

Issues in Teaching Entrepreneurship to Heterogeneous Groups of Students

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Abstract

Entrepreneurship for Engineers at the University of Pittsburgh is a course geared toward undergraduate seniors and graduate students in all engineering disciplines. The premise of the course is to combine engineering innovation with business development that will result in new product development plus a thorough understanding of what is required to launch a new product. Since students are from varied backgrounds, including many disciplines of engineering and sciences, as well as business, teams are made of individuals with different knowledge sets and mind sets.

The course requires teams to develop a product and move through all of the steps towards launching a company culminating in a prototype, a business plan, an executive summary, and a presentation suitable for obtaining venture capital. Evaluation comments by the students identified a number of significant issues. These include:

1. The heterogeneity of students: Students included full time undergraduate students, full time U.S. educated graduate students, full time foreign educated graduate students, and part time graduate students working full time. This mix is exacerbated by the different academic backgrounds, time constraints of the student groups, and diversity. The challenge is how to put together teams that get along, have different talents, and are productive.

2. Lack of background: Many engineering students have the ability to innovate, but have no background in finance, marketing, sales, management, etc. The challenge is to develop ways of presenting material for which most students have no background in a manner that they can absorb and use.

3. Need for personal attention: Teams need individual guidance. The challenge is to design the course such that students can get the personal attention they need without sacrificing the large body of knowledge that they must learn to be effective entrepreneurs.

4. Individuals who are incompatible with the team: The challenge is to find a way of enabling non-productive individuals to continue in the course without stifling the entrepreneurial spirit and commitment of the rest of the team members.

5. The materials necessary to teach a course in Entrepreneurship for Engineers are either scattered or not readily available: The challenge is to put together a body of material that will be comprehensive, but in a form that addresses the engineer's needs.

Introduction:

Entrepreneurship for Engineers at the University of Pittsburgh is a graduate course aimed at teaching the nature of entrepreneurship and the skills required to move through the entire spectrum of entrepreneurial activity from innovation to post financing management. It is open to students from all engineering disciplines and outstanding undergraduate seniors are also permitted in the course. The premise of the course is to combine engineering innovation with business development with the goal of developing a new product and giving the student a thorough understanding of what is required to launch a new product. This includes management; finance, including projections and initial working capital required; market identification; legal issues, including intellectual property concerns; research and development; staffing; funding sources; and sales considerations. Since students are from varied backgrounds, including many disciplines of engineering and sciences, as well as business, teams are made of individuals with different knowledge sets and mind sets.

The course requires teams to develop a product and move through all of the steps towards launching a company culminating in a prototype, a business plan, an executive summary, and a presentation suitable for obtaining venture capital. This course was introduced in the fall of 2001 and attracted 30 students. In general, this course was well received, but the experience of teaching the course and the subsequent evaluation comments by the students, identified a number of significant problems. The evaluation was on balance positive with the majority of the students considering the course to be above average. However, the ratings were distinctly dichotomous with most valuations at the top or the bottom of the scale. As follow-up to the formal evaluation process, several other faculty were asked to meet with students who had taken the course to obtain a more in-depth assessment of what they liked and didn't like. This feedback, when added to comments that accompanied the numerical evaluation process, was used to identify problems for future examination and change.

Most of the students, who did not like the course, were most dismayed because the design of the course did not match their expectations. This leads to an overall question of whether or not a course of this design is feasible. A number of comments indicated that the students wished the course to be more in depth in some small part of the course as actually given. Several clearly did not learn what they wanted to learn. These students were more interested in learning about what made individual entrepreneurs successful, than deal with the technical requirements to become an entrepreneur.

The Setting

Before examining the problems that occurred, it is important to mention that construction of the teams was by design. The idea was to make sure that all of the electrical engineers or part-time students from a single company or all women or everyone from a similar racial or ethnic group did not gravitate to the same team. The ambitious material content

of the course dictated that the teams needed to be diverse. In order to give some credence to student's personal choices, the first class included a self-introduction of each student with a few minutes of background and interests. Students were then sent an email with a list of all of students and the requirement that they choose, in order, the top fifteen students they wanted to be on their team. The instructor then matched choices in such a way that six teams of five students each were determined. The teams included preferences where possible, but were constructed to be diverse relative to prior education, industrial experience, disciplinary background, gender, ethnicity, and whether they were a full time or part time student. In the second week of the course a new student entered and they were assigned as a sixth member to one of the teams. In the third week a student on one of the five person groups dropped the course, resulting in a significant disadvantage to that group. There was no ability to move the extra person to the smaller group since they had already become engaged in the product group to which they were assigned.

The teams were given two weeks to come up with a preliminary recommendation for a product. The product had to make sense and be commercially viable. Since this was not a course in product development, emphasis was not placed on how good the product was, though clearly, better product ideas were easier to develop a business plan around. Some of the product ideas were a combination snow boarding lock and tool kit, an electronic shower control, a pet exerciser, an electronic dog training control, a new kind of beverage, and an outdoor trails product. While all products were not of an engineering nature, they each required engineering skills to design or develop.

The Issues

Five issues were identified as critical to course improvement. These issues were identified from the written comments that accompanied the course evaluation that took place at the conclusion of the course. The first major problem was **the heterogeneity of the students**. Students included full time undergraduate students, full time U.S. educated graduate students, full time foreign educated graduate students, and part time graduate students working full time. This mix was further exacerbated by the different academic backgrounds represented within each of these groups. Almost all engineering undergraduate backgrounds were represented as well as computer science, mathematics, and business. Moreover, time constraints for each of the student groups is different; e. g., full time students want to meet during the day while part time students prefer evenings. In addition, there was considerable diversity with three of the students being Hispanic, four being African-American, and eight being women. A major complaint was related to differences in how seriously certain students took the course. Part-time graduate students, in particular, had little patience with under-performing undergraduates.

A premise of the course was that real companies need the various talents that come from a heterogeneous group of individuals. Students preferred to work in teams with their friends, in particular, with other students that had matching characteristics. The challenge is how to put together teams that get along, have different talents, and can be productive. After considerable thought and discussion with both students and other faculty, it appears

that while the heterogeneity issue is real, it hides other problems. The course is taught from the perspective of how one develops a company in the United States. Many international students don't relate to the challenges that occur in the entrepreneurial process. Even more important, the students in this class have different objectives. For those who want to learn about and understand the entrepreneurial process, the course seems to be on target. For those who are just seeking an elective and don't have any commitment towards the entrepreneurial process, the course is too difficult and requires too much work. Retrospectively, it is clear that a significant number of students in the class wanted to learn what it is like to be an entrepreneur and what makes certain entrepreneurs successful. They were not so much interested in understanding and simulating the road to a successful entrepreneurial endeavor, as they were to hear about successes. It appears that a closer screening of students permitted to take the class is necessary. Part of that process will be to make presentations prior to registration so that students will understand better what the purpose of the course is.

A second serious issue was **the lack of background in some areas by many students**. Engineering students typically have the capability of innovation development; but, for the most part, they have little or no background at all in finance, marketing, sales, management, etc. It is not the intent of an entrepreneurial course for engineers to make the students experts in all of these areas; however, if they are to be prepared for entrepreneurial activities, they must be sufficiently conversant with these areas to be an integral part of a team. This means that not only must they understand something about entrepreneurial areas where they are not the primary knowledge holder, but they must also appreciate the skills, problem areas, and time constraints of those who bring knowledge that they don't have. An objective of the course is to inculcate the students with the ability to understand and set priorities. The challenge is to develop ways of presenting material for which most students lack background in a manner that they can absorb and use and do it within the confines of a one-semester course. Unfortunately, most of the material for which the students have little background would require extensive reading and, even then, these readings would give the students methodology, but not necessarily a real appreciation for the subject matter. A more Socratic approach to teaching this material in conjunction with different material will be attempted the next time the course is given.

The third issue with teaching this course was **the need by the students for more personal attention**. The teams need individual guidance. In each area covered, the teams need to be able to have individual instructor time and coaching to keep them on track. This is very labor intensive. With five students on a team and meetings usually requiring at least an hour, the challenge is to design the course such that students can get the personal attention they need without sacrificing the large body of knowledge that they must learn to be effective entrepreneurs. This would be easy to do if it were possible to give a course with 16-20 students in a well-designed classroom. Unfortunately, in the School of Engineering at the University of Pittsburgh, this is not going to happen. Demand for the course is very large and it is unlikely that the course could be capped at much less than thirty and, more probably, forty. The classrooms of this size are traditional and are not convenient for group work. Change in course design has the most potential

for alleviating this problem. By creating a set of in-class, background assignments that would be done during the second half of the class, it is anticipated that individual groups could meet with the instructor, while the rest of the class will complete the assignments. With Socratic style review at the next class, background material can be better absorbed while some time every other week can be in the form of individual guidance.

The fourth issue is **how to work with individuals who are incompatible with the team**. This is an interesting classroom issue. In the real world of entrepreneurship, individuals who turn out to be incompatible with the entrepreneurial team, either by virtue of personality or commitment, are removed from the group. In a classroom setting this is much more difficult to accomplish. Diversity did not appear to be the issue. The personality and work habits of the individual student were much more likely to be a problem. In a real entrepreneurial endeavor, personalities and work habits tend to shake out or the company never gets off the ground. Those who can't get along either realize that they don't like being part of the group and resign or they are forced out by the other members of the group. In a classroom setting, you can't operate the class as though it is a "Survivor" TV show. Every student need to be presented with all of the material and all of the experiences taught in the class. The challenge is to find a way of enabling non-productive individuals to continue in the course without stifling the entrepreneurial spirit and commitment of the rest of the team members.

At the conclusion of the class, students were given a questionnaire that allowed them to evaluate their teammates. While this is useful in identifying the incompatible or uncooperative students and can be used to reduce the grade of an individual, it is not useful in assuring excellence for the entrepreneurial project itself. Some thought has been given to developing ways that a team member can be voted off the team for non-performance. The process can be made reasonably fair with it being very difficult to rid the team of an individual. In real entrepreneurial situations, the remaining entrepreneurial group pays a penalty when someone is forced out, but they see the long-term benefits to be greater than the penalty. Some simulation of this process might work. However, the question remains of what to do with students removed from teams. They must be permitted to participate in some entrepreneurial activity, perhaps, being part of some recovery team.

The final issue is that **the materials necessary to teach a course in Entrepreneurship for Engineers are either scattered or not readily available**. This is a problem that is indigenous to the development of a new course. If a course is taught over a significant period of years, then any good faculty member should be able to assemble appropriate materials, but the choices for a new offering leave much to be desired. The books and other materials available to teach entrepreneurship courses are either "cook book, how to", primarily motivational, or segments of what an engineer would need to know. If an individual wanted to study entrepreneurship on their own, most could not even figure out which books and materials to select. The engineer needs to understand the role they play in innovation and enough about the entrepreneurship process to find colleagues with which to pursue their invention or idea. The challenge is to put together a body of

material that will be comprehensive, but in a form that addresses the engineer's needs. It is an interesting area for someone to seek a grant to assemble such material.

Discussion

At first glance, it might appear that these issues are no different than those that one would expect in any upper level undergraduate/graduate course. However, there are unique aspects of a course in entrepreneurship that make these problems significantly more difficult and much more critical in delivering a course that meets students' objectives. In most courses in engineering, students have a good idea of what content will be contained. If they don't have the prerequisites, there are other courses or books available that allow them to prepare. In most survey type courses; i.e. courses that cover a large amount of diverse material, the topics do not require significant background. In comprehensive entrepreneurship courses, the amount of material that would be prerequisite is far too vast for a typical engineering student to have time to master and yet, the demand for understanding entrepreneurship is great.

Obviously, some of the issues do occur in other courses, but they are exacerbated by the nature of entrepreneurship. In a typical class that uses teams, there are alternatives that can be considered for an incompatible member. In an entrepreneurship course, it is nearly impossible to move someone to a different group after the first few weeks and, even during the first several weeks, the move is very disruptive. The need for more personal attention is common to courses containing a large project, but when the project is of an entrepreneurship type, the students need significant time to develop the product and the business plan, but do not have the necessary knowledge at the right time or in the right sequence. This places a much larger burden on the instructor to fill in knowledge as needed over and above the didactic order of the course.

A course format that tries to cover all of the aspects of entrepreneurship that engineers need to consider their interest in pursuing innovation is very ambitious. Most schools do not have the resources to provide the multiplicity of courses that would be required to learn the necessary material and absorb the entrepreneurial spirit. Concomitantly, most engineering students do not have time in their programs to take the totality of courses necessary. Most entrepreneurs learn much of what they know by experience, usually trial and error. This usually involves failure with successive mistakes providing the expertise one needs to be successful. Of course, nothing replaces good luck or being in the right place at the right time. This course was designed to prepare students for an entrepreneurial experience, but by virtue of being in a classroom, it can only be a simulation.

The overall question is "Can a course of this breadth be a worthwhile learning experience?" Perplexingly, the answer is yes for some students and no for others. If we are to continue to provide this course, we have to deal with the issues identified. The five issues discussed: the heterogeneity of students, the lack of background for many students, the need for personal attention, individuals who are incompatible with the team, and the

problem that the materials necessary to teach a course in Entrepreneurship for Engineers are either scattered or not readily available, are critical to examine.