An International Freshman Exchange Program: A Trial for Engineering Design Education

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ABSTRACT
The Engineering school of Tohoku University has been offering a Team-based Engineering Design Course to its first year students since 1996 in order to increase the level of both motivation and interest in engineering. Freshmen are required to select one of approximately 150 topics and do some research on this topic. This course also provides opportunities for students to participate in exchange programs with the University of Washington (UW) and the University of Science and Technology Beijing (USTB). In the Tohoku-UW exchange program, which began in 1999, between 10 and 25 students of Tohoku visit the UW annually to present the results of the subjects the school has appointed in advance in the Team-based Engineering Design Course. In the Tohoku-USTB exchange program, which began in 2007, about 15 students from each university participate in a one day meeting organized by the students themselves. They give a presentation on either the results of the subject they selected in the course, or on an engineering related topic both groups have agreed to in advance. In this paper, a detailed history, the objectives, a schedule and the budget in these unique exchange programs is introduced together with an outline of the course and its contribution to the engineering design education.

Keywords: Engineering education, Freshman education, Presentation skill, International exchange

I. Introduction
The Japan Accreditation Board for Engineering Education (JABEE), which was established in 1999 and became a signatory member of the Washington Accord in 2005, works in close cooperation with engineering associations and societies when accrediting programs in engineering education. Up till now, 409 engineering programs in total from 158 educational institutions have been accredited. In the accreditation process, JABEE evaluates whether the programs in engineering education conducted by institutions of higher education reach the levels expected by society and accredits only those programs that meet the required standards. The details of the accreditation criteria and process are described elsewhere [1] but, briefly, the most important factors for well-designed education program are 1) the quality of the educational curriculum based on the learning and educational objectives set by the institutions themselves, 2) the PDCA (Plan, Do, Check and Act) cycle considered vital for quality education and for continuous achievements and improvement, and 3) engineering design education. Among them, engineering design is regarded as perhaps the most important pillar of engineering education [2]. In the Washington Accord Signatories [3], also, this component is considered one of the most important criteria when accrediting the program.

Engineering design is not about simple picture drawing but involves a team of engineers to be able to integrate their knowhow in a variety of areas and perform as a team to satisfy their customer’s demands [4]. The graduation research project required of seniors in Japanese universities is widely recognized as a highly effective engineering design education program. The same principals are applied in the engineering design education program for freshmen in our university. Actually, Tohoku University’s Team-based Engineering Design Course was planned in the context of a broad international interest in providing unique and effective freshmen education for engineers.
II. The Team-based Engineering Design Course in Tohoku University

1. Outline

The educational mission of the School of Engineering, Tohoku University, is to nurture creative professionals capable of thinking and acting independently with a broad perspective, a strong sense of humanity and awareness of nature so that they are capable of advancing the development and innovation of science and technology in the twenty-first century based on Tohoku University's traditional philosophy, "Research First". The School of Engineering actively pursues the fundamental goal of engineering: contribute to the welfare of humankind. It does this through competitive cooperation in research involving the application of science and technology on the foundation of basic science, which in effect improves life for all mankind and enriches people’s lives. As the first step of such engineering education policy, the school has been offering a Team-based Engineering Design Course to its first year students since 1996 [5]. The primary objective of this course is to motivate the participants and arouse a strong interest in engineering in them during the early stage of engineering education.

2. Research subjects

In 2010, 153 subjects were offered from the entire engineering school, which in Tohoku University is composed of five departments. From 1996 to 2010, 8473 students (796 for 2010) took this two credit course. Students are free to select from the whole range of topics on the list and carry out research, and are in no way confined by the department the students are actually enrolled in. This makes it possible for students from different departments to work together. Table 1 lists some examples of interesting subjects. MD-12 is a subject provided from the department of Materials Science and Engineering. Students who select this subject first learn both the fundamental properties of magnetic materials and the principles of various magnetic devices. Then they work together to design and develop a new magnetic game utilizing magnetic phenomena. M-10 is a subject provided from the department of Mechanical Engineering. Students are required to design and fabricate bridge models using paper and bonding agents only. The design procedures involve some simulations using software for improving the strength of the bridges. Finally, the final products of the various groups are evaluated in a competition based on their strength.

In principle, no concrete solutions are provided for any of the subjects and the students work hard to find their own unique solutions to the task they have chosen. Their results are presented at the end of the second semester. Expectations with regard to these results is not high: the emphasis is entirely on the process required to complete the task they choose.

III. International Freshmen Exchange Program

1. History

The Team-based Engineering Design Course in Tohoku University provides opportunities for students to participate in exchange programs with the University of Washington.