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Hands-On Entrepreneurial Engineering Management Course and Its Experiential Learning

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Abstract

Entrepreneurial Engineers are educated for the forthcoming economy and market, where entrepreneurs with technical skills have tremendous opportunities and career options. This new course was developed in Spring 2015 and offered in Summer 2015, delivering skills sets in engineering, marketing management, economics and globalization for the 21 century's state-of-the art Renaissance Engineers and Managers as a faculty-led program in Turkey.

The authors strongly believe in experiential learning. Traveling, experiencing, and exploring other cultures helps students grow personally and professionally. It is one of the most in-depth learning experiences to immerse oneself in a new culture and customs in a whole new country. Students had the opportunity to learn by solving real-world industrial problems in a practical business model setting. They grasped how to bring products and services to market, and how to start their own company to market and sell product ideas. They understood how to be an entrepreneur in a small company, or how to lead successful entrepreneurial projects in a large company. They have learned subjects such as engineering economy, quality control, supply-chain management, ergonomics, marketing, and operations control from course professors, young entrepreneurs, and industry visits.

The course has been offered by one business management faculty and one manufacturing engineering technology faculty. There were five engineering and seven MBA students. The course had a number of teaching-with-technology tools, including Turnitin, Desire2Learn, and Podcasts. The evaluation component was the university approved IDEA evaluation.

This paper will report the development, implementation, and evaluation components of this course and its best practices.

Background

Tennessee Technological University (TTU) has a number of new initiatives in order to increase the competence of its students in innovation and entrepreneurship. Students gain such kind of skill sets during their educational period at TTU. Some of them are summarized below.

Eagle Works is a new Innovation and Entrepreneurship competition [1] which helps students develop a new business concept and structure it for the competition held every Spring Semester. First held in Spring 2015, TTU Eagle Works Innovation and Entrepreneurship Competition encourages and supports student entrepreneurship at TTUy. Contestants form teams focused around an innovative business idea, validate their business ideas with lean concepts, write a business plan, and pitch their idea to a panel of judges for a chance to win thousands of dollars in awards. TTU supports contestants by providing fun events, workshops, groups of like-minded

people, a cutting edge makers space, virtual reality technologies, for-credit classes, and awards from sponsors and industry partners.

The Innovation and Entrepreneurship (I&E) Certificate is an interdisciplinary program of study designed to provide students with the tools necessary to incorporate entrepreneurship and innovation in every field of study. The focus of the program is to provide each student with the opportunity to develop entrepreneurship and innovation skills through problem solving, creativity, and teamwork while they practice strategies for meeting needs within the increasingly competitive global marketplace. The certificate provides a combination of explicit training in entrepreneurship and innovation, validated expertise in subject areas, and experiential learning through practical application. Students who obtain this certificate will possess knowledge of language, process and strategies for innovation, and hands-on experience of taking part in entrepreneurial activities.

The iMakerSpace [2] is a newly structured production environment created at the second floor of the university library. It is a partnership between the College of Engineering and College of Business with the goal of creating an interactive space for students and faculty to use collaboratively while working on innovation and entrepreneurship projects. The iMakerSpace has all the equipment needed for small scale prototyping and fabrications. It also includes a meeting space that is available to all TTU students and faculty and that is outfitted with modular accessories such as white boards, desks, chairs, presentation equipment, and technologies such as 3D printers.

The Pathways to Innovation Program (PIP) [3], created and run by Epicenter, is designed to help institutions transform the experience of their undergraduate engineering students and fully incorporate innovation and entrepreneurship into a range of courses as well as strengthen co- and extra-curricular offerings. Participating schools assemble a team of faculty and academic leaders to assess their institution's current offerings, design a unique strategy for change, and lead their peers in a two-year transformation process. TTU PIP team, a combination of the faculty and senior administration of the College of Engineering and College of Business, provides oversight and advice to the activities in the iMakerSpace. PIP initiative also provides students who are trained University Innovation Fellows. The Fellows lead student based innovation and entrepreneurship initiatives across campus.

Development and Implementation

The plan for the new course was to give students the opportunity to solve real-world industrial problems in a practical business model setting. The objective was to let students learn how to bring real products and services to market, and how to improve business strategies and the products of that company. The strategy was to seed some practical models and proven cases so that they learn how to be an entrepreneur in a small company, or how to lead successful entrepreneurial projects in a larger company. The concepts covered by the instructors, young entrepreneurs, and guest lecturers were on economy, quality, supply-chain management, advanced manufacturing, marketing, and operations control.

The course was offered as a Faculty Led Program at Meliksah University, Kayseri, Turkey in May 2015. A number of lectures and industry visits has been organized to solidify students' learning and comprehension. Course materials were made available in a D2L (Desire2Learn) system called iLearn at Tennessee Tech University. Sample course materials are given in Figure 1.

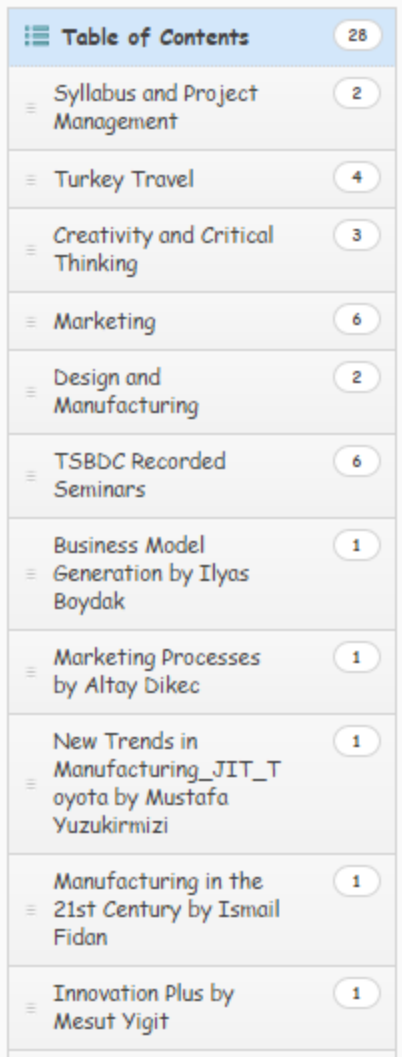

Figure 1: Sample Topics Covered in the Entrepreneurial Engineering Management Course

Course assessment and evaluation has been managed via Turnitin system. Students and student teams submitted their course assessment materials and projects through Turnitin, which helped instructors to evalaute their skills in English, grammar, plagirism, professionalism and ethics. Figure 2 shows a picture from the Course Turnitin Site.

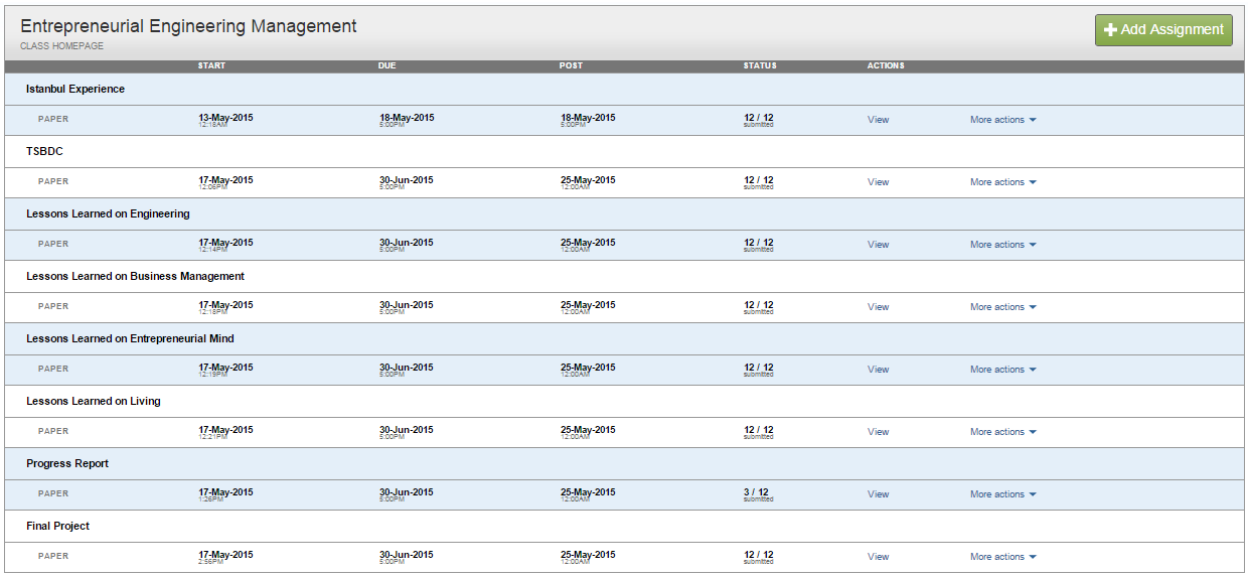

Figure 2: Turnitin Site of the Entrepreneurial Engineering Management Course

The course was structured around the basics of experiential learning. A number of informal learning opportunities was provided with the local businesses, engineering firms, non-profit organizations and trade organizations. Figures 2 and 3 provide two examples from Kayseri Chamber of Industry tours and an onsite visit of a participating young entrepreneur.

Figure 3: Kayseri Chamber of Industry Tour: Students received lectures from the industrial leaders

Reflections on Experiential learning

Living in a different culture/country is a whole new level of experiential learning. Living in a new country engages students intellectually, socially, and physically all the time. Living in a new country encourages interaction with fellow students, with the world at large, and with oneself by building and nurturing relationships.

Figure 4: Onsite Visit of Young Entrepreneur, Mehmet Ozmen's Potato Storage Units in Nigde

Living in a new setting comes with its own challenges. Students must adjust to food, temperatures, sleep conditions, and physical facilities like showers and restrooms. Travelling to new places and meeting new people is an invigorating, rewarding, and intellectually stimulating process. It is important to adapt in some ways to the host country's expectations and customs. It is important to learn to respect other cultures and traditions in spite of the similarities and differences that may exist. For a rewarding travel experience, it is also important to observe, to listen, and to avoid judging.

Several theories on phases of cultural adjustment explain different stages in the adjustment process. According to Gregory Trivonovitch, four stages of cultural adjustment are Honeymoon, Hostility, Integration/Acceptance, and Home. According to Trivonovitch, "these four stages are cyclic in nature, not linear, and a person will encounter periods of adjustment continuously as he or she moves from one situation to another." Benefits of this course experience involved not only traveling to a new country but also traveling with people from different backgrounds, cultures, and interests. Out of the 14 people on the trip, at least seven nations were represented. One student was born in Kuwait, raised in Canada, and lives in the US. One was from Cameroon, one was from Vietnam, one from Nepal, and one from India, Two brothers had Ugandan background, and one of the professors was from Turkey. Learning about so many cultures and people was a bonus for this unique, enriching experience. At least one participant "would not trade it for anything."

Course Evaluation

To evaluate the success of the course, IDEA (Individual Development and Educational Assessment) tool has been used for the engineering students [4].

Your Average Scores

	Your Average (5-point scale)	
	Raw	Adj.
A. Progress on Relevant Objectives [1] **Two** objectives were selected as relevant (Important or Essential –see page 2)	4.7	4.6
Overall Ratings		
B. Excellent Teacher	4.7	4.5
C. Excellent Course	4.7	4.5
D. Average of B & C	4.7	4.5
Summary Evaluation (Average of A & D) [1]	**4.7**	**4.6**

[1] If you are comparing Progress on Relevant Objectives from one instructor to another, use the converted average.

[2] The process for computing Progress on Relevant Objectives for the Discipline and Institution was modified on May 1, 2006. Do not compare these results with reports generated prior to this date.

Your Converted Average When Compared to All Classes in the IDEA Database

Comparison Category	A. Progress on Relevant Objectives		Overall Ratings: B. Excellent Teacher		C. Excellent Course		D. Average of B & C		Summary Evaluation (Average of A & D)	
	Raw	Adj.	Raw	Adj.	Raw	Adj.	Raw	Adj.	Raw	Adj.
Much Higher Highest 10% (63 or higher)	64	63								
Higher Next 20% (56–62)			58		62	60	60	58	62	61
Similar Middle 40% (45–55)				55						
Lower Next 20% (38–44)										
Much Lower Lowest 10% (37 or lower)										

Your Converted Average When Compared to Your: [2]

Discipline (IDEA Data)	60	62	56	56	60	61	58	59	59	61
Institution	57	61	55	55	58	61	57	58	57	60

IDEA Discipline used for comparison:
Engineering–Related Technologies

Figure 5: IDEA Evaluation Scores

	Importance Rating	Your Average (5-point scale)		Percent of Students Rating		Your Converted Average When Compared to Group Averages: IDEA Database		IDEA Discipline [1]		Your Institution [1]	
		Raw	Adj.	1 or 2	4 or 5	Raw	Adjusted	Raw	Adjusted	Raw	Adjusted
21. Gaining factual knowledge (terminology, classifications, methods, trends)	**Essential**	**4.7**	**4.7**	**0%**	**100%**	**64 Much Higher**	**64 Much Higher**	**60 Higher**	**63 Much Higher**	**57 Higher**	**62 Higher**
22. Learning fundamental principles, generalizations, or theories	Minor/None										
23. Learning to *apply* course material (to improve thinking, problem solving, and decisions)	Important	4.7	4.5	0%	100%	63 Much Higher	60 Higher	60 Higher	60 Higher	58 Higher	59 Higher
24. Developing specific skills, competencies, and points of view needed by professionals in the field most closely related to this course	Minor/None										
25. Acquiring skills in working with others as a member of a team	Minor/None										
26. Developing creative capacities (writing, inventing, designing, performing in art, music, drama, etc.)	Minor/None										
27. Gaining a broader understanding and appreciation of intellectual/cultural activity (music, science, literature, etc.)	Minor/None										
28. Developing skill in expressing myself orally or in writing	Minor/None										
29. Learning how to find and use resources for answering questions or solving problems	Minor/None										
30. Developing a clearer understanding of, and commitment to, personal values	Minor/None										
31. Learning to *analyze* and *critically evaluate* ideas, arguments, and points of view	Minor/None										
32. Acquiring an interest in learning more by asking my own questions and seeking answers	Minor/None										
Progress on Relevant Objectives		**4.7**	**4.6**			**64**	**63**	**60**	**62**	**57**	**61**

[1] The process for computing Progress on Relevant Objectives for the Discipline and Institution was modified on May 1, 2006. Do not compare these results with reports generated prior to this date.

Much Higher = Highest 10% of classes (63 or higher)
Higher = Next 20% (56–62)
Similar = Middle 40% (45–55)
Lower = Next 20% (38–44)
Much Lower = Lowest 10% (37 or lower)

Figure 6: IDEA Evaluation Scores on Gaining Factual Course Knowledge and Experiential Learning

The instructor selects teaching goals and controls for extraneous variables (e.g., motivation and class size). Students rate their progress in each course compared to other courses on goals such

as gaining factual knowledge, learning to apply course material to solve problems, acquiring skills in working with others as a team, learning to analyze and critically evaluate ideas, and developing creative capacities. Figures 5, 6, and 7 provide the results received from the Web-based IDEA Survey.

Teaching Methods and Styles

	Relevant to Objectives: (see page 2)	Your Average (5-point scale)	Percent of Students Rating 4 or 5	Suggested Action
Stimulating Student Interest				
4. Demonstrated the importance and significance of the subject matter	**All selected objectives**	**5.0**	**100%**	**Strength to retain**
8. Stimulated students to intellectual effort beyond that required by most courses	**All selected objectives**	**4.7**	**100%**	**Strength to retain**
13. Introduced stimulating ideas about the subject	**All selected objectives**	**4.7**	**100%**	**Strength to retain**
15. Inspired students to set and achieve goals which really challenged them	**All selected objectives**	**5.0**	**100%**	**Strength to retain**
Fostering Student Collaboration				
5. Formed "teams" or "discussion groups" to facilitate learning	Not relevant to objectives selected	5.0	100%	
16. Asked students to share ideas and experiences with others whose backgrounds and viewpoints differ from their own	Not relevant to objectives selected	5.0	100%	
18. Asked students to help each other understand ideas or concepts	Not relevant to objectives selected	5.0	100%	
Establishing Rapport				
2. Found ways to help students answer their own questions	**All selected objectives**	**5.0**	**100%**	**Strength to retain**
1. Displayed a personal interest in students and their learning	**23**	**5.0**	**100%**	**Strength to retain**
7. Explained the reasons for criticisms of students' academic performance	Not relevant to objectives selected	4.7	100%	
20. Encouraged student–faculty interaction outside of class (office visits, phone calls, e-mails, etc.)	Not relevant to objectives selected	5.0	100%	
Encouraging Student Involvement				
11. Related course material to real life situations	**23**	**4.7**	**100%**	**Strength to retain**
9. Encouraged students to use multiple resources (e.g. data banks, library holdings, outside experts) to improve understanding	Not relevant to objectives selected	5.0	100%	
14. Involved students in "hands on" projects such as research, case studies, or "real life" activities	Not relevant to objectives selected	5.0	100%	
19. Gave projects, tests, or assignments that required original or creative thinking	Not relevant to objectives selected	5.0	100%	
Structuring Classroom Experiences				
3. Scheduled course work (class activities, tests, projects) in ways which encouraged students to stay up–to–date in their work	**All selected objectives**	**4.3**	**100%**	**Strength to retain**
6. Made it clear how each topic fit into the course	**All selected objectives**	**5.0**	**100%**	**Strength to retain**
10. Explained course material clearly and concisely	**All selected objectives**	**4.3**	**100%**	**Strength to retain**
12. Gave tests, projects, etc. that covered the most important points of the course	**21**	**5.0**	**100%**	**Strength to retain**
17. Provided timely and frequent feedback on tests, reports, projects, etc. to help students improve	Not relevant to objectives selected	4.7	100%	

5-point Scale: 1 = Hardly Ever 2 = Occasionally 3 = Sometimes 4 = Frequently 5 = Almost Always

Comments: Use the space provided in the text area below for your comments.

- This course was beyond anything I could have imagined going in. I would recommend this course to anyone. It truly opened my eyes to the world. Dr Fidan and Dr Barger were perfect instructors for this course. They challenged us to new levels, and had such great networking and information for us.

Figure 7: IDEA Evaluation Scores on Teaching Methods and Styles

Conclusions

The Entrepreneurial Engineering Management course was another collaboration between the College of Engineering and the College of Business faculty and students. In the past, various honor courses and service learning courses were jointly offered to engineering and business students. This time, the motivation was to inject the I&E concepts to course students. Although it

was offered the first time the feedback received from participants indicated that the concept was successfully delivered to students and that the overall result was a huge success. Innovation is a bi-product of creative thinking and it is a field of limitless possibilities. Creative thinking or thinking outside the box is essential for engineers and business people. Kayseri, Turkey is known for its entrepreneurship and businesses. The culture encourages innovation and entrepreneurship and nurtures them with support. Students in the class had the privilege of meeting many Kayseri entrepreneurs and dining with them, interacting and learning how they started, what inspired them, and what their goals are. The top qualities that stood out to students were passion, hard work, and a willingness to explore opportunities to expand their business. Entrepreneurship seems natural in Kayseri: it has become the cultural norm and expectation. Overall, this implementation was an inspiring faculty-led-program, and students definitely learned a lot about entrepreneurship.

Acknowledgements

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References

[1] TTU Eagle Works Innovation and Entrepreneurship Competition, https://www.tntech.edu/eagleworks, visited on March 25, 2016.

[2] Maker Space – iMakerSpace, https://www.tntech.edu/engineering/research/idli/ttu-maker-space, visited on March 25, 2016.

[3] Pathways To Innovation Program, http://epicenter.stanford.edu/page/pathways-to-innovation, visited on March 25, 2016.

[4] IDEA Assessment and Evaluation Too, http://ideaedu.org/services/student-ratings-of-instruction/, visited on March 25, 2016.