ON-SITE AND ONLINE COMBINATION FOR STUDENT EXCHANGE PROGRAM

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ABSTRACT

Yeungnam University (YU), South Korea, and Rajamangala University of Technology Thanyaburi (RMUTT), Thailand, have collaborated internationally for a short-term exchange program for students under the project titled Global Capstone Design Project (GCDP) since 2018. Its objectives are to provide students with an actual product design-build-test hands-on experience, to enhance design capability for an Internet-of-Things (IoT) device, to interact with students and faculty from different universities and countries, to develop a global mind-set and effective communication skill, and to improve a global competence through international teamwork. The program consists of 3 phases: (1) a 3-day on-site program 1 for project scoping and planning held at RMUTT, (2) a 6-month online collaboration with coaching supports from both institutions and (3) a 5-day on-site program 2 for project finalizing and presentation held at YU. Ten teams of Thai and Korean students are formed and worked together for 8 months on implementing Design Thinking and creating an IoT product. The team's projects are assessed and awarded at the end of the exchange program. GCDP in 2018-2019 year has finished successfully as planned. However, for 2019-2020, the last phase of the GCDP, which was planned to be held on-site at YU, was changed due to the forbidding of travel to Korea. The activities were re-designed to provide opportunities for the student to finalize and present their projects using an online meeting platform. At the end of program 1 and program 2, student feedback surveys were conducted using an online questionnaire. The results show that the students experienced product design, production, and testing based on their disciplines. They have strengthened their capabilities through the actual product design using design thinking. In addition to improving personal and interpersonal skills when solving engineering problems, they have developed international sense, effective communication skills, and international teamwork skills.

KEYWORDS

international collaboration, design thinking, design-build-test experience, Standards: 5, 8

INTRODUCTION

Internationalization and mobility requires commitments from the institution and study programs to expose students to foreign cultures, promote curriculum transportability, enable qualification portability, encourage joint awards, and support transparent recognition (Campbell and Beck, 2010). CDIO optional standards have been approved by the CDIO council since 2020, pushing the participating institutions to expand their CDIO implementation in wider dimensions regarding the evolving of the engineering education context (Malmqvist et al., 2017, 2020). The description of the internationalization and mobility optional standard is shown below:

> *"*The institution demonstrates a tangible organizational commitment to internationalization and student mobility. It enunciates the exposure, promotion, facilitation, opportunity and scholarship of an internationalized curriculum, qualifications and international mobility of students. Curricula which prepares engineers for a global environment and exposes them to a rich set of international experiences and contexts during their studies. Student learning outcomes include attributes and competencies which are recognized through international accords. Authentic cultural awareness learning experiences are embedded within the curriculum or social activities. Opportunities are made available for students to learn second and third languages. Studying abroad and other international experiences (including internships, exchanges) are encouraged and recognized for credit. Institutional cross-credit for study abroad is transparent. The institution establishes partnerships with international universities, benchmarks programs internationally and is actively involved in international engineering education scholarly activities."

Even prior to the release of CDIO optional standards, there have been a number of international collaborations among CDIO institutional members. Exchange activities are in wide range; for example, student and staff exchange, workshops, camps, internship, co-operative education, credit-transfer program, double-degree program, joint-degree program, and joint research. When preparing the institution to pursue internationalization, Salti et al. (2019) advised 3 phases of pre-institutionalization, institutionalization, and post-institutionalization. The pre-institutionalization requires the understanding of policies, the involvement of stakeholders and funding identification. The institutionalization phase needs an internationalization structure with details of activities and mechanism for the implementation. The post- institutionalization phase involves knowledge sharing lessons of good practices, scales up and sustains the positive outcomes.

A number of literatures shared successful international collaboration activities, contributing the benefits and challenges as learning lessons for others. Säisä et al. (2020) described the international cooperation model between two project offices; "theFIRMA" at Turku University of Applied Sciences (TUAS), Finland and AGILE@SoC at Singapore Polytechnic, Singapore as learning environments that encourage hands-on learning activities with industry paid projects. Hokkaido Information University, Japan and Rajamangala University of Technology Thanyaburi (RMUTT), Thailand have evolved their international collaboration with more exchange programs in ICT-based international workshops. A successful outcome of web design contest resulted in involving more students, faculty members and staff and expanding to short film contest and computer programming contest within 10 years (Anada et al., 2018). Not only does the student develop personal skills; critical thinking, creative thinking, problem solving, but they also progress in interpersonal skills in team working, communication and communication in English language (Rian et al., 2019). With the Erasmus Lifelong Learning Program, European universities organized numerous international intensive projects across

the region. The students collaborated in multi-disciplinary teams with project-based learning experience to solve engineering problems in a CDIO context. The projects provided chances to deepen and strengthen partnership between universities, enhancing opportunities for future collaboration in curriculum and course design within the international context (Piironen and Karhu, 2017).

This paper aims to share how Yeungnam University (YU), South Korea and Rajamangala University of Technology Thanyaburi (RMUTT), Thailand:

(1) Co-create a student exchange program "Global Capstone Design Project".
(2) Provide both onsite and on-line experiences to participating students.
(3) Evaluate the program for future improvement.

INTERNATIONAL COLLABORATION

RMUTT, Thailand and YU, South Korea started their international collaboration in 2015 after representatives from both universities met in the 2014 CDIO Asian Regional Meeting in Kanazawa, Japan. From 2015-2018 academic years, YU invited RMUTT students to participate in the International Capstone Design Project (ICDP) Camp hosted by Hub Center of Engineering Education (HCEE). Each year, around 60 students from South Korea, Japan, Singapore and Thailand were involved in a one-week intensive camp. The theme of ICDP was to design, build and test autonomous electric vehicles, with the main objectives to (1) promote teamwork among international students, (2) improve communications skills among international students, (3) enhance problem solving capabilities on complex real engineering problems, and (4) enhance multidisciplinary design, design thinking and making capabilities. Figure 1 demonstrates ICDP activities in the past from 2015-2018.

Figure 1. ICDP activities from 2015-2018

At the end of 2018 ICDP, RMUTT and YU have initiated a new model for international collaboration with a new pursuit: for two-way student and staff mobility compared to 1-way mobility of ICDP. This two-way mobility program consists of 3 phases as shown in Figure 2:

(1) A 3-day on-site program 1 for project scoping and planning held at RMUTT.
(2) A 6-month online collaboration with coaching supports from both institutions.
(3) A 5-day on-site program 2 for project finalizing and presentation held at YU.

The C-D-I-O (Conceive-Design-Implement-Operate) concept was applied when the organizer planned the activities, so that the students could experience the emerging context of the engineering profession nowadays.

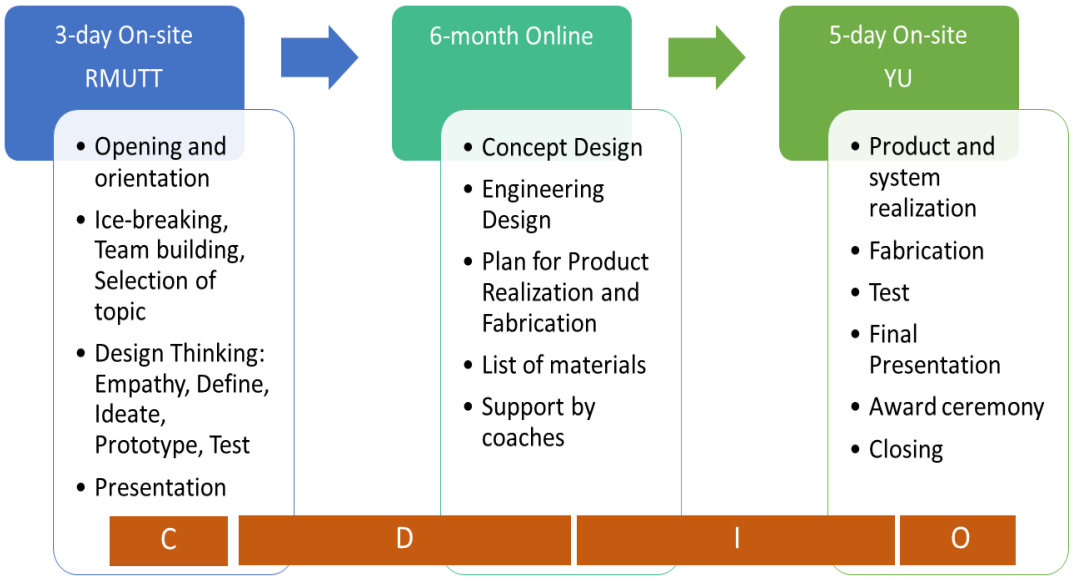

Figure 2. GCDP Student Exchange Program

The new model is called a Global Capstone Design Project (GCDP). With an emerging technology, GCDP focuses on the implementation of Internet-of-Things (IoT) along with Design Thinking and Engineering Design techniques. The objectives of GCDP consist of

(1) Providing students with an actual product design-build-test hands-on experience.
(2) Enhancing design capability for an Internet-of-Things (IoT) device.
(3) Interacting with students and faculty from different universities and countries.
(4) Developing a global mind-set and effective communication skills.
(5) Improving a global competence through international teamwork.

Phase 1: On-site RMUTT Design Thinking and Project Scope

Phase 1 is scheduled in January right after the New Year holiday, where Korean students will transfer to Thailand to meet their Thai team members. There are a total of 10 teams of 7-8 students with equal numbers of Korean and Thai students. The students are from different disciplines; engineering, design, computer science, information technology, and technical education. The engineering students come from different majors; automotive, aeronautic, computer, design convergence, electronic and electrical, food, industrial, mechanical, network, robotic. HCEE is responsible for arranging multi-disciplinary groups. The key objective of phase 1 is to guide the student through the Design Thinking process; namely, Empathy, Define, Ideate, Prototype and Test.

A 3-day intensive workshop encourages the students to work intensively from 9 am to 6 pm to generate the project ideas. The detailed program is shown below:
Day 1:

- Opening ceremony and orientation of the program by the local host to welcome everyone, explain the history of collaboration and the program in general.
- Ice-breaking and team building activities led by the local host.
- Lecture by HCEE professor on Design Thinking.
- Group work facilitated by coaches: The students can discuss and agree on a topic they are interested in working on.

Day 2

- Group work facilitated by coaches: The students interview potential users of their projects. The information is then used to define a user need statement. The teams ideate several ideas, summarize an initial concept and make prototypes.

Day 3

- Group work facilitated by coaches: The students prepare their presentation.
- Presentation: The students present their prototype along with the test results with their potential users. After each presentation, there is a 5-minute question and answer available for feedback and clarification of the project.
- Lecture on Project Management by RMUTT professor to guide the students for the upcoming online collaboration and progress reports with team coaches before meeting again at Phase 3.

Phase 2: Online (Remote Collaboration)

Phase 2 is scheduled from January to June with 2 milestone checkpoints to assure continuous collaboration remotely. Faculty members from both institutions are assigned to be coaches for each team. The first check-point is in March, followed by the second check-point in May. The students work remotely to finalize the concept after receiving feedback from users, generate engineering design, plan for a real fabrication at Phase 3, list all materials needed and submit the list to HCEE. At each check-point, the students and coaches arrange an online synchronous meeting. The students present their team progress and receive feedback from coaches.

Phase 3: On-site YU Project Finalization and Presentation

Phase 3 is scheduled in July, now Thai students' turn to visit South Korea. A 5-day intensive workshop focuses on product realization through fabrication hardware, complete software, check on hardware-software integration and testing. The final presentation is the key event, where the groups show how their product works in a real life setting. To celebrate these great achievements of the students, different categorical awards are given to all teams, along with certificates of participation at the closing ceremony. Figure 3 shows the whole journey of the GCDP model. Figure 4 displays photos of phase 1 and phase 3 events.

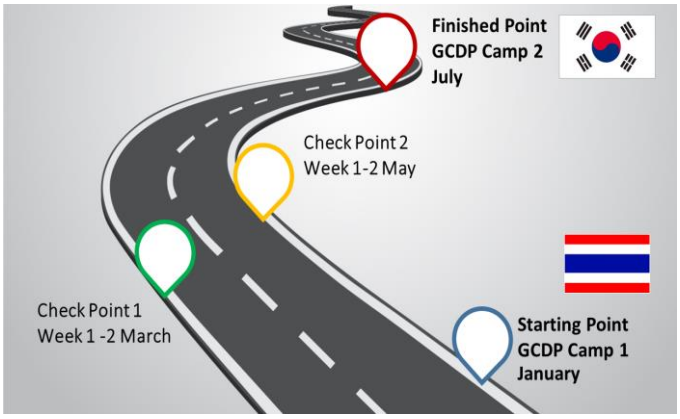

Figure 3. GCDP Journey

Figure 4. GCDP Phase 1 at RMUTT and Phase 2 at YU

EVALUATION

GCDP in the 2018-2019 academic year had finished successfully as planned. However, for 2019-2020, the last phase of the GCDP, which was planned to be held on-site at YU, was cancelled due to the forbidding of travel to South Korea. The activities were re-designed to provide opportunities for the students to finalize and present their projects using an online meeting platform.

At the end of Phase 1 and Phase 3, student feedback surveys are conducted using an online questionnaire. There are 4 parts of the questionnaire; (1) Basic information on gender, university, major and year of study, (2) An open-ended question asking what the student expect to improve most in this program, (3) A 5-scale rating score asking the student to rate the importance of the program goals, (4) A 5-scale rating score asking the student to rate the student achievement and (5) An open-ended question for the student feedback of the program.

There were 74 students in 2018-2019 and 73 students in 2019-2020 responded in the questionnaires. Figure 5 shows distributions of basic information for 2018-2019 and 2019-2020 participants. In 2018-2019, there were 71% male and 29% female students. In 2019-2020, there were 81% male and 19% female students participating in the GCDP. The majority of participants were 3rd year students with 64% in 2018-2019 and 71% in 2019-2020.

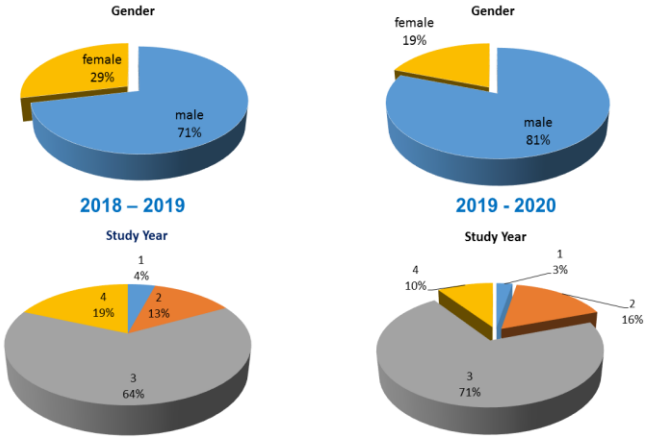

Figure 5. Gender and Study Year of Participating Students

Section 3 of the questionnaire asked the respondents to give a 5-scale score on the importance of their goals to participate in GCDP. The scales are 5-extremely important, 4-very important, 3-important, 2-not important, and 1-not important at all. Figure 6 displays average scores of pre-program and post-program data from 2018-2019 and 2019-2020. "Experience actual product design, build, and test with major knowledge" received a highest score, becoming the top rank, followed by "Solve engineering problems and collaborate in engineering design" as a 2nd place. "Improve global competencies through international teamwork" was the 3rd rank. It is obvious that in the post-program, average scores were higher than the pre-program scores, except the "Exchange with participating professors and students from other universities" and "Improve global competencies through international teamwork" on 2019-2020 due to the change to online which prohibited on-site collaboration.

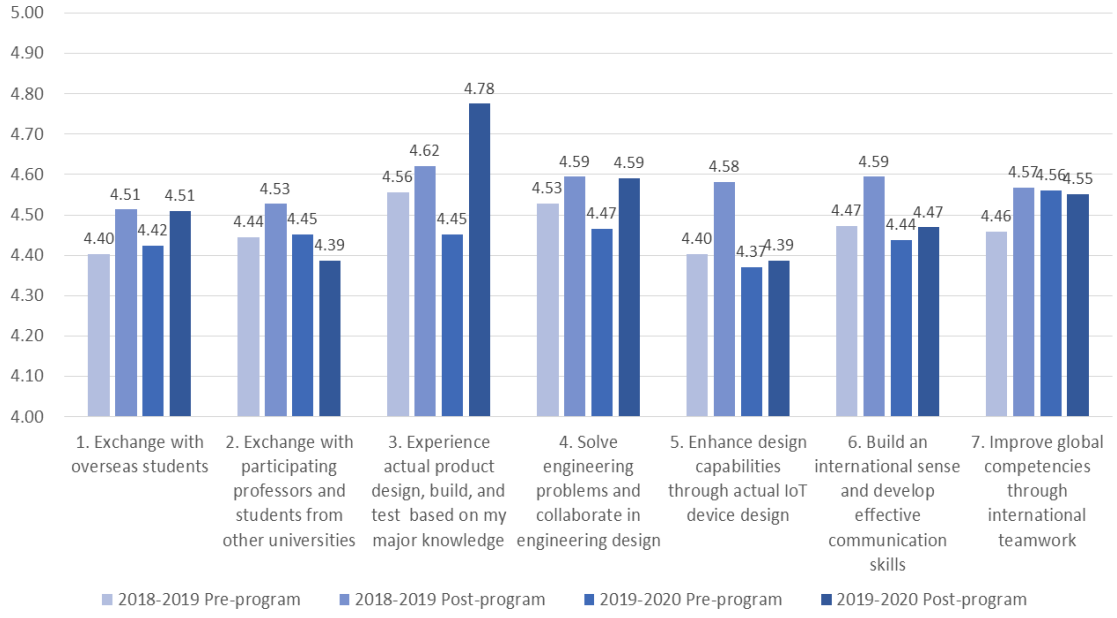

Figure 6. Pre- and Post-program Data on the Importance of Goals

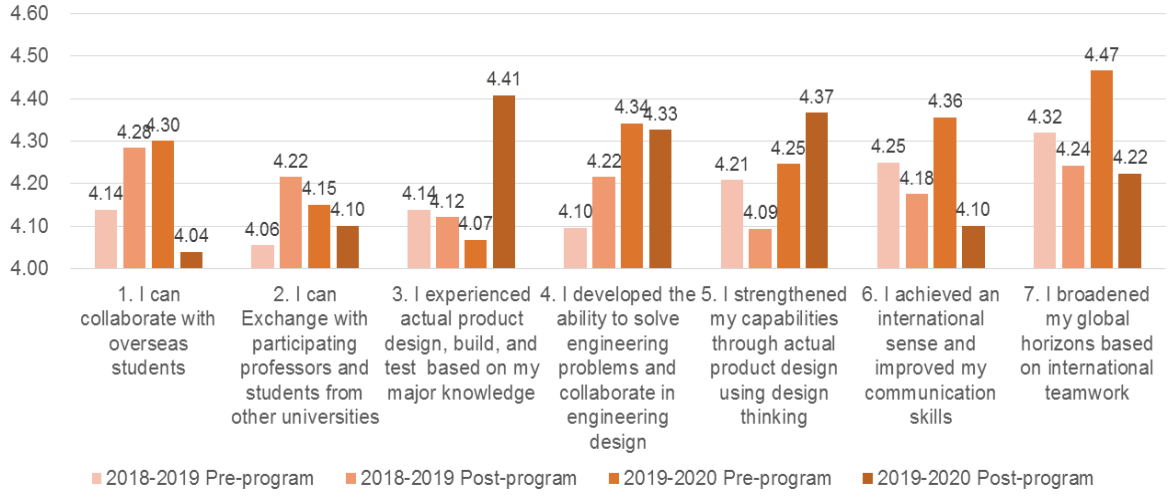

Figure 7. Pre- and Post-program Data on the Achievement

Section 4 asked the respondents to self-evaluate how much they achieved. The scales are 5-totally agree, 4-somewhat agree, 3-agree, 2-somewhat disagree, and 1-disagree. Figure 7 demonstrates the average scores of pre-program and post-program for both 2018-2019 and 2019-2020 events. "I broadened my global horizons based on international teamwork" was in the top rank of the achievement. However, when looking at the post-program achievement in 2019-2020, there were lower scores in achievement number 1, 2, and 6. This was due to the change from on-site to online because of the travelling prohibition, disabling participants to collaborate and exchange ideas face-to-face. However, achievement number 3 and 5 show higher scores because the completion of the project and the overcome of challenges during those 7 months.

Student Feedback

Section 5 asked the students to give feedback to the program. The student gained experiences in improving their disciplinary knowledge, personal and interpersonal skills and widen their international perspectives. Examples of their feedback are below:

"Taking a program on the theme of design thinking, as an engineer, was able to understand the idea of a designer, and it became an opportunity to broaden the perspective of thinking. In addition, since I had to make one high-quality IOT device, the ability to automatically produce coding and hardware improved."

"By sharing opinions with overseas students, we were able to conduct the Capstone program from various perspectives."

"It was a meaningful time for me to participate in long-term team projects, to improve my communication skills, improve my communication skills, solve engineering problems, and improve my teamwork skills."

"Although the language spoken with foreign students is different, it seems that I have gained a good experience to communicate as an engineering student."

"It seems that I gained a global perspective by working on a project on the same social issues as students from other countries."

Teacher Perspectives

The GCDP implemented the CDIO concept to provide experiences to the students to practice engineering problem solving [CDIO Syllabus 2.1] and engineering design in the multidisciplinary team-based environment [CDIO Syllabus 3.1], so they are granted opportunities to improve their interpersonal skills, as well as using English as a medium of communication [CDIO Syllabus 3.3.1]. Throughout 7 months, the students practice and develop their "conceive – design – implement – operate" skills [CDIO Syllabus 4.3-4.6] and project management skills [CDIO Syllabus 4.3.4]. Moreover, students experience a different working environment. On-site workshop enables face-to-face communication and team bonding opportunity, while online working is more flexible in time and resource management. Even with the pandemic situation causing initial plans to change, the students have still developed strong learning attitudes [CDIO Syllabus 2.4].

The GCDP employed CDIO Standard 5 which provide design-implement experiences to students working in projects. The GCDP activities based on active experiential learning

methods [CDIO Standard 8] which engage students to think, generate ideas, solve problem and encourage professional engineering practice. Moreover, the participated teachers as coaches to the student teams viewed GCDP as a great opportunity for enhancing faculty competence [CDIO Standard 9] to share their expertise, communicate in foreign language and practice their coaching skills. GCDP was a good start for future expansion of the collaboration between instructions, for example, on-the-job training, cooperative education and research. The challenge that both students and teachers encounter was the language barrier which slowdown or sometimes discourage the student to work effectively. The reassurance from coach and team member can help overcome this challenge.

CONCLUSION

The GCDP project promotes internationalization, student and staff mobility. The survey results show that the students have experienced a product design, production, and testing based on their disciplines. They have strengthened capabilities through the actual product design using design thinking. In addition to improving personal and interpersonal skills when solving engineering problems. They have developed an international sense, effective communication skills, and broaden their horizon based on international teamwork.

The 3rd year of GCDP in 2020-2021 academic year started in January 2021. With the travelling restriction, the organizer plans to hold the events fully online. Activities are, again, redesigned to accommodate this challenging situation. The authors plan to share the outcome of the next GCDP in the near future.

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BIOGRAPHICAL INFORMATION

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Dong Joo Song is a professor emeritus of Yeungnam University, Korea. He is currently a President of Korea Society for Creative Applications. He has participated in CDIO conference twice to present his engineering education programs in Hub Center for Engineering Education, Yeungnam University. His current interest is a research and development of Design Thinking in Korea.

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