

Assessing different approaches to instilling the Entrepreneurial Mindset

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Abstract

Over the last eight years, Villanova University has been creating a culture in which engineering students have been provided opportunities to develop an entrepreneurial mindset. These opportunities include an engineering entrepreneurship minor open to engineering students of all majors, extra-curricular activities ranging from short 15-20 minute events to competitions spanning several months, inter-university senior design projects, and embedded activities in core engineering classes. The question arises as to how effective these particular approaches are in instilling the entrepreneurial mindset in engineering students. A survey was developed to determine how students' participation in the various entrepreneurial learning opportunities impacted various facets of students' entrepreneurially-minded thinking. Also, direct student assessment was performed in the second junior-level course and senior-level course in the engineering entrepreneurship minor program to assess their entrepreneurial skills.

The survey was administered during the fall 2014 term to all 506 junior and senior engineering students. The response rate to the survey was 17% (although 132 students started the survey, only 86 completed it in its entirety). The direct assessments were performed during the final presentations of the junior and senior level courses in the spring 2014 and fall 2014 terms, respectively. All junior and senior students in these two courses participated in the direct assessment.

The data show that most of the students who completed the survey felt that they exhibited many of the traits of an entrepreneurially minded student such as their abilities to design products to meet customer needs and work on teams. The engineering entrepreneurship minor program and entrepreneurial extra-curricular activities helped to develop students' skills in assessing markets, obtaining funding, and

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bringing a new product/service to market. This was borne out by both the direct and indirect assessments. The results from this assessment exercise will be used to further improve our programs.

Introduction

Villanova University has been engaged in teaching entrepreneurship/intrapreneurship skills to its engineering students since 2007. Faculty members in the College of Engineering (CoE) were engaged in informal discussions with their colleagues in the Villanova School of Business to consider how best to include entrepreneurial education into the engineering program during the spring 2007 term. Over the summer of 2007, the Kern Family Foundation invited Villanova University's CoE to submit a proposal to develop a program to instill the entrepreneurial mindset in undergraduate engineering students. A proposal was submitted and a grant funded to develop course material for the introduction of entrepreneurial education into the engineering curriculum. Key faculty members from the CoE worked with colleagues from the Villanova School of Business to prepare a proposal to the university administration to offer a minor in engineering entrepreneurship. This proposal was submitted and approved in the spring of 2008 and the program launched with the first cohort of students in the fall 2008 term. Details of the minor and its constituent courses are provided in reference [1]. The minor starts in the fall semester of sophomore year and concludes in the fall semester of senior year. The first cohort of students to complete the engineering entrepreneurship minor graduated in May 2011 and there have been three subsequent cohorts of graduates from the program.

In addition to the curricular activities to teach undergraduate engineering students about entrepreneurship, we have also organized a number of entrepreneurially-minded extra-curricular events on campus. These include short activities which last only a few minutes (elevator pitch-type events) through to multi-month long, business plan competitions. These activities may involve individual students or teams of students presenting ideas to submitting fully developed business plans and are open to students from all over campus, including engineering students.

Of course, every student comes to campus with a range of already developed entrepreneurial skills and mindset. So while the engineering entrepreneurship minor courses and the extra-curricular events are on-campus mechanisms to further develop undergraduate engineering students' entrepreneurial mindsets, this is being built on a foundation that the students bring to campus from prior activities or innate orientation.

The goal of the assessment activity reported here was to evaluate how well the various activities contributed to instilling skills related to the entrepreneurial mindset in our undergraduate engineering students.

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Survey Instrument Details

A survey instrument was developed to indirectly assess, through student self-reporting, to what extent the students' entrepreneurial mindset was being enhanced/developed through the different opportunities, curricular and extra-curricular, described in the introduction. The survey instrument was administered to all junior and senior engineering students. They were given the option to take the survey or opt out. The survey was divided into four sections. For the general questions unrelated to specific course or extra-curricular activities, a 5 point scale was used for the assessment since a wider variety of responses was expected. For the three sections that were more specific to curricular or extra-curricular activities, a 4 point scale was used since these responses were expected to fall in a narrower range. Each of these sections is described below.

The first section of the survey focused on students' self-perceptions of development of an entrepreneurial mindset without any specific exposure to particular classes or activities. The aim of this first section was to get a general sense of how the students viewed the development of the entrepreneurial mindset regardless of whether they participated or not in curricular or extra-curricular activities designed to support the development of the entrepreneurial mindset. The questions asked the students to rate to what extent they exhibited entrepreneurial mindset traits based on the KEEN frameworks [2]. A 5-point scale ranging from "Not at all" to "Greatly" was used for reporting responses. Examples of some of the questions asked in the first section of the survey were:

"To what extent do you:

- exercise curiosity about the surrounding world?"
- persist through and learn from failure?"
- identify new business opportunities?"

A total of 22 questions were included in the first section of the survey.

The second section of the survey was directed at students who had taken classes in the engineering entrepreneurship minor program. These questions were focused on assessing to what extent the engineering entrepreneurship minor courses had successfully developed skills and mindset traits related to engineering entrepreneurship. Examples of questions that were asked are:

"To what extent did your participation in the engineering entrepreneurship minor develop your abilities to:

- Design and develop a new product or service to meet a customer's needs or wants?"
- Estimate demand for a new product or service?"

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- Present a product or service to obtain funding?”

These questions requested a response on a 4-point scale ranging from “Not at all” to “Greatly”. There were a total of 15 questions in this section of the survey.

The third section of the survey instrument was directed at students who participated in extra-curricular activities. As described in the introduction, many entrepreneurially-minded extra-curricular events are held around campus at Villanova University. These range in time spans of one hour to several month-long competitions. The third section of the survey was designed to address how these activities helped to instill the entrepreneurial mindset in students. The respondents to this section of questions were asked to check off the activities in which they had participated and then to indicate to what extent these activities had supported the development of their entrepreneurial mindset. Again a 4-point scale was used for this purpose as used in the first section and the questions were also identical to the questions in the first section.

The fourth section of the survey was directed at assessing how participation in inter-university senior design projects had helped to nurture the entrepreneurial mindset. Over the last three years, a sub-network of universities within the network of KEEN schools has performed joint activities together. This sub-network of universities includes the University of Detroit, Mercy, Baylor University, University of Dayton, and Villanova University. This sub-network is referred to as the Helping Hands Dense Network (HHDN). One of the joint activities of these HHDN universities was the participation of students from two different universities in joint senior design projects. Several students from Villanova University have participated in this activity and the final section of the survey was aimed at determining to what extent this particular activity helped to develop the entrepreneurial mindset within student participants from Villanova University. The questions asked in this section were similar to the ones asked in the other sections and used the same 4-point scale.

Results and Discussion

The survey was offered to all 506 junior and senior engineering students. Of these students, 132 students started the survey but only 86 completed it in its entirety, an overall response rate of 17%. A survey was assumed completed if a student finished answering all questions relevant to them. For example, if a student did not take any course in the engineering entrepreneurship minor program, and therefore skipped those questions, the survey was considered complete if all other questions relevant to the student were answered. Figure 1 shows the self-reported responses of the students in some of the entrepreneurial mindset attributes. It shows that students generally feel that their engineering education has provided them a significant level of confidence in various entrepreneurial skills. In particular, exercising curiosity about the world

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around them, persisting and learning through failure and their resourcefulness, all scored above 4.0/5.0 in the self-reporting. Figure 2 shows the students' self-perceptions on another battery of skills. It is clear from this figure that the students have limited confidence in their ability to use creativity and systems thinking in their problem solving. Figure 3 shows that students have a lot of confidence to work in teams and in their ability to persuade others based on facts. Both of these skills were self-scored at above 4.0/5.0.

Figure 4 shows student responses related to character and values. It clearly shows that students perceive themselves as having strong character and ethical values. They also indicate that contributing to society is an important factor in achieving personal fulfillment. All of these questions were scored above 3.3/4.0 and these results are consistent with the character and values promoted throughout Villanova's community.



Figure 1. Students' self-reported responses to a first group of entrepreneurial mindset attributes

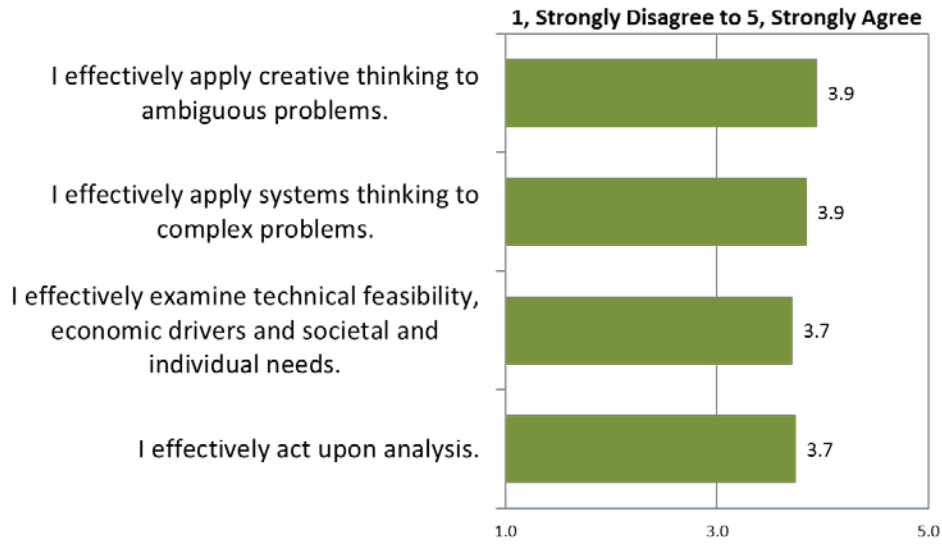


Figure 2. Students' self-reported responses to additional entrepreneurial mindset attributes

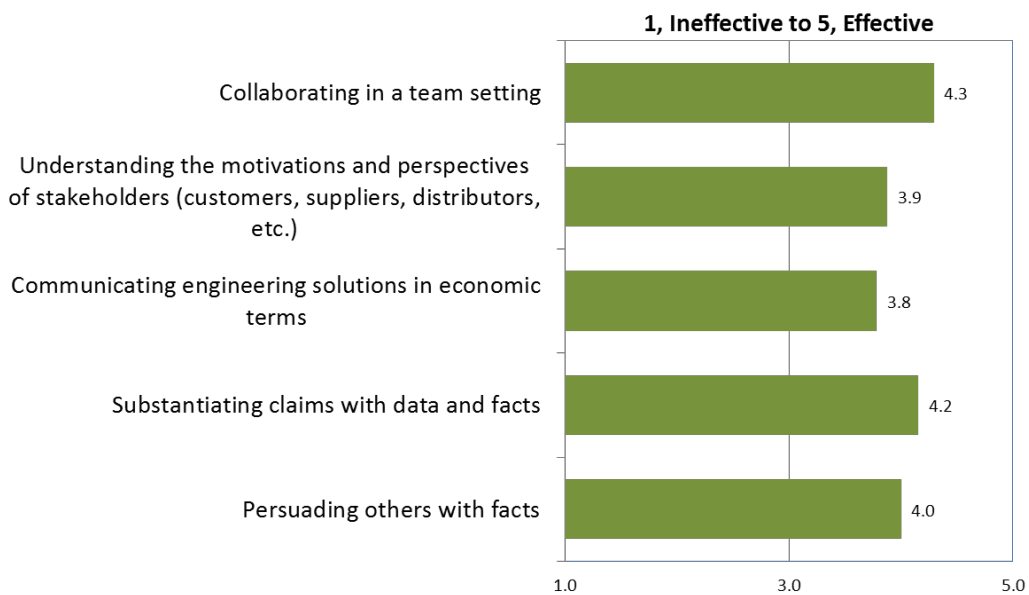


Figure 3. Students' self-reported responses of a group of entrepreneurial skills

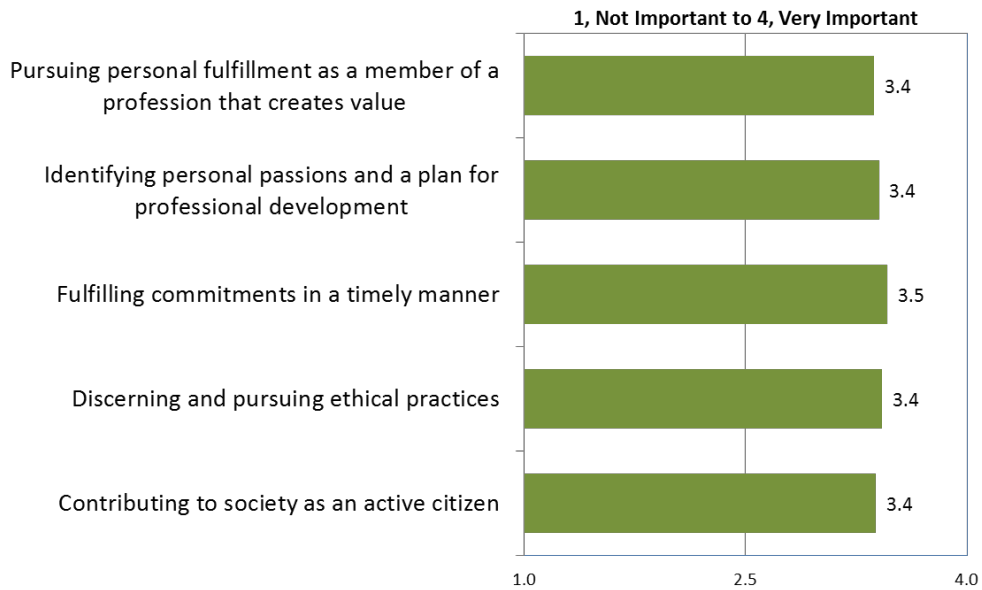


Figure 4. Students' self-reported responses of their ethics and values as related to an entrepreneurial mindset

Figure 5 shows the students' self-reported assessment on how they feel they compare with their peers in a number of areas. In this chart the students feel very confident about their team work, leadership, persistence, and problem solving and communication skills relative to their peers. The areas in which they feel least confident are tolerance for ambiguity and willingness to take risks.



Figure 5. Self-reported students' abilities relative to their peers

For those students who have taken classes in the entrepreneurship minor program, there were significant strengths in the areas of ability to design a product/service to meet a customer's needs, present a product or service to obtain funding, and bring a new product or service to market (see figure 6).

13% of the respondents had performed an inter-university joint senior design project. The results of their self-assessments are shown in Figure 7. As can be seen in this figure, students participating in these projects felt that they had learned to effectively design a product/service to meet a customer's needs and to work in a team. However, they did not indicate confidence to bring a product/service to market or present a product or service to obtain funding, strengths that were reported by students taking classes in the engineering entrepreneurship minor program.

In addition to the survey, additional questions were added to the regular course evaluations that are administered in every course at the end of the semester. Figure 8 shows the responses to these questions in two electrical and computer engineering courses (ECE1 and ECE2) and overall responses from the students participating in the inter-university projects. As can be seen from

this figure, the responses were somewhat higher than in the general student survey but the strengths still seemed to be aligned with the findings from the general survey.

Figure 9 shows the self-assessments of entrepreneurial abilities for students who had participated in extra-curricular entrepreneurial events. In this case students appeared to have some confidence

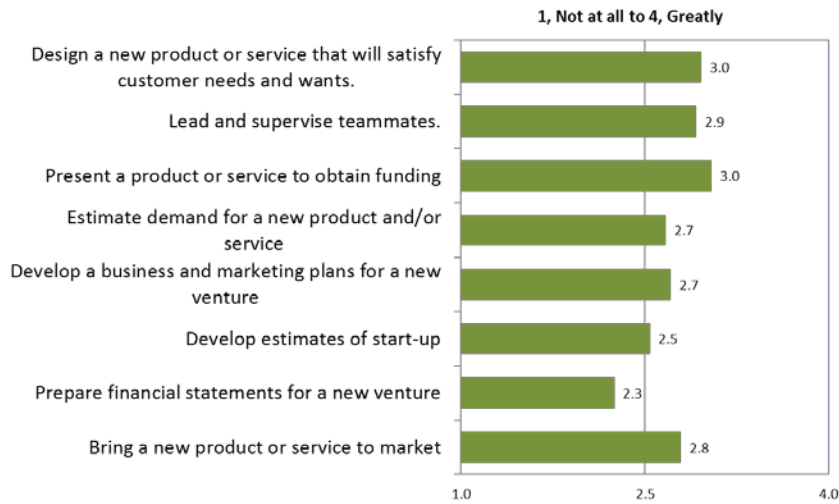


Figure 6. Entrepreneurial abilities reported by students taking classes in the engineering entrepreneurship minor program.

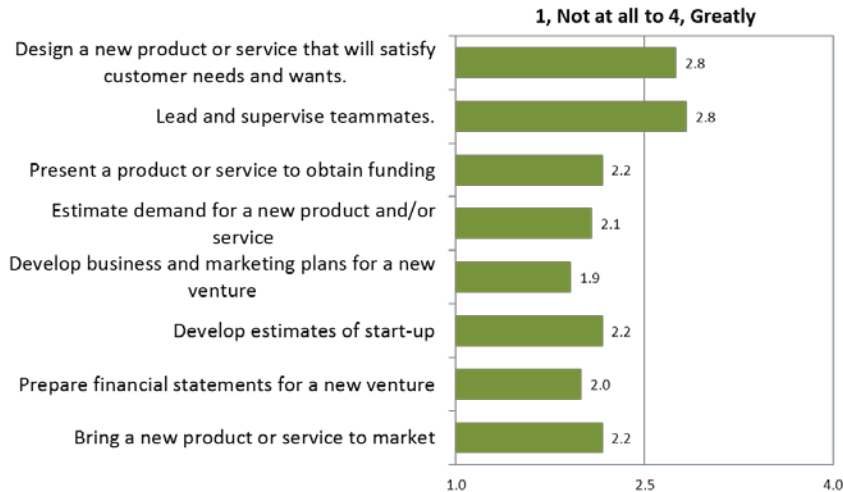


Figure 7. Entrepreneurial abilities reported by students performing joint senior design projects with other universities.

in their abilities to design a product/service to meet a customer’s needs, to work in a team, to present a product or service to obtain funding and to estimate demand for a new product or service.

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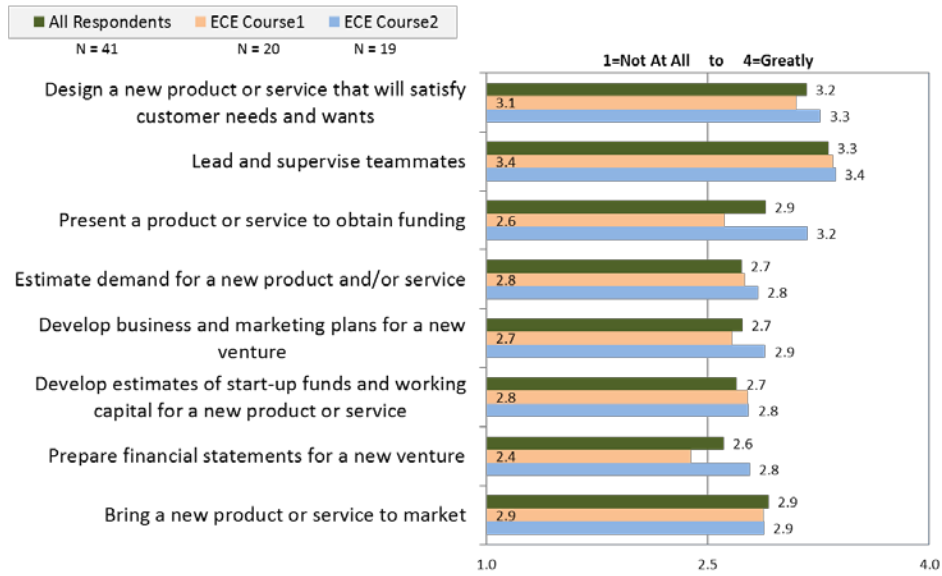


Figure 8. Responses from students on course surveys for senior design project students doing the inter-university projects.

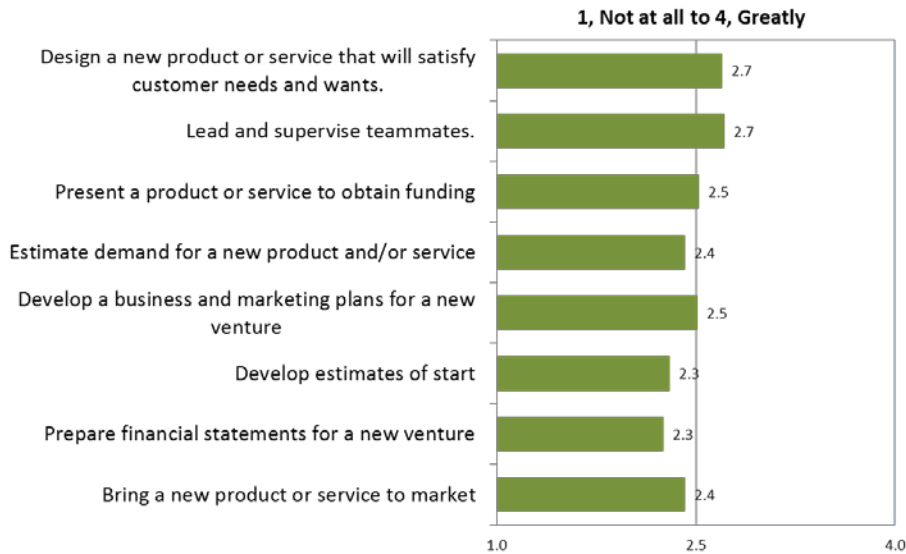


Figure 9. Entrepreneurial abilities reported by students participating in extra-curricular entrepreneurial activities/competitions.

In addition to the indirect, student self-reported assessment, direct assessment of two entrepreneurship minor classes was conducted. A rubric was followed and the results of the assessments of the two classes, the second junior-level course in the minor (referred to as E3) and the senior-level course (referred to as E4) are shown in figures 10 and 11, respectively. The

project presentations were generally performed well in the junior level class and improved significantly by the end of the senior class. The quality of the prototypes was good in both classes. In the senior class, students were also asked to prepare a Kickstarter campaign for their ventures and 70% of the students were judged to have performed at the proficient level in this activity.

<p>Name</p> <p>Description</p> <p>Rubric Detail</p>				
<p>There were 5 project teams with 17 students that were evaluated with this rubric.</p> <p>The percent who scored in each level of achievement is shown in the box.</p> <p>For example, 100% of the projects evidenced proficiency for Pitch Organization; 47% for Pitch Content and 24% for Pitch Clarity.</p>				
Levels of Achievement				
Criteria	Does Not Meet Expectations	Developing	Meets Expectations	Proficient
<p>Pitch Content</p> <p>Weight 26.00%</p>	<p>65 to 73 %</p> <p>Pitch contained little to no valuable material. Contained major omissions.</p>	<p>74 to 82 %</p> <p>Presentation had moments where valuable material was present but as a whole content was lacking.</p> <p>18%</p>	<p>83 to 91 %</p> <p>Pitch had a good amount of material and coverage. Most key elements supported with credible content.</p> <p>35%</p>	<p>92 to 100 %</p> <p>Pitch had an exceptional amount of valuable material and coverage. Provided references to establish credibility in all key elements.</p> <p>47%</p>
<p>Pitch Organization</p> <p>Weight 10.00%</p>	<p>65 to 73 %</p> <p>Pitch lacked organization and had little evidence of preparation.</p>	<p>74 to 82 %</p> <p>There were minimal signs of organization or preparation.</p>	<p>83 to 91 %</p> <p>Pitch organization could have been much stronger with more preparation.</p>	<p>92 to 100 %</p> <p>Pitch was well organized, well prepared, concise and easy to follow.</p> <p>100%</p>
<p>Pitch Clarity</p> <p>Weight 4.00%</p>	<p>65 to 73 %</p> <p>Presenters were unconfident and demonstrated little evidence of planning prior to presentation.</p>	<p>74 to 82 %</p> <p>Presenters were not consistent with the level of confidence/preparedness. Key pieces of information were not clear.</p> <p>18%</p>	<p>83 to 91 %</p> <p>Presenters were occasionally confident with their Pitch however the delivery was not as engaging as it could have been.</p> <p>59%</p>	<p>92 to 100 %</p> <p>Presenters were all very confident in delivery and they did an excellent job of engaging the audience. Preparation is very evident.</p> <p>24%</p>
<p>Prototype Quality</p> <p>Weight 60.00%</p>	<p>65 to 73 %</p> <p>Prototype provided little evidence of effort and vision.</p>	<p>74 to 82 %</p> <p>Prototype is slightly beyond the concept phase. A minimal set of functionality was demonstrated.</p> <p>18%</p>	<p>83 to 91 %</p> <p>Basic features were demonstrated without error. Could have been a much stronger demonstration with more effort.</p> <p>18%</p>	<p>92 to 100 %</p> <p>Quality of prototype was exceptional. Level of effort is very evident. Prototype performed as described. Key functionality was demonstrated without error.</p> <p>65%</p>

Figure 10. Direct assessment of final course project in second junior-level engineering entrepreneurship minor course.

<p>There were 5 project teams with 20 students that were evaluated with this rubric.</p> <p>The percent who scored in each level of achievement is shown in the box.</p> <p>For example, 70% of the projects evidenced proficiency for Pitch Content, Pitch Organization, Pitch Clarity and Kickstarter Proposition.</p>				
Criteria	Levels of Achievement			
	Does Not Meet Expectations	Developing	Meets Expectations	Proficient
Pitch Content Weight 30.00%	65 to 73 % Pitch contained little to no valuable material. Contained major omissions.	74 to 82 % Presentation had moments where valuable material was present but as a whole content was lacking.	83 to 91 % Pitch had a good amount of material and coverage. Most key elements supported with credible content.	92 to 100 % Pitch had an exceptional amount of valuable material and coverage. Provided references to establish credibility in all key elements.
Pitch Organization Weight 10.00%	65 to 73 % Pitch lacked organization and had little evidence of preparation.	74 to 82 % There were minimal signs of organization or preparation.	83 to 91 % Pitch organization could have been much stronger with more preparation.	92 to 100 % Pitch was well organized, well prepared, concise and easy to follow.
Pitch Clarity Weight 5.00%	65 to 73 % Presenters were unconfident and demonstrated little evidence of planning prior to presentation.	74 to 82 % Presenters were not consistent with the level of confidence/preparedness. Key pieces of information were not clear.	83 to 91 % Presenters were occasionally confident with their Pitch however the delivery was not as engaging as it could have been.	92 to 100 % Presenters were all very confident in delivery and they did an excellent job of engaging the audience. Preparation is very evident.
Prototype Quality Weight 35.00%	65 to 73 % Prototype provided little evidence of effort and vision.	74 to 82 % Prototype is slightly beyond the concept phase. A minimal set of functionality was demonstrated.	83 to 91 % Basic features were demonstrated without error. Could have been a much stronger demonstration with more effort.	92 to 100 % Quality of prototype was exceptional. Level of effort is very evident. Prototype performed as described. Key functionality was demonstrated without error.
Kickstarter Proposition Weight 20.00%	65 to 73 % Kickstarter campaign provided little evidence of effort and vision.	74 to 82 % Kickstarter campaign had moments where valuable information and value proposition was present but as a whole content and intent was lacking.	83 to 91 % Kickstarter campaign had a good amount of directed information, was somewhat memorable however value proposition was uncertain.	92 to 100 % Kickstarter campaign had an exceptional amount of directed information and high value proposition, was very memorable and intent was clear.

Figure 11. Direct assessment of final course project in senior-level engineering entrepreneurship minor course.

Conclusions

Villanova engineering students get a lot of opportunity to perform team-based projects and give presentations. They are confident in their abilities in these areas and this is matched by the direct assessment of their skills. All engineering students perform senior design projects and so have confidence in their ability to design products/services to meet customer's needs. However, while students may have that confidence, it is not clear that this particular ability is properly assessed by the students themselves because they may only be designing to technical specifications without necessarily clearly understanding the functional needs of the customer.

The abilities of students to perform market analyses for products/services, understand how to obtain funding for a product/service or bring a new product or service to market are all rated relatively low by the students. However, students taking the engineering entrepreneurship minor program have more confidence in their ability to perform these types of tasks. This is also borne out in the direct assessment of students in their final course in the engineering entrepreneurship minor program. Some students participating in the extra-curricular activities report confidence in

some of these skills. However, the inter-university projects did not really help in enhancing these particular skills.

There are clearly ways that we can use the results of this assessment exercise to improve our programs. Based on our data, two particular skills that stand out as needing improvement are performing market research and preparing financial statements. We will consider adjustments to our curricula as well as extra-curricular activities to improve these two abilities in our students.

Acknowledgements

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References

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