study how to capitalize on and recognize opportunities during the process of creating and distributing information, especially in the news and entertainment industries. Content focuses on new media

production and distribution, media business models and management, media ethics, and new media law.

The New Ventures cluster is based in the College of Business. This cluster focuses on developing the business skills required to create, develop, and manage entrepreneurial companies. Some of the skills taught include opportunity recognition, resource acquisition, marketing, finance, and new product development. Furthermore, students will have the opportunity to select coursework which will enable them to become more familiar with the legal and ethical aspects of owning and managing a small business.

The Social Entrepreneurship cluster is based in the College of Engineering. The coursework in this cluster overlaps with the Human Engineering and Social Entrepreneurship Certificate program. Consequently, the course sequence within this cluster is well fairly well defined. Students in this cluster actively engage with partnering communities in marginalized areas across the world to research, design, test, and commercialize their ventures with the goal of creating and developing economically sustainable, socially acceptable solutions within specific local contexts.

The Technology Based Entrepreneurship cluster is also based in the College of Engineering. This cluster most closely resembles the previously offered Engineering Entrepreneurship (E-SHIP) minor and contains several of the same classes. However, the new structure allows more focused attention on developing technology-based products and businesses. Students enrolled in this cluster will also learn skills in financial accounting for start-ups, marketing, and intellectual property management.

While each cluster has individual objectives, the minor as a whole seeks to increase students' entrepreneurial self-efficacy, problem solving ability, and opportunity recognition skills. Additionally, the coursework is designed to expose students to the entrepreneurial mindset and educate them on various career paths and options that require entrepreneurial skills. Since students will be completing coursework for the minor over several years, an assessment plan was designed with overall goal of tracking the students' progress, knowledge, skill development, and attitudinal changes as they proceed through the minor and begin their careers.

Assessment Methods

Survey 1

Students enrolled in seven participating entrepreneurial classes in the minor completed the survey immediately after the add/drop period to ensure that there would be minimal fluctuations in course enrollment. The completion rate of the first survey was 79.04% (132 out of 167). The initial survey consisted of a number of demographic questions, a scale of creative self-efficacy, and a scale of entrepreneurial self-efficacy, which are described further below. Students were also asked to rate the importance of a variety of entrepreneurial skills.

Demographic Questions

Students were asked several questions in an attempt to gauge their previous exposure to entrepreneurship. Previous research has shown that entrepreneurial parents influence their children's intention to pursue entrepreneurial endeavors⁴. Consequently, students were asked if they had a parent, close relative or mentor, who was an entrepreneur or small business owner. Additionally students were asked to describe any products or ventures that they were currently working on. Finally, students indicated how many previous entrepreneurial related classes they were taking or had completed.

Creative Self-Efficacy

Creativity is frequently listed as an important skill or trait of entrepreneurs^{5,6}. The skill can be applied during multiple entrepreneurial situations including idea generation, problem solving, and opportunity recognition. While educators are still working on the best method of developing and measuring creativity, it is possible to gauge an individual's creative self-efficacy, which Tierney and Farmer defined as 'the belief that one has the ability to produce creative outcomes' (p. 1138)⁷.

For this study, permission was granted to use Tierney & Farmer's Creative Self-Efficacy Measure⁷. The measure contains three items (with a Cronbach's alpha, internal consistency reliability, coefficient of $\alpha=.574$) on a 7 point Likert scale (1= very strongly disagree through 7= very strongly agree). The scale has been used in numerous research studies and has demonstrated sound psychometric properties.

Entrepreneurial Self-Efficacy

Entrepreneurial self-efficacy has been repeatedly linked to an individual's intention to start a new venture^{8,9,10,11}. McGee, Peterson, Mueller, & Sequeira defined entrepreneurial self-efficacy to be 'a person's belief in their ability to successfully launch an entrepreneurial venture' (p.965)¹². In this study, entrepreneurial self-efficacy was measured using a scale that was developed by McGee *et. al.*¹². The scale contains 26 items (with a Cronbach's alpha, internal consistency reliability coefficient, of $\alpha=.925$) measured on a 5 point Likert scale (1=very little confidence through 5= complete confidence).

Entrepreneurial Skills

Researchers, educators, and entrepreneurs have deemed a diverse set of skills to be important for a successful entrepreneur to possess. However, no true consensus exists in regards to a definitive skill set, which may accurately reflect the amorphous nature of the profession. Regardless, as an educational program, skill development is an integral aspect of the minor.

As a result, the instructors and evaluation team created a list of entrepreneurial traits or skills that should be addressed throughout the coursework including: creativity, optimism, opportunity recognition, the ability to act on an opportunity, persistence, ethical decision making, collaboration skills, the tolerance for ambiguity, communication skills, risk taking ability, belief in success, and compassion. The participants were asked to rate the importance of each skill to entrepreneurs on a three point Likert scale (1= Not at all important through 3=extremely

important). Additionally, the participants were asked to indicate on a sliding scale from 0 to 100, how much they thought overall entrepreneurial ability and innovativeness is innate (0) versus learned (100).

Survey 2

Students completed another survey at the end of the semester, which was distributed during the last several weeks of classes. An additional entrepreneurial related class was included in this assessment on the request of the instructor, making the total number of included classes eight. The completion rate of the surveys was 46.21% (128 out of 272). The second survey was very similar to the initial survey and contained the same scales of creative self-efficacy (with a Cronbach's alpha, internal consistency reliability coefficient, of $\alpha=.805$) and entrepreneurial self-efficacy (with a Cronbach's alpha, internal consistency reliability coefficient, of $\alpha=.952$). The students were again asked the importance of the same set of entrepreneurial skills, but this time they were also asked to rate how much they thought the class that they had just completed had influenced the development of each skill. However, the biggest difference between the two surveys was in the demographic questionnaire, which was changed to focus on students' future career plans and participation rates in other entrepreneurial events on campus and in the community.

Results

Survey 1

A vast majority of the students (125 out of 132) who completed the survey were enrolled in their first entrepreneurially-focused class. As a result, the survey responses provide a unique opportunity to examine students' initial thoughts about entrepreneurship and innovation, which will serve as a baseline for future assessments. However, some students had previous exposure to entrepreneurs or entrepreneurship with 71.2% of reporting knowing or having an entrepreneur as parent, relative, or mentor students, and 25.2% of students indicating that they were currently working on a new product or venture.

The participants were 68.3% male and 28.1% female, with 7.2% identifying as Hispanic/Latino, 67.6% as White, 5.8% as Black or African American, 11.5% as Asian, and .7% Pacific Islander. At the outset, 0.7% of students intended to enroll in the food and bio-innovation cluster, 33.1% in the new venture cluster, 7.9% in the new media cluster, 7.2% in social entrepreneurship cluster, 8.6% in the technology-based cluster, 7.9% were unsure which cluster to enroll in, and 33.8% of students were not planning on completing the minor.

Results from the first survey demonstrate that the students believe that entrepreneurial and innovative skills can be both learned and innate. Additionally, the students rated the following entrepreneurial skills as the most important: the ability to recognize opportunities, the ability to act on opportunities, persistence, creativity, communication skills, and their belief in their ability to succeed.

Since most of students were just beginning to learn about entrepreneurship and innovation in an academic setting, an analysis was conducted to determine if any differences existed between students who had previously been exposed to entrepreneurial or innovative activities outside the classroom either as a result of working on their own product or venture or being related to an entrepreneur. ANOVA results show that students who are currently working on a new product or venture have a higher mean on the entrepreneurial self-efficacy scale ($F_{1, 122} = 12.607, p = .001$) and the creative self-efficacy scale ($F_{1, 132} = 21.400, p = .001$) than when compared to students who are not currently working on a new product or venture.

However, there were no significant mean differences found between individuals with entrepreneurial parents in regards to creative self-efficacy and entrepreneurial self-efficacy. Additionally, there were no significant mean differences between students who intended to complete the minor when compared to students who did not intend to complete the minor. The only gender difference that was found indicated that males had a significantly higher mean on the creative self-efficacy scale ($F_{1, 132} = 4.898, p = .036$) than females.

Survey 2

Unfortunately, only 70 students completed both surveys. As a result, we only have complete demographic information on these students. However, the second survey sample of 128 students still provided useful information. At the end of the semester, .8% of students intended to enroll in the food and bio-innovation cluster, 12.5% in the new venture cluster, 7.8% in the new media cluster, 6.3% in social entrepreneurship cluster, 5.5% in the technology-based cluster, 10.9% were unsure which cluster to enroll in, and 55.5% of students were not planning on completing the minor.

The rise in the percentage of students not planning on completing the minor can be partially explained by the addition of another class to the data pool, as the number of students in this group jumped from 47 to 77. More interestingly, the frequency of students in the new venture cluster dropped from 46 to 16, indicating that students may be coming into that cluster with expectations that differ from the course content.

The addition of questions focusing on career intentions will allow the program to examine changes in students' interests and perceptions over time. Students were allowed to indicate the probability of performing a variety of career options on a scale from one to five. At the end of the semester, 13.3% of students indicated that they were likely or extremely likely to attend law school after graduation; 36% graduate school; 4.6% medical school; 34.3% start their own business; 38.5% work for a start-up; 62.5% a large business or corporation; and 11% a non-profit organization.

Other descriptive results are similar to results found in survey one, which demonstrate that the students believe that entrepreneurial and innovative skills can be both learned and innate. Additionally, the students rated the following entrepreneurial skills as the most important: the ability to recognize opportunities, the ability to act on opportunities, persistence, creativity, communication skills, and their belief in their ability to succeed.

The data from the 70 students who completed both surveys were further analyzed. However, no significant mean differences on the second survey were found between individuals with entrepreneurial parents in regards to creative self-efficacy and entrepreneurial self-efficacy. Additionally, there were no significant mean differences in these variables based on gender, or intention to complete a cluster in the minor. The only significant mean difference was found between students currently working on a new product or venture, who score higher on the entrepreneurial self-efficacy scale than students not currently working on a current venture ($F_{1,68}=4.387$, $p=.040$).

Descriptive comparison of responses from the participants who completed both surveys are presented in Tables 1 and 2. At the end of the semester, students indicated that they thought both entrepreneurial ability was more able to be learned in comparison to their responses at the beginning of the semester $F_{69}=2.803$, $p=.007$. Additionally, responses on the entrepreneurial self-efficacy scale and creative self-efficacy scale were compared across time. The results show that both slightly increased, but not enough to reach statistical significance.

Students also reported that their coursework improved their abilities to recognize opportunities, work collaboratively, and communicate effectively at the largest rates. While many of the skills were rated at similar levels of importance across time, there were noticeable increases at the end of the semester in the recognition of the importance of making ethical choices, collaborating, tolerating ambiguity, and communicating effectively.

Discussion

The results of these ongoing evaluations will provide useful program planning information to the faculty and instructors. While the current results did not produce very many statistically significant results, they are still encouraging and provide indicators of students' perceptual changes across time. Given the relatively stable nature of self-efficacy, the small increases shown after one only semester of instruction in entrepreneurship is promising. If these findings are consistent for the entire length of the minor, there will be ample evidence of student growth over time. Eventually, as students near graduation, we will be able to compare the traits and skills of students who completed different clusters to both evaluate the clusters and get a better understanding of the differences in entrepreneurship across contexts.

Several challenges arose during the assessment process, which are and will constantly be revisited throughout the life of the program. First, determining which variables and measures to include in the survey presented was difficult. Ultimately, self-efficacy scales were chosen because of their more established psychometric properties in entrepreneurial research when compared to other measures. Clearly, there is a need for more studies focusing on the reliability and validity of instruments used to assess entrepreneurial traits^{8,13}. As a result, other scales may be adapted, created, or used to evaluate the progress and entrepreneurial skill development of the students throughout the minor.

However, the length of the survey also needs to be considered before including additional instruments into this assessment. Students in higher education institutions may feel that they are being surveyed too frequently. Additionally, some faculty members voiced concerns about

including too many surveys in class and how it would both impact their instruction as well as their end of the semester evaluations. In order to mitigate these feelings and perceptions, several actions were taken. Surveys were only distributed to the classes of faculty members who volunteered to participate. Survey distribution dates were discussed and negotiated with the instructors, and instructors were given the opportunity to include course or cluster specific questions in the survey for their class.

Given the trepidation of some of the instructors, consideration was given to simply surveying the students outside of class. Without access to class lists, participants would be recruited from administrative lists of students who have declared the minor. Unfortunately, many students do not actually declare their minor until late in their academic careers. As a result, less longitudinal data would be collected, and it would become more difficult to analyze student progress and skill development. Another option that was considered was embedding the survey into the course content (i.e. making it an assignment or a scheduled activity). Since student response rates were relatively high for the first survey, we continued using this strategy for the second survey with mixed results.

Furthermore, surveying the students through the course management website may also produce some interesting effects because the students may be taking several entrepreneurially focused classes concurrently. More challenging from an administrative standpoint, the non-core courses may be completed before the core courses (either intentionally or unintentionally), which may impact the results of the assessment. Therefore, fastidious record keeping is required and the surveys must be relatively consistent across time in order to determine the effect course order may have on the results.

The impact of the minor on engineering students is still unknown. Because few changes were made to the engineering cluster, as compared to the previously offered engineering entrepreneurship minor, engineering students will not likely see the impact to the content of their courses. However, one area that could see an impact is the number of cross-disciplinary connections that students are able to make in their entrepreneurship classes. As mentioned above, students can enroll in any of the clusters, regardless of their minor. For example, an engineering student may enroll in the Food and Bio-Innovation cluster. Similarly, a journalism student may choose not to enroll in the New Media cluster but instead enroll in the Social Entrepreneurship cluster if this is where his or her interests lie. Because the Engineering Entrepreneurship (E-SHIP) minor was one of the only formal programs where students could get entrepreneurial experiences before the new minor was established, students from different majors often enrolled in it. However, now that new clusters are being offered, it remains to be seen as to how diverse the clusters will be. This is an area that we will be tracking closely.

As the assessment progresses, we will continually be evaluating both the assessment procedures and results in order to make improvements with the ultimate goal of developing the minor to better address student needs and make progress in the key learning objectives for the new minor: to increase students' entrepreneurial self-efficacy, problem solving ability, and opportunity recognition skills.

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Appendix A: Tables

Table1: Mean and standard deviations of students who completed both surveys

Measure	Survey 1 – M (SD)	Survey 2 – M (SD)
Entrepreneurial Skills Mostly Innate (0) or Mostly Learned (100)	48.41 (15.51)	56.01 (18.30)
Innovation Skills Mostly Innate (0) or Mostly Learned (100)	41.83 (22.24)	44.49 (22.96)
Creative Self-Efficacy	16.54 (2.33)	16.59 (2.76)
Entrepreneurial Self-Efficacy	102.53 (14.87)	103.10 (15.43)

Table 2: Mean and standard deviations of skill questions for students who completed both surveys

	Importance Rating - Survey 1 - M (SD)	Importance Rating - Survey 2 - M (SD)	Skill Development Rating – Survey 2 - M (SD)
Creativity	2.86 (.352)	2.86 (.355)	2.29 (.593)
Optimism	2.76 (.432)	2.75 (.469)	2.20 (.694)
Opportunity Recognition	2.96 (.204)	2.97 (.170)	2.61 (.597)
Acts on an Opportunity	2.96 (.204)	2.97 (.169)	2.57 (.579)
Persistence	2.90 (.302)	2.91 (.284)	2.47 (.653)
Makes Ethical Choices	2.51 (.583)	2.62 (.597)	2.26 (.695)
Collaborative	2.51 (.531)	2.67 (.505)	2.61 (.519)
Tolerance for Ambiguity	2.43 (.627)	2.54 (.632)	2.13 (.705)
Good Communicator	2.84 (.367)	2.97 (.169)	2.61 (.546)
Calculated Risk Taker	2.80 (.437)	2.86 (.394)	2.43 (.604)
Belief in One's Ability to Succeed	2.93 (.259)	2.94 (.235)	2.44 (.651)
Compassionate	2.53 (.607)	2.52 (.678)	2.11 (.790)