Capstone Design Project by Team Activities

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Abstract

This paper deals with the introduction of capstone design project by team activities in Department of Electronics and Communication Engineering, Korea Maritime University. This course is referred to as Creative Engineering Design for spring semester of 4th-year undergraduates. The course focuses on creative thinking and cooperative mind to students by learning engineering design skills, realizing their idea through design project and recognizing practicality of their systems. The intent of the course is to provide a true "capstone" experience, where students can combine their skills to achieve the successful completion of a project. This paper describes class process and evaluation method, and cooperative works with mentees and industrial mentors connected through Hanium network for IT mentoring activities.

Keywords: Engineering education, Capstone design project, Creative engineering design, Team activity, Evaluation, IT industrial mentoring

Ⅰ. Introduction

In the 21 century, engineering education is focused on design education based on engineering creativity (Lee, 2008; Choi, 2008; Jung, 2008). After completing basic engineering designs and major subjects during three years, creative engineering design based on total design for spring semester of 4th-year students is to improve student's active and creative ability. It is also intended to enhance a role of team member and ability for solving engineering problems by team working. The subject requires a lot of endeavors and abilities compared to general subjects. Especially, the intent of the subject based on outcome based education is to be completed student's mini-projects by integrating their knowledge and skills after having three years course. In the course, student groups have to design and build electronics projects representative of those commonly encountered in real life environment. Application of practical/theoretical experience and knowledge from prior courses is required. Typically, a class is divided into groups of approximately four or five students by themselves and the teams choose their ideas through brainstorming. And then they have to appoint industrial mentors connected through Hanium network for gaining advices to implement their ideas. The role of faculty staff is to monitor the team activities, guide the students and promote project outcomes of each team. In this paper, the contents provide course procedure and an explanation of the techniques used to evaluate student work in Department of Electronics and Communication Engineering, Korea Maritime University.

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Ⅱ. Course Procedure

A project will typically be directed to solve a specific problem and is expected to involve:

- problem identification and description;
- analysis of existing methods;
- description of possible approaches to solving the problem;
- evaluation of different approaches;
- selection of the approach, specification of goals, and determination of milestones;
- implementation of this plan with adaptations as required;
- documenting the evolution of the project;
- design and construction of system, including soft-

ware tool; and
- testing, demonstrating, and presenting.

For the class, students were assigned to groups of approximately four or five students per group. In order to promote effective teamwork, several team building and communication exercises are incorporated into the initial phases of the course. Since there were forty students in the class, we made five groups of four students and four groups of five students for a total of nine groups. These are usually permanent groups whose membership remains constant throughout the semester.

Many engineering schools have recognized the need to provide training for students in systems design and in the application of design knowledge acquired through training in solving problems(Thomos, 2009). Many efforts are being made by schools to provide the required training to students with advisory mentors in or out of school. Partnerships between schools and industry have greatly improved the likelihood that students will get the necessary training required to sharpen their skills as they acquire the needed knowledge and aptitude desirable of an engineer. Thus, in our course, a faculty member and an industrial mentor are joined in a team. The industrial mentors are assigned among the members of a pool of Hanium site(Hanium, 2009) with considering their backgrounds and discussion with faculty advisor and team member. The instructional faculty in charge of the class has responsible for course management as shown in <Table 1> and has the opportunity to review and comment on the deliverables and grading criteria and finally give some rating after collecting all evaluations. The course consists of three presentations, final presentation and exhibition. Each team has to submit a project proposal, plan to use within limited construction expense (300,000 Won) and project timetable. At first presentation, the team leader presents the role of team member, communication with mentor, the survey plan and the conceptual design plan. At second presentation, the other member of each team presents project progress and critical issues from work activities. At this time, each team has to show a moving picture including the overall team work. And the third presentation is presented about additional construction expense and justification of the reason and review of final timetable. Finally the final project results and the moving pictures are presented and then each team demonstrated a prototype of their project in a poster gallery room to all students and all members of the faculty.

<Table 1> Course Outline.

Introductions and Team Formation	Week 1
Team Building Exercises	Week 1&2
Basic Project Concept, Mentor appointment	Week 3
Project Proposal, Preliminary Cost and Time Schedule	Week 4-5
1st Presentation for Role of Member, Mentor Activity and Initial Design	Week 6
2nd Presentation for Layout/Design and Constructibility Reviews	Week 7-8
Building Interior and Exterior Design	Week 9-11
3rd Presentation for Revised Costand Time Estimates	Week 12
Overall Design Completion and Performance Test	Week 13-14
Final Presentation and Exhibition	Week 15

Ⅲ. Course Evaluation

The evaluation items of each team are shown in <Table 2>. The items consist of midterm and final oral presentations, two moving pictures, exhibition result, final written report, utilization of Hanium boards, and mentor evaluation. In the case of oral presentations, the students have to present the results of their projects with 5-minute oral presentations [Fig. 1] and 3-minute moving pictures [Fig. 2]. In order to show the performance of their prototype, each team has to demonstrate a prototype of their project with technical explanation for professors and mentors to visit and understand about what they have worked on for 14 weeks [Fig. 3]. Hanium site provides advisory boards to students and mentors for encouraging mentors easily to exchange students in project design. So for the group grade of the course the number of use in the advisory boards of each team is counted. To evaluate individual members of each team, we adopted a mentor evaluation as shown in [Fig. 4]. That reflects level of participation, effort and sense of responsibility rather than academic ability as a team member. As for team evaluation, there is one big problem with the team grade. If the team

<Table 2> Grading Criteria and Basic Deliverables.

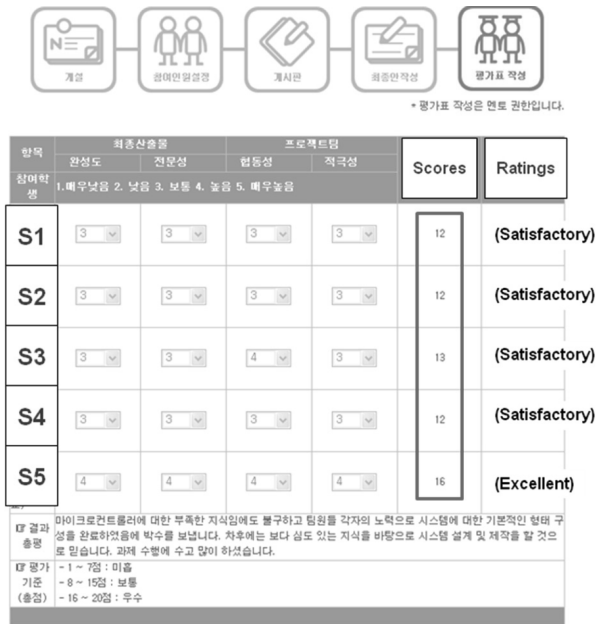
Mid-Term Presentation: Project Creativity, Engineering Skill	15%
Final Presentation: Project Completion	25%
Exhibition: Product Performance	25%
Moving Picture: Role of Member, Design Procedure, Explanation	10%
Final Report: Experimental Results, Discussion	10%
Utilization of Hanium Boards: Mentor Exchange	5%
Mentor Evaluation: Personal Contributions, Level of Work	10%
Total	100%
Peer Evaluations	Reference

[Fig. 1] Midterm and final presentations for project evaluation.

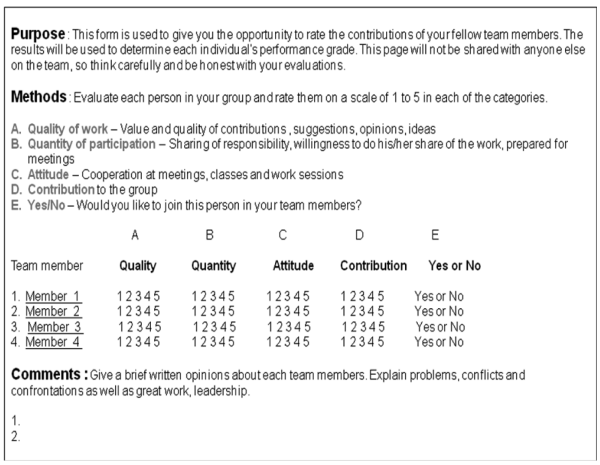
[Fig. 2] Moving pictures for Midterm and final presentations.

[Fig. 3] Exhibition to explain the performance of their prototype after final presentation.

members do not contribute equally to the team's effort, the other students feel that it is not fair for their grading(Sadowski, 2002). In order to compensate for the problem, although peer evaluation by team members is conducted in each team with ratings form of



[Fig. 4] Mentor evaluation for individual members through Hanium site.



Purpose: This form is used to give you the opportunity to rate the contributions of your fellow team members. The results will be used to determine each individual's performance grade. This page will not be shared with anyone else on the team, so think carefully and be honest with your evaluations.

Methods: Evaluate each person in your group and rate them on a scale of 1 to 5 in each of the categories.

A. **Quality of work** – Value and quality of contributions, suggestions, opinions, ideas
B. **Quantity of participation** – Sharing of responsibility, willingness to do his/her share of the work, prepared for meetings
C. **Attitude** – Cooperation at meetings, classes and work sessions
D. **Contribution** to the group
E. **Yes/No** – Would you like to join this person in your team members?

	A	B	C	D	E
Team member	**Quality**	**Quantity**	**Attitude**	**Contribution**	**Yes or No**
1. Member 1	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	Yes or No
2. Member 2	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	Yes or No
3. Member 3	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	Yes or No
4. Member 4	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	Yes or No

Comments : Give a brief written opinions about each team members. Explain problems, conflicts and confrontations as well as great work, leadership.

1.
2.

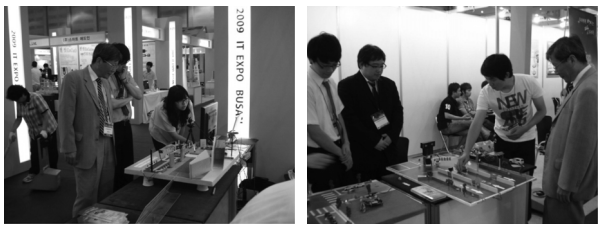
[Fig. 5] ratings form for peer evaluation.

peer evaluation as shown in [Fig. 5], that is just used as a reference. Maybe the peer evaluation will be used at next semester after much discussion. The faculty advisor participates in the grading of each team at midterm and final presentations and exhibition except their advisory team.

Ⅳ. Team Activities

This course is a practical approach to help students gain experience in teamwork, communication, project

[Fig. 6] Capstone design contest in Innovation center for engineering education in KMU.



[Fig. 7] 2009 IT EXPO Busan exhibition.

management and technical skills that will help them in their career paths. Especially the participation in project competition will encourage students to apply their knowledge to practical design use, and to promote team work(Jang, 2008). After completing the final evaluation, several excellent teams are selected and recommended to attend the in- or out-school contests and exhibitions. As students participate in a contest and the outcomes of their projects carried out during one semester are evaluated, students' motivations and accomplishments for project activities are enhanced. [Fig. 6] shows capstone design contest in Innovation center for engineering education in Korea Maritime University. This contest has regularly been held to drive students to work harder and to set higher standards for themselves. [Fig. 7] shows 2009 IT EXPO Busan exhibition in which the selected team projects were displayed. It helped for students to be able to lift up their motivation and responsibility in project activities. We have supported that students could continuously participate in in- or out-school contests and exhibitions because the work environment and experiences of students were very similar to what they would eventually encounter after graduation.

V. Conclusion

The creative engineering design in my department is intended to enhance the fulfillment of student project and develop their engineering skills and abilities as our students decide autonomous team configuration based on teamwork, material survey, information collection, target establishment, complementation procedure. They can get a help to accomplish their project from faculty advisor and industrial mentor. During the project procedure, students can realize that cooperation with team member is necessary for getting the best outcome and are aware of necessity for active participation. Thus students can learn how to cooperate and what the role of team members through the course. As for team evaluation, if the team members do not contribute equally to the team's effort, the other students feel that it is not fair for their grading. To prevent the unfair evaluation, personal evaluations from faculty advisor and industrial mentor are included in the total evaluation. Moreover peer evaluation will be considered as an evaluation tool in next semester for precise individual evaluation.

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