Interdisciplinary Engineering Education by Business Model

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Abstract

For a long time, requirement of capstone design as well as major education was emphasized in engineering education. Moreover, now days, requirement of education for future oriented problem-solving engineering leader is gradually increasing. For this, engineering education of not only capstone design but also integration of engineering and non-engineering factor and business model education for product and service also required. In order to satisfy this requirement, a lecture for future oriented problem-solving engineering leader was opened. In this lecture, final achievement of class was creative business model of students, for this, three dimensional engineering design education, communication skill and adaptation were decided as three essential factors. Also novel curriculum was made for these three factors and student participation induced for student-centered education. At the end of semester, business model presentation meeting was held, in this meeting students presented their own business model. Also outsiders were invited for objective evaluation of students' business model. As a result, novel method for student-centered interdisciplinary engineering education was attempted from this lecture.

Introduction

Today's corporations require engineers who have knowledge on various fields as well as their major. Much research has been done on what capabilities corporations need. Emphasis on capstone design as well as principle knowledge in engineering education has long been placed for a long time. At the same time, besides capstone design capability, the demand for future oriented problem-solving engineering leaders who can realize interdisciplinary cooperation is growing gradually. Since the demand for capstone design has long been emphasized, much education programs have been developed and carried out to produce results. Prerequisites for capstone design education are internal motivation which makes students curious and interested. To this end, student-driven creative engineering education models were required, and Abeek has been introduced to establish and certify them. At the same time, for better learning results, various majors developed many PBL (Problem Based Learning) and non-PBL (non-Problem Based Learning). And for more efficient PBL, Studio Learning is also developed.

Compared to traditional lecture-based education, current capstone design education is much improved in that it motivates students and applies major knowledge. However, it is not good enough to help students learn interdisciplinary design capability. As mentioned earlier, corporation need engineers with various capabilities. This paper introduces "Future Design in Engineering" the course developed by engineering college of Yonsei University. The course is developed to provide various engineering students for chances to apply engineering factors and learn non-engineering ones. The students of the course learn how to establish various business models as well as capstone design. They experience the overall business process by planning and developing business models on their own. With this, this paper develops the course for future oriented problem-solving engineering leaders based on interdisciplinary cooperation and checks how the actual course works.

Three Major Factors

The Future Design in Engineering course is developed based on following purposes. First, educate character and leadership for maximizing specialized knowledge. Second, provide participatory education for product planning, analysis, and business model development. Third, improve full dimensional design capability, problem adaptation and communication capabilities. Fourth, develop the creative business model to commercialize new and existing products and transfer technology. Therefore, the Future Design in Engineering course does not focus on capstone

design but business models. Figure 1 shows the scope of the business model design which is the objective in the Future Design in Engineering course. This figure is based on the pyramid structure which covers product success. As shown in the figure, current capstone design covers from idea generation, research, invention claim through patents. Therefore, the final goal is the successful patent.

On the other hand, business model design is about the design process after current capstone design. The goal of this course is to develop the unique business model which covers product development and leads to successful business with successful patents and product service.

Figure 1: Scope of the Business Model in the Future Design in Engineering Course

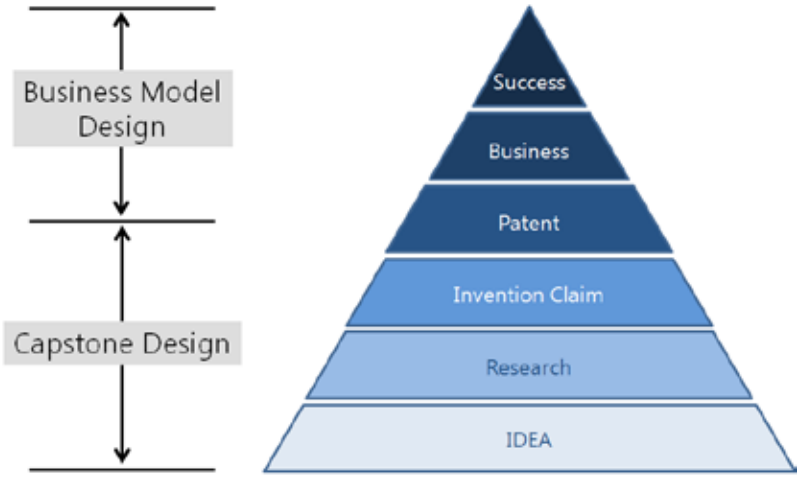
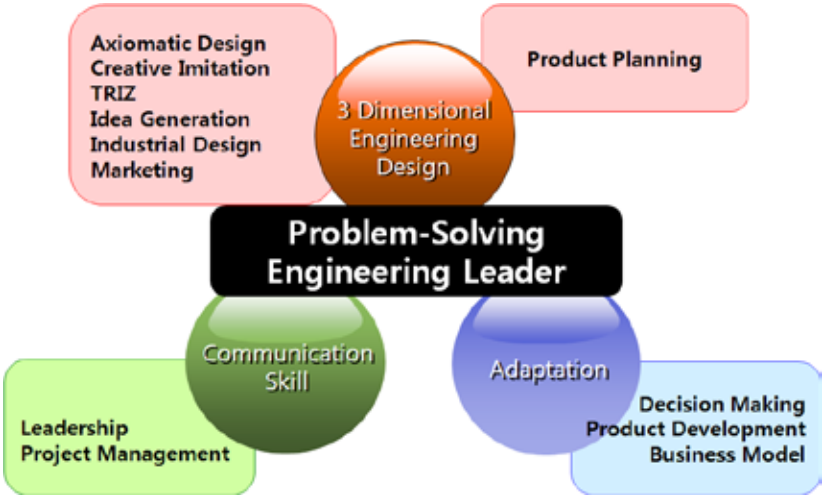


Figure 2: Three Major Factors of "Future Design in Engineering."



As mentioned earlier, this course is different from capstone design. Therefore, it is necessary to define new goals for new objects. The purpose of this course is to raise future-oriented problem-solving engineering leaders through interdisciplinary cooperation. To this end, major factors should be defined. The major factors are three dimensional engineering design, communication skill, and adaptation. The need for three dimensional engineering has been emphasized to solve engineering problems. Along with this, for interdisciplinary cooperation, communication skills are getting more important. They are also necessary to solve various problems. Figure 2 shows three major factors of "Future Design in Engineering" and their sub-factors. For the three major factors, sub-factors are decided. They are all described in the figure.

Introduction of Future Design in Engineering

Currently, in the Future Design in Engineering course at Yonsei University, a team of three professors (Professor Cha Sung Woon from Mechanical Engineering, Professor Lee Su Kyung from Computer Science, Professor Lee Hyun Joo from Chemical Engineering) gives lectures, and students carry out individual activities and group activities. The main class is given to all students and the sub-class is given to separate groups. There are three sub-classes. The three professors give a lecture to the main class where all sub-class students attend. Also, each professor runs sub-classes. Table 1 shows the structure of Future Design in Engineering. Since this course aims at interdisciplinary cooperation, it accepts engineering students from sophomores to seniors. The main class and the sub class are given two hours a week. Students learn searching of patents (WIPS), planning of project (MS Project), and promotion (Windows Movie Maker) in their own sub-class. The course lasts one semester. During that period, students make three presentations for their business model. Their presentations are given in the main class, and are assessed by professors and students to reflect their grade.

Table 1: Structure of "Future Design in Engineering"

	Main Class	Sub-Class
Course	Future Design in Engineering	
Credit	3	
Open for	Engineering Students from Sophomores to Seniors	
Size	Large Scale Class	Small Scale Class
Time	2hours/week	2hours/week
Type	Lecture, Team Presentation	Discussion, Individual Presentation
Remark	Practice WIPS and Project Management in the Sub-Class	

Curriculum of Future Design in Engineering

To achieve the purposes and objectives of Future Design in Engineering, a new curriculum is required. Adding an understanding of business models and character education to capstone design, a new curriculum is designed for the course. The curriculum consists of leadership, idea, intellectual property right, three-dimensional design, marketing, promotion and introduction of the business model. While lectures are minimized, much practical cases and student cases are presented to motivate students.

Future Design in Engineering is made up of team projects and personal projects. The team project is to develop business models by team. The personal project is to analyze products that the student bought and present ways on how to improve them. The students can choose products freely and analyze them from engineering, functional and marketing perspectives. Then, they come up with improvement plans and present them in the sub-class.

The curriculum starts from idea for business model design and analysis to completion step by step. Between steps, the students give presentations and check their completion ratio.

Table 2: Personal Project & Team Project.

	Personal project	**Team project**
Type	Personal	Team
Content	Product Analysis and Improvement	Business Model
Presentation	Personal presentation	Team presentation
Carried out in	Sub-class	Main Class

Student Products

Figure 3: Student Products (a) MADAM Homepage and (b) Fruits Peeled by Mother

(a)

(b)

For the 1st semester of 2008, 11 teams with 50 students attended the course and developed various business models. Also, they joined the Creative Exhibition hosted by Engineering College at Yonsei University in June 2008 and presented their business models. Their business models can be divided into two categories. The first one is to improve

existing products and develop the profit model with new marketing and sales strategies. The second one is about the web-based content. They improved the existing business model which were not profitable and created new content to make profits. The business models in this category are Bbangsang (shopping mall for jeans with improved PR), MADAM (online culture content), and Fruits Peeled by Mother (online fruit delivery service).

Results of Future Design in Engineering

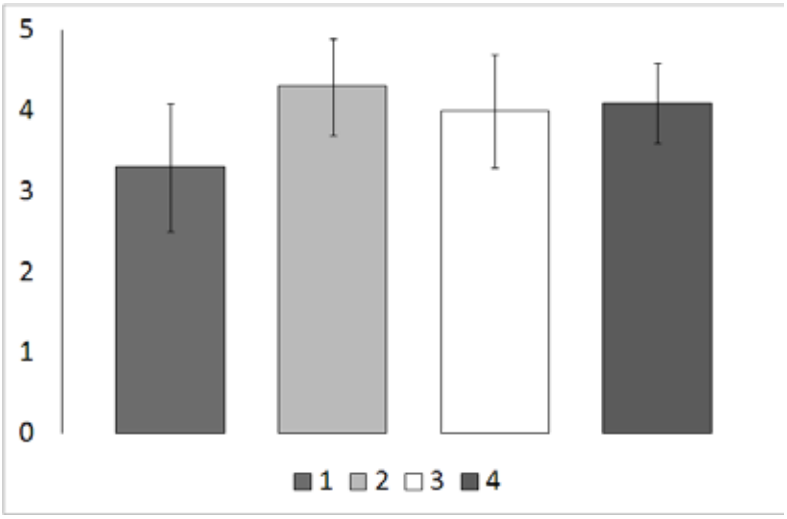
To check how well educational purposes were achieved in Future Design in Engineering, the students were polled after the course was over. Questions for the poll are as follows.

The following are educational purposes of Future Design in Engineering. How much do you think such purposes are achieved? '

1) Educate character and leadership for maximizing specialized knowledge.
2) Provide participatory education for product planning, analysis, and business model development.
3) Improve full dimensional design capability, problem adaptation and communication capabilities.
4) Develop the creative business model to commercialize new and existing products and transfer technology.

On a scale of 1 (Negative) to 5 (Positive), the students were asked to give their points. 40 students gave their responses. Figure 3 shows the results with their mean and standard deviation.

Figure 3: Poll Result



According to the result, all questions have higher than three points and their points are close to 4. Due to the nature of this course, it is hard to directly evaluate how well the course worked. However, this result shows the students who attended Future Design in Engineering saw the purposes were achieved somewhat. When the result is seen in detail, while question (2) has the highest point, 4.3, question (1) has the lowest point, 3.2. So, this shows much more efforts should be made for character and leadership education.

Conclusions

Interdisciplinary education based on business models is a program to raise future oriented problem-solving engineering leaders with various capabilities who are demanded by today's corporations. This program can be seen as an attempt to teach communication skills, problem adaptation, and planning capability which are not taught in traditional engineering education.

The Future Design in Engineering course provided at Yonsei University shows, engineering students were satisfied

with discussions and cooperation with students from other majors, which were not possible in traditional engineering education. In this course, for objective assessment, the students had the investment conference with external investors and presented their business models. This course was carried out for first and second semester in 2008. Since the course is new, there should be more efforts to design the curriculum more systematically and improve educational materials. Also, this course needs consistency with other engineering courses such as capstone design.

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