PROGRAM DESIGN ON GLOBAL PROJECT BASED LEARNING FOR MULTICULTURAL AND MULTIDISCIPLINARY ENGINEERING STUDENTS IN COLLABORATION WITH LOCAL COMMUNITIES

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ABSTRACT

College of Systems Engineering and Science and Graduate School of Engineering and Science, Shibaura Institute of Technology (SIT) have been providing educational programs in the systems engineering design with multidisciplinary and Project Based Learning (PBL) courses. The authors also implemented outbound global PBL programs in collaboration with industries and local communities. Based on those achievements, we developed an inbound short-term global PBL program in Japan to educate engineering students in multidisciplinary and multicultural environments with support from local industries and communities. Thirty under/postgraduates from six universities in Southeast Asia, three from a Japanese partner university, 30 students from SIT participated the PBL program. Some PBL project themes were proposed by local governments and a company. The participants explored social issues in Japan by conducting field work in Saitama City and an Aizu district in Fukushima prefecture. In this paper, we describe the educational design of the inbound global PBL program and assessment methods for its educational effects.

1. INTRODUCTION

Engineers today have to work with members having various disciplines, different background, cultures and languages under their assignment in global environment. Graduate Attributes and Professional Competencies presented by International Engineering Alliance (IEA) explains “Role in and diversity of team” as one of the profiles, to function effectively “as a member or leader in diverse teams and in multi-disciplinary settings” (IEA, pp. 11, 2013). Education for engineering students also more likely need to enhance their accomplishment and competency for communication, working in groups with diversity.

As another trend seen in recent years, engineering education is to be required to provide students with awareness and understanding of social issues as well as solid technical knowledge and skills. The declaration at the 5th World Engineering Conference and Convention (WECC2015) notes that engineers must “not only work for the advancement of specialist knowledge in the areas of science, technology, and engineering, but they must also take into account societal concerns” (Kyoto Declaration, pp. 2, 2015).

To respond to those social requests, there have been various approaches of PBL programs in Europe, North America and Asia (Segalàs, et al., 2011, Budny and Gradoville, 2011, Servant, 2013). Some of them were also designed to incorporate community service learning or social working (Coyle, et al., 2005, Gilbert, 2014).

Meanwhile, as to engineering education in Japan, there is still little advanced practice of PBL programs with both of diversity and social aspects.

2. DEVELOPMENT OF PBL PROGRAMS AT SIT

College of Systems Engineering and Science at SIT has delivered educational programs in systems engineering design based on multidisciplinary and Project Based Learning (PBL) course for more than 20 years (Inoue and Hasegawa, 2008, Inoue, 2011). In our curriculum in undergraduate education, exercises and lectures are executed alternately and evolutionally in three steps for students from five different departments. They learn theories, methods and techniques for systems engineering and project management from the lectures while working on the exercises applying those knowledge in multidisciplinary settings.

We also developed two types of PBL programs for the postgraduate course. One is short term global PBL program started in collaboration with King Mongkut’s

University of Technology Tonburi, Thailand in 2013 (Hasegawa, et al., 2014). Another approach is on-campus PBL program applied by collaboration with industries and local communities as a regular subject during the semester (Furukawa, et al., 2014). Those programs are designed to enhance students' cross-cultural communication and teamwork skills for solving practical social issues.

Previous works on those programs have shown their educational effects with assessment tools such as learning portfolio, rubric, Progress Report on Generic Skills (PROG) test, and Technical Communication Can-Do List extended from CEFR (Inoue, et al., 2014a, 2014b, 2015).

Based on those achievements, we developed an inbound global PBL program held in SIT Omiya campus which trained engineering students under the multidisciplinary, multicultural environment in collaboration with local communities and a company.

3. DESIGN OF GLOBAL PBL PROGRAM AT SIT

We implemented a short term PBL program at SIT Omiya Campus in December 2015 as shown in table 1, which had both of diversity and social aspects.

Table 1 Program schedule of global PBL at SIT

Day 1	Thu. Dec. 10	13:00-14:00	Orientation Provide Student ID Card and Scholarship to overseas students
		14:00-15:00	Icebreaking activity by TA
		15:00-16:00	Welcome Tea Party
		16:00-17:00	Presentation for Project Themes, Grouping
		17:00-18:00	Group activities
Day 2	Fri. Dec. 11	AM	Group activities: Confirmation of the theme, and Requirement analysis
		PM	Group activities: Goal setting Assessment planning, Budget planning and Schedule planning for activities
		16:00-16:30	Introduction of SIT exchange program for overseas students and faculty members
		16:30-18:30	Panel Discussion by faculty members of SIT and partner universities
Day 3	Sat. Dec. 12	AM/PM	Group activities: Field Work for DR and Preparation of design review (DR) materials
Day 4	Sun. Dec. 13	6:30	Pick up students staying at dorm
		7:00	Trip to Aizu highland by chartered bus
		12:00-13:00	Showa Village: Lunch made by grandmothers in the village
		13:00-17:00	Showa Village: Group interview and research at the each district
		19:30-20:00	Dinner
		21:00-22:00	Cultural Exchange
Day 5	Mon. Dec. 14	9:00	Departure
		12:00	Lunch
		13:00-16:00	Mitsubishi Fuso: Laboratry Visit
		18:00-19:00	Design review (DR)
Day 6	Tue. Dec. 15	AM/PM	Group Activities (Research/Survey/Production) in accordance with the planned schedule
Day 7	Tue. Dec. 16	AM/PM	Group Activities (Research/Survey/Production) in accordance with the planned schedule
Day 8	Thu. Dec. 17	AM	Group activities: Preparation for final presentation
		15:00-18:00	Final presentation
		18:00-19:00	Farewell Party
Day 9	Fri. Dec. 18	10:40-12:10	PROG test, CEFR-based Can-do List
		12:10-13:00	Closing Ceremony
		PM	Preparation for departure

3.1 Multicultural and multidisciplinary grouping

We invited 30 undergraduates/graduates from six universities in five countries in Southeast Asia as below, while three from Tokyo Denki University and 30 students from SIT including exchange students from Vietnam, Malaysia, Ethiopia applied for the program.

- Institute of Technology of Cambodia
- Institut Teknologi Sepuluh Nopember, Indonesia
- National University of Singapore
- King Mongkut's University of Technology, Tonburi
- Suranaree University of Technology, Thailand
- Hanoi University of Science and Technology, Vietnam

We also invited faculty members from each university for further collaboration, and held a panel discussion on global engineering education. It created an opportunity to extend our overseas network and enhance multilateral cooperative relationships among partner universities.

As same as SIT's systems engineering education for undergraduates, we did not confine the participants to specific field of discipline for this program, but brought together them with various areas of expertise in engineering and science. Participants also had different backgrounds and ages from 2nd year of Bachelor to Master course students with experience in actual business.

In this program, 10 project teams were formed with six to seven students. Based on the results from questionnaire of self-evaluation on the first day of program, those teams were composed of multicultural, multidisciplinary and age mixed. Communication with other members would be based on English, body language, drawings, or any other tools they found. SIT students were expected to take initiative to apply their knowledge and skills on systems engineering methods to project management in each team.

Additionally, five of students from Japan, Thailand and Indonesia who had participated in the global PBL course in the past were assigned as teaching assistants to support students' activities and coordination for the program operation.

3.2 Collaboration with local government and company

One of the knowledge profiles provided by IEA is explained as "Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the professional responsibility of an engineer to public safety; the impacts of engineering activity: economic, social, cultural, environmental and sustainability" (IEA, pp.9, 2013).

From such perspective, each team were required to develop a project theme through breaking down keywords suggested by faculty members, such as ecology, energy, eco-tourism, mobility, welfare and medical systems, and disaster prevention. Additional themes were also proposed by Saitama City Hall and a private company regarding Tokyo Olympic/Paralympic game, urban design at Urawa-Misono district in Saitama City, financial services for both of Japanese and international students.

Fig. 1 Site visit on Waste Water Treatment Facilities

Some of the teams visited places such as a sports stadium which would be a venue for Olympic game, urban

development project site, and wastewater treatment facilities in Saitama City (See fig. 1). Others made surveys by questionnaires, stakeholder interviews, and collected information and statistics data.

The WECC2015 also declared that engineers were required to "contribute to the development of a better life for the people living in a globally aging society expected to occur in the near future" (Kyoto Declaration, pp. 2-3, 2015). Aging and depopulation in rural areas have been serious issues in Japan. There is a concern for difficulty in maintaining local communities and own traditional cultures. Students were required to be realized those social issues existing or upcoming in their countries in the near future. Furthermore, they were expected to understand the necessity of diversity in each area, and became aware of their roles for regional/rural sustainable development.

From such point of view, in parallel to the work on each project, students had a field research in Showa Village in Fukushima Prefecture, one of the typical places facing those problems. Its population over 65 years old marked 55.4% in 2014, which was the 5th highest ratio in Japan (Fukushima Prefectural Government, 2015). After the briefing of basic information of aging population in Japan and Southeast Asia, each group was given three missions in their field research as (1) Group interview with a key person in the village, (2) Walk around and take memos, photos and movies of anything they get interested, surprised or attractive, (3) Find the way to go back to the place of meeting within the time limit.

Participants also had an opportunity to visit a R&D center of automobile company to learn advanced technology in Japan, however, it wasn't announced to students until Day3. They were forced to reschedule their activity plan and work in the night on their trip to prepare for Design Review (DR). Such kinds of accidental schedule changes and unexpected missions often occur at actual projects. We provide those "surprise experience" in our global PBL programs to design them for enhancing students' ability to adapt to changing conditions, and reinforcement of communication skills and relationship among team members.

3.3 Presentations of projects

In the program duration of nine days, students had several presentations. Faculty members made comments and suggestions from their respective points of view as a role of investor for the project. Each team was required to explain its theme and activity plan on Day 3. They also had DR and submission of budget plan on Day 5. Their final proposals were reported to more than 100 audiences including students, academic/non-academic staff of SIT and other universities, officials from local governments, representatives of the companies, and other individuals interested in our global PBL program at the final presentation on Day 8.

The final presentations should be include (1) background and objective, (2) requirement analysis for present status and needs, objective, requirements, strategy, goal and criteria plan for evaluation, (3) implementation such as summary and scope, implementation plan, (4) evaluation including its method and result, (5) Conclusion (See fig. 2).

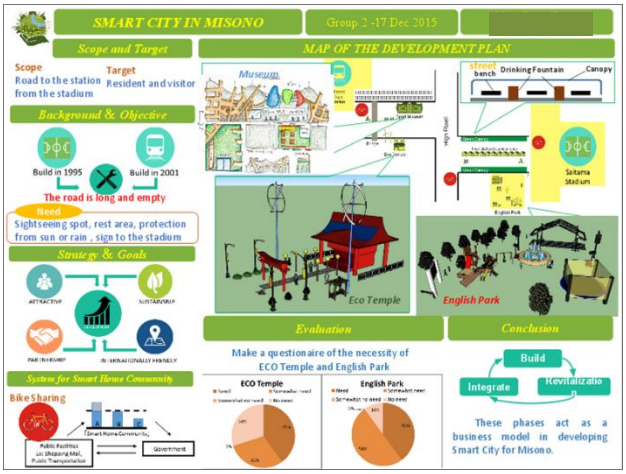

Fig. 2 One of the materials for the final presentation

3.4 Assessment of the program

For the results of performance as a team, evaluation were delivered by faculty members, participants of other teams and audiences at both of DR and the final presentation. The assessment standards included (1) creativity, (2) usefulness, (3) completion, (4) feasibility, (5) achievement to the goal on each project. Meanwhile, the educational effects for individual students were evaluated by Outcomes Assessment based on rubric, Progress Report on Generic Skills (PROG) test and Technical Communication Can-Do List extended from CEFR at the end of the program. Regarding the assessment of field research in Showa Village, we introduced a self-assessment questionnaire to evaluate students' achievement levels on their communication skills, self-control skills and problem-solving skills.

Based on the results from those different types of assessment tools, it became possible to analyze quantitatively from various dimensions for the educational effects on our global PBL program.

CONCLUSION

We developed a Project Based Learning program on multicultural, multidisciplinary and collaboration with local governments and industry. It is recognized to be consistent with direction of global engineering education. This program was brought by accumulated experiences in educational programs in systems engineering and PBL programs at SIT. We proceed analyzing and verifying the assessment on this program for further improvement.

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