STUDENT LEARNING OUTCOMES FROM A MULTIDISCIPLINARY CAPSTONE ENTREPRENEURSHIP COURSE

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Abstract

In recent years, universities and colleges have been addressing the need for innovation through the creation of entrepreneurship programs. These programs offer courses, competitions, and mentors to help students with their entrepreneurial endeavors. New programs traditionally create courses that focus on business skills and seminars that teach students about entrepreneurs. While these courses are often content-rich, students may not transfer these skills into action without additional experiences with entrepreneurship. Six years of experience with the University of Michigan multidisciplinary capstone entrepreneurship class has resulted in the creation of an immersive entrepreneurship course that integrates both skills and action. Unlike typical courses that focus on business techniques and knowledge, the course focuses on the underlying behavior of entrepreneurship. Through their journal reflections, students have identified and articulated solutions to major barriers that often inhibit students from transferring entrepreneurial knowledge into entrepreneurial action.

Introduction

It is becoming commonly accepted that science and technology innovation is the source of economic growth for the future. Thus, as educators of tomorrow's innovation workforce, engineering universities and colleges are actively redesigning engineering curricula to integrate additional curricular and co-curricular programs and studying the impact of these changes on how students learn. These programs have largely been focused on connecting STEM students to real-world problems (domestic and international), multidisciplinary initiatives, and cultivating an entrepreneurial environment for the students to take ownership of their passions. The growth in new program development and engineering education research has spawned a diverse set of innovative approaches to engineering education inside and outside of the classroom.

Context

Ten years ago, the University of Michigan (U-M) College of Engineering launched an ambitious effort to shape future engineers through interdisciplinary initiatives: international programs, multidisciplinary design, and entrepreneurship. Each initiative contributes to creating interdisciplinary skills for complex global environments (Conger et al. 2010). The creation of the entrepreneurship programs at U-M's College of Engineering was a result of findings and recommendations from a 2007 committee report on Empowering Entrepreneurial Students

(Zurbuchen et al. 2007). The committee of university faculty, students, and industry representatives suggested that exposure to innovation and entrepreneurship could help U-M students differentiate themselves in the global economy. They made a series of recommendations on how the college could take action to release the entrepreneurial spirit within U-M students.

One of the recommendations called for the creation of a Program in Entrepreneurship. In 2008, the College of Engineering launched the Program in Entrepreneurship, an academic program that provides U-M students an opportunity to explore entrepreneurship in an academic context. Students are required to take at least one course from four categories that result in at least nine credit hours of courses focused on entrepreneurship. The four categories include an entrepreneurship seminar, a core entrepreneurship course, an elective, and a capstone multidisciplinary course. While students have some flexibility with the core and elective courses—which provide students with the opportunity to specialize their interests in entrepreneurship—all students must enroll in the entrepreneurship seminar and capstone course. The first capstone course was offered in the fall of 2008. This engineering program set the precedent for the addition of a university-wide Minor in Entrepreneurship, which was first offered in the fall of 2014.

throughout the program. At its very core, the course has been an opportunity for students to pursue personal entrepreneurial endeavors while participating in an academic program.

When first offered in the fall of 2008, the capstone course took the form of an independent study course. Three students enrolled with their own business ideas and worked towards launch with faculty oversight and mentorship from the local entrepreneurial community. While this was effective for the first iteration, it was clear that not all students enrolling in the Program in Entrepreneurship would have a business idea to pursue. Thus, a more structured format was developed to accommodate a range of entrepreneurship students.

Experience with the 22 different sections that have been offered over the past six years (greater than 570 students enrolled) has revealed a series of fundamental observations:

1. *Diverse student understanding of entrepreneurship*. As a required part of the curriculum, students of all levels and passions enrolled in the capstone course. Some students were simply trying to fulfill an academic requirement and others were filled with passion to launch a venture. The varying levels of enthusiasm and perspectives resulted in a diverse enrollment with respect to entrepreneurship knowledge, skills,

COURSE	OBJECTIVE
Entrepreneurship Seminar	To expose students to entrepreneurship through exposure to entrepreneurs.
Core Entrepreneurship Course	To learn fundamental concepts of business models through coursework and problem-based learning.
Elective Entrepreneurship Course	To obtain a more in-depth understanding of a specific aspect of entrepreneurship.
Capstone Practicum	To immerse the student in entrepreneurship through experiential learning.

Since its inception, the Entrepreneurship Capstone Course has been the flagship engineering entrepreneurship course and the culmination of entrepreneurship learning

and aptitude. Students at all levels of entrepreneurial intent enrolled in the course: some did not have an entrepreneurial idea, some had an idea they wanted to launch, and others already had existing ventures. This diversity presented a challenge in delivering a cohesive curriculum that could support each individual learner.

2. *Conflict of objectives*. Like most entrepreneurship classes, the course leveraged current entrepreneurship curricula focused on the actual development of business or commercialization plans. While students became well versed in crafting the components of a business plan, they were often left with a colorful sales pitch that lacked critical real-world elements such as a viable plan of execution, potential customers, a cohesive business model, or a tangible solution.

3. *Teaching is not learning.* Like most nascent entrepreneurship programs, "successful" entrepreneurs were recruited to "teach" in the capstone. As to be expected, new instructors taught using the models they were most familiar with, lectures and stories. While entertaining, this approach was not always the most effective means of fulfilling student-learning objectives. How could we enhance student-learning by actively acknowledging advances in student-learning research (Ambrose et al. 2010)?

4. *Separation of idea and learning.* While recent advances in delineating the entrepreneurial process (Blank and Dorf 2012) and fundamental components of the business model (Osterwalder and Pigneur 2010) have enabled a framework for entrepreneurial courses, students were often so committed to their personal "great" ideas, they were not receptive to learning any critical entrepreneurial skills

that provided insights or even data that challenged and refined their "great" idea.

5. *Primary research versus secondary research*. With the rise of the internet and accessibility to big data, students were particularly well versed in data mining. This benefit often acted as a major barrier to entrepreneurial success. Students were capable of developing arguments for broad market need through internet and library data mining, yet were inhibited when required to identify and confirm a market need with individual customers. Even when individual customer interaction occurred, it was often limited to close friends and family members, prone to polite confirmation bias. Actually selling their own product to customers outside their own social network was crucial to the enhancement of their primary research.

Integrating these real-time observations into course development, a team of engineering faculty with entrepreneurial experience and practicing entrepreneurs have been iteratively developing the Entrepreneurship Capstone Course into an immersive educational practicum experience that leverages new advances in research about learners and pedagogical approaches as a framework to cultivate an active entrepreneurial learning environment (Ambrose 2013; Bransford, Brown, and Cocking 1999). This framework is built on an infrastructure with a shared curriculum and learning outcomes, which enables entrepreneurs to be effective instructors and augment the course with their practical experience without sacrificing student learning for undirected, anecdotal exposure to experienced entrepreneurs. The evidence-based learning models integrated into the course include: student reflections, problem-based learning, peer-to-peer learning, and collaborative learning. This paper describes a review of student reflections collected over a single semester (Winter 2014) from two separate sections led by two

3

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different entrepreneurs.

Course Design

The following discussion describes the Entrepreneurship Capstone Course in its most current form as of winter 2014. The course is a problem-based learning lab with direct instructional guidance, designed to bring students from any school, college, or major at the University of Michigan to work on entrepreneurial endeavors. The class builds on a series of hands-on entrepreneurial exercises that expand entrepreneurial skills and knowledge through launching ventures.

The fundamental learning objectives of the course are to:

- Learn the customer discovery process
- Actively practice exercising the customer discovery process
- Become familiar with the process of starting a business

The 14-week capstone experience is divided into three parts, each centered on a team project. The first two projects are designed to provide a framework for and develop essential skills, such as idea formation, customer discovery, opportunity scoping and validation, entrepreneurial mindset, constructing and validating business models, and value creation. The first project is specifically designed to help students overcome many barriers to approaching entrepreneurship, such as approaching customers and soliciting feedback. Once they do that, then other challenges become more manageable. The second project provides students with the skills necessary to construct and validate business models. Finally, the third project offers the students an opportunity to reinforce their newly developed skills in a capstone experience. Students enrolled in the class are informed that all exercises in the course are designed to augment the classroom experience and any one-time sales experience is simply for the purpose of fulfilling a class

requirement and not self-employment or gaining income.

The course heavily applies an anthropological design framework and process developed by Menlo Innovations (www.menloinnovations.com). The course is based on lectures, workshops, hands-on activities, and discussions to help students better understand entrepreneurship and successfully complete the projects under the mentorship of practicing entrepreneurs.

Part One: Scrap Box Mini-Ventures
Overview

The first three weeks of the course focuses on becoming acquainted with business models, experiencing entrepreneurship, creating revenue, and developing the entrepreneurial mindset (Kriewall and Mekemson 2010). Students have the opportunity to launch a venture from ideation to revenue generation, providing a foundation for the remainder of the course. Students are specifically not instructed on the value or methods of customer discovery (Blank and Dorf 2012).

For the first and second projects, team formation is the responsibility of the instructor. Teams are specifically created to represent diversity across majors, schools, and colleges, if possible. Team size is limited to three or four students, based on the ability to diversify the teams and number of students enrolled in the class.

Instructions

Each team is asked to invest $10 in raw materials, to be purchased from The Scrap Box (www.scrapbox.org), a local Ann Arbor non-profit organization that promotes creativity and sustainability by providing the community with inexpensive recycled materials. The Scrap Box warehouse is full of unique, recycled materials that come from manufacturers and businesses, which would otherwise end up in landfills. Students are instructed to turn the raw materials into

something potential customers will value and then sell the product for more than the cost of the raw materials. Resources purchased outside of The Scrap Box are "taxed" at 100%, i.e., every $1 spent outside of The Scrap Box is documented as $2. Students may also use resources that they already have or can borrow at no cost (e.g., glue, scissors). As they generate profit and sell their product, initial proceeds should be reinvested to create additional product until the end of the exercise.

During the exercise, students are reminded to pay attention to who is investing the initial $10, where the raw materials and inventory are stored, where the product will be sold (in person, eBay, elsewhere), what will become of the profits, and how the team will make decisions.

Weekly Assignment

Each week, students are instructed to reflect upon their journey: how they sold their product, resources used, individuals encountered, what they learned from potential customers, and any conflicts that occurred.

Part Two: Problem Identification and Value Creation
Overview

During weeks four to seven, students are taught how to use the customer development process to refine and validate a business model design. Students also learn to better understand and recognize business models that other companies use. Through a team project, students identify and validate a business opportunity as a means of solving a real-world, societal problem. Students learn to ask customer-focused questions, test ideas, develop prototypes, and interpret data to create value for customers and make better business decisions.

Students are regrouped into new teams of three or four, as dictated by the instructor. They are also subjected to a "forced pivot" during this assignment.

Instructions

Each individual student is instructed to come to class with three big problems. The problems could have been identified through brainstorming, personal experience, or previous customer discovery (e.g., obesity, prison systems, driving). These ideas are then shared with the student's team during class. The teams are required to select one of the problems and create a concise problem statement that addresses the stakeholders, the magnitude of the problem, and its importance to the stakeholders.

Once the problem statement is clear, students are instructed to brainstorm up to 50 potential solutions within a set amount of time (e.g., 20 minutes during the class period). The solutions should be ranked, highest being the most obvious solutions to the team. The students then spend the next four weeks validating the problem by: 1) identifying potential customers, 2) identifying where they can observe these potential customers, 3) observing potential customers in action, 4) talking to potential customers to identify specific aspects of the problem they are trying to solve for the customer, 5) developing a potential solution that will offer the most value to the customer, and 6) reconciling any preconceived opinions they may have regarding the problem. Customer interviews are meant to help students better understand the problem they are trying to solve.

A critical component to the exercise is the forced pivot, which forces students to immediately discard the first six to ten solutions they list on their brainstorming document. By removing the solution ideas that are rooted in the students' initial, and often incorrect, assumptions about the customers' context, students are challenged to learn more about that context. In doing so, the students arrive at a completely new set of solutions that are a direct result of a deeper and firsthand understanding of the problem that they are working to solve. Students

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are held accountable to both the customer observations and interactions and the exclusion of their initial solutions.

Weekly Assignments

Students are instructed to reflect on several aspects of the experience on a weekly basis and iterate their business model based on customer feedback. Customer feedback will either confirm the customer segment and value proposition or help the student iteratively redefine the problem, customer segment, and value proposition. Students are expected to develop preliminary prototypes based on customer feedback and socialize them with additional customers during the interview process. The project culminates with the students implementing their solution and observing whether or not it had the impact that they intended.

Part Three: Venture Creation
Overview

The final project spans the last seven weeks of the class and offers students the opportunity to apply and integrate newly developed skills from Projects 1 and 2 to a problem of the students' choice. Students are allowed to select their own project and create their own teams of three to four.

Instructions

Students teams are instructed to complete the following tasks over seven weeks:

1. Problem Definition: Identify a problem that you are aware of or that you discover.

2. Customer Discovery: Perform customer discovery to:

    • Validate the pain by observation and testing
    • Validate a way to create value by relieving the pain or providing a gain by observation and testing
    • Identify real customers

3. Product: Develop a product or service based on customer discovery.

4. Canvas: Establish a tested Business Model Canvas from customer discovery, testing, and product development work. This canvas evolves throughout the project as students update it with new customer discovery and product/solution testing information.

5. Launch: Launch an early stage venture.

Weekly Assignments

Assignments help the student move through the process. During the first phase, students must document the validation of the value proposition and customer segments. During the second phase, students move into implementation and execution; they extend testing, further developing the product or service and validating other parts of the business model (costs, key activities, and revenue). Documentation is iterative, using the Business Model Canvas as a framework.

Methods

Student reflection assignments for two sections of the Entrepreneurship Capstone Course taught in winter 2014 were analyzed for this study. After each project (one to three), students were instructed to submit an individual personal reflection of the exercise. The open-ended reflection assignment was guided by the following questions:

• What have you learned about yourself as a result of this project?
• What have you learned about entrepreneurship as a result of this project?
• What surprised you about the project?
• What was your biggest "ah-ha" moment about entrepreneurship while working on this project?
• How did your work on this project transform a concept that you had read in a book into a real life experience and change your perspective on that concept?
• How did your team's dynamic help or hinder your team's success on this project?
• What might you have done differently to help improve the team's performance?

- What did you find was the most challenging part of this project?
- Was there a particular part of this project that you found very exciting and you would like to do again?

Content analysis, guided by Glaser and Strauss' (1967) grounded theory for qualitative analysis, was performed and documented in NViVO. It was used to aggregate common themes in student responses as a representation of student perceptions throughout the course.

Results

Student reflections, three per student, were collected over a single semester in two sections of the entrepreneurship course (n=66, 33/section). Both classes had higher male enrollment than female. Students ranged from sophomores to seniors.

Gender	Section 1	Section 2
Male	22	23
Female	11	10

While the course was offered in the College of Engineering, all College of Engineering entrepreneurship courses are open to students across campus. Students enrolled in the classes represented five schools across the university: the College of Engineering, College of Literature, Arts and Sciences, School of Art and Design, School of Kinesiology, and School of Business. The large number of Literature, Arts and Sciences students is representative of the recent growth in interest about entrepreneurship from liberal arts students at the University of Michigan. There are over two times as many LSA students as engineering students at the University of Michigan.

School/College	Section 1	Section 2
Engineering	8	7
Non-Engineering	25	25

In reviewing the student reflections, student responses were categorized into three major themes: challenges, lessons learned, and issues with teams. Responses were consistent across both sections.

Challenges

Students appeared to struggle the most with the first project. By far, they were most challenged by the act of selling. Students commented on their fear of the cold call, approaching an unknown individual to make a sale. They struggled with many aspects of the sale: approaching someone that was not within their network, trying to explain a novel idea to someone new, and convincing the person that the idea was worthy of a financial exchange. Idea generation also presented a barrier to the students. They were overwhelmed with the options at The Scrap Box and had difficulties identifying a problem that they wanted to solve based on the materials available to them and ultimately believing in the product themselves. The third most difficult challenge to the students was finding a time to meet. While this may seem trivial to instructors, it is often one of the biggest struggles of students today. More and more courses are team-based and require engaged learning outside of the classroom, adding greater stressors on students than may be obvious to instructors.

While student references to challenges decreased for the following two projects, the one consistent challenge was talking to potential customers. In a similar vein to challenges with the act of selling, students were particularly vocal about their discomfort with talking to people to get feedback. Some students expressed confidence after a first sale or confirmation of a need, but many still struggled with how others perceive their ideas and products.

Lessons Learned

While it was clear that students were uncomfortable with reaching out to customers for real-time feedback, they also recognized the value of the experience. The most consistent learning across projects and

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sections was the value of interacting with customers to identify the true customer needs, pains, and the value of the solution. It is important to note that students recognized the need of not only talking to the customer but also observing the customers in real time to understand the context of the need. Students also reflected on their personal preconceptions of problems and solutions and how that was often a significant barrier to success, as these preconceptions were often demonstrated to be inconsistent with customer needs when students allowed themselves to focus on the customers instead of their own "great" idea. The second most common learning outcome articulated by students was the need to have a personal connection and passion for their entrepreneurial endeavor. In instances where the collective team selected a product that may not have resonated with an individual, the individual struggled with contributing to the project and the teammates struggled with integrating that individual.

Students also commented on the value of forced execution and experimentation on a real-world project that they could personally investigate. Students commented on the value of experimentation and being held accountable for their findings. Rather than relying on feedback from their professors or impersonal surveys, students are challenged to formulate experiments that must actually result in financial transactions. The sales generated—or in some instances not generated—transformed the student's perception of entrepreneurship from an academic exercise to reality. Theory is not practice.

The forced pivot also played a critical role in many students' learning in the course. For many students, the forced pivot elicited irritation. Upon reflection, students commented that while those initial solutions were the obvious solutions, the forced pivot pushed them to truly understand the problem they were trying to solve. Students were forced to shift their approach from immediately developing a great product to trying to understand the problem.

Several students shared that the experiential learning aspects broadened their perspective of entrepreneurship. Many walked into the class with preconceptions that focused on high-tech, maximizing revenue without concern for profit, and the belief that the venture capital model is the primary model for starting a business. This broadened perspective included, in some cases, surprising self-discovery about their own passions, interests, and aptitude for entrepreneurship. Some would describe this awakening as life-changing in regard to their future career progression. In some instances, as teams were successful in finding real customers, their passion for their venture concept grew, despite having no initial personal connection to the product or service.

Finally, students also articulated several skills that were developed throughout the process, including communication, using the Business Model Canvas, networking, testing ideas, observations, and how to execute an idea.

Teams

Student reflections were rich in comments about teams. Comments focused particularly on the need to have a cohesive team that can communicate well for success. Several teams struggled because of misalignment of personal goals and commitment to the team, problem, or solution. In some instances, students that did not resonate with the problem were de-motivated and contributed to a negative culture within the team. In fact, this was used actively as an important teaching component of entrepreneurship and the instructors worked closely with the project teams to address team conflicts through lectures, class activities, and office hours before projects were completed. Students that collectively developed an idea and committed

to the evolution of the project felt they were more successful. Students also saw value in the diversity of skills and perspectives in the team. Diversity of skills, majors, and backgrounds shed light on different perspectives of the problems they were solving, as well as different potential solutions.

Conclusions

The past several years have seen a growth in the effort to understand student learning. The education community has come a long way in understanding how the intersection of learning theory and higher education can influence a new culture in engineering education, a hands-on professional discipline. This approach has a great deal in common with the future of entrepreneurship education. The course described in this paper is a deviation from the traditional entrepreneurship courses, leveraging new innovations in entrepreneurship education and putting recent advances in student-centered learning into practice to develop a more efficient pedagogical model of learning entrepreneurship for a more diverse makeup of students.

As entrepreneurship education continues to evolve and more universities look to establish new programs, much can be learned from the results of this kind of course development. Entrepreneurship education is not as simple as listening to entrepreneurs speak about successes and failures. Entrepreneurship education is not just about the "how" of business and commercialization. Entrepreneurship is an active process that demands thoughtful, active learning. To develop the innovative workforce of tomorrow, entrepreneurship education will see the most success by integrating both education theory and practice.

Acknowledgements

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