ASEE 2016
INTERNATIONAL FORUM
NEW ORLEANS, LOUISIANA / JUNE 25, 2016

Paper ID #17562

India and Japan Joint Project-Based Learning -What was Learned from the Design Thinking Workshop-

Ms. Ayano OHSAKI P.E., Okayama University

Ms Ayano OHSAKI is an assistant professor at Okayama University. She also works as an assistant professor at the Innovation Center for Engineering Education, Tottori University since 2012. She is in charge of development new engineering education program. The objectives of the program are improvement of creativity, collaboration skills and problem solving skills. Students learn communication skills, project management skills, analysis, etc. by working on design assignments and projects in this program. More than 400 students are studying in this program. She is writing a textbook and developing an assessment system for this program.

She is pursuing her doctoral research in Computer Supported Collaborative Leaning (CSCL) and the Engineering Design. Prior to this, she also has over 5 years of experiences as a Production Engineer. She designed a jig, production processes and production systems for on-vehicle unit systems.

India and Japan Joint Project Based Learning
-What is the Learnt from Design Thinking Workshop-

This study proposes a new instructional method with design thinking for international engineering education program. I had international PBL (project-based leaning) courses with Indian students twice times. Those PBL aims to learn as follows: (1) Intercultural and diversity mind, (2) Project Management, (3) Design Thinking, (4) Engineering knowledge and skills. To make suggestion for a new instructional method, I analyzed the daily reports and final reports whom Japanese participants of two courses write as Design Based Research (DBR). DBR is the one of the research method for learning. According to BARAB and SQUIR (2004)[1], Design Based Research is "a series of approaches, with the intent of producing new theories, artifacts, and practices that account for and potentially impact learning and teaching in naturalistic settings". Reeves(2006) made a process flowchart of DBR as fig.1 [2].

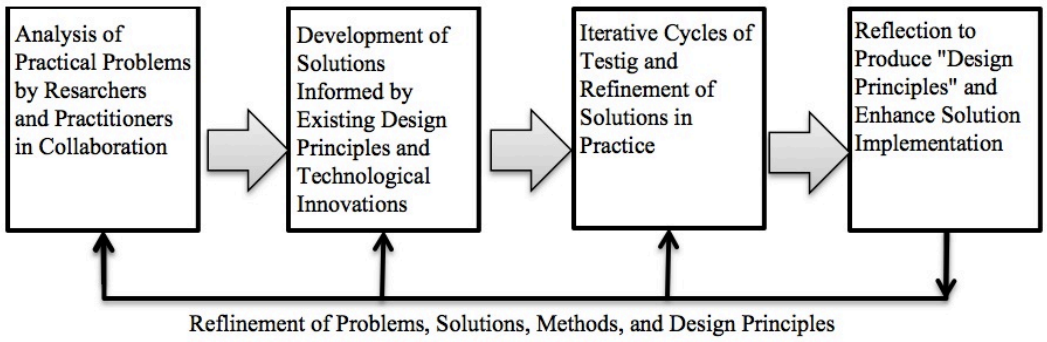

Fig.1 process of DBR [2]

Higher education of engineering needs to develop global engineers with both knowledge and problem-solving skills. Especially, Japanese engineering education has focused on engineering design. The Japan Accreditation Board for Engineering Education defines engineering design as an "open-ended and creative problem-solving process based on the knowledge of science, technology, and social sciences and humanities"[3]. Engineering design is interdisciplinary and diverse problem solving related to engineering. Recently, many Japanese universities have engaged in international PBL [4][5][6]. However, there has been little research on PBL's effects in the international environment. In consequence, we should discuss about the between educational effects of PBL and learning environment. We must define the learning objective in this program. I set "Design Thinking"[7] as main objective, because Design Thinking has paid attention for the methodology of innovation. Many Universities has special curriculum for Design Thinking such as Stanford University,

USA [8], University of Tokyo, Japan [9] etc.

PBL is a construction of Project-based learning or Problem Based Leaning. According to Yuasa at el (2011)[12], it is focused on learning new knowledge and skills in Problem-based learning, and it is focused on using their knowledge and skills in Project Based Leaning. But a teacher has a role of a facilitator for learns in both of PBL. Furthermore, Barron at el (1998)[13] suggested "that there are strong advantage to pairing problem-based leaning and project-based learning", because problem-based learning is scaffold activities in project-based learning. Consequently, there is no distinction between problem-based learning and project-based learning in this paper. I set activities to learn new knowledge and skills and using students' knowledge and skills through this PBL.

Students learn from their experiences and community in PBL. Therefore, the teacher has to design learning environment based on the theory of learning. Scardamalia (2002) defined twelve design principles to clarify about knowledge building and the technology that supports it as table1 [14].

I have started this international workshop program since 2015. I designed learning environment with design principles for knowledge building in both of programs (table 1) (table 2)(table 3).

In 2015, three Japanese students and six Indian students took part in this program. The theme of 2015's program is "Application software with Augmented Reality (AR) for Visitors". Students developed an application software that people can use on android smartphone. Indian students and Japanese students developed new application software for each other. Students ware required knowledge of JAVA, knowledge of AR, graphic design skill and programing skill as engineering knowledge and skills. All of Japanese students came from engineering department, but major was different. One was chemical engineering, another was mechanical engineering and the other was information technology. Three Japanese students had another PBL before visiting India in 2015, They made prototypes of other software. But Japanese participants ware not in the same group. Two students ware in the same group with another student, one student had a project alone. Japanese students had a meeting for an hour and a half after class of the other project weekly. Students and a teacher discussed about Indian culture and prepared visiting India in that meeting.

In case of 2016, three Japanese students and four Indian students took part in this program. The theme of 2016's program is "Health food robotics". Students developed a robot for helping healthy life. Indian students made an application software of the robot, and Japanese students made a body of the robot. Students ware required knowledge of arduino [15], knowledge of circuit design, programing skill and techniques of processing and making something by hand as engineering knowledge and skills. One Japanese student came from agriculture department, however he had experiment of making other robot. The major of other two Japanese students was applied science. They came from engineering department. The program of 2016 started officially from middle of December, 2015..Students did not have much time to prepare for real collaboration term. On the other hand, I revised that program from the experience of 2015. The first revision was setting a starting report. It aimed that students concentrated their learning objective. In addition, I made mixed team with Indian and Japanese to share their knowledge.

Table1. Design principle and learning environment of experiments

	Design principle	2015 program	2016 program
1	Real ideas, and authentic problems	To solve visitor problems	To solve a participant's problem
2	Improvable ideas	Mindset of radical collaboration	
3	Idea diversity	All of participants can ideate	
4	Rise above	Having reflection time	Making reflection report
5	Epistemic agency	Setting a role of teacher as facilitator	
6	Community knowledge, collective responsibility	Distributed responsibility for the project	
7	Democratizing knowledge	Mindset of radical collaboration	
8	Symmetric knowledge advancement	Participants have difference role	Participants have difference knowledge
9	Pervasive knowledge building	Mindset of radical collaboration	
10	Constructive uses of authoritative sources	Mindset of radical collaboration	
11	Knowledge building discourse	Participants define the goal of project	

12	Embedded and transformative assessment	Evaluation by participants

Table2. Details of two years program

	2015 program	2016 program
Project theme	Application Software with Augmented Reality for Visitors	Health Food Robotics
Participants	3 Japanese, 6 Indians	3 Japanese, 4 Indians
Preparation lessons	37.5 hours	10.5 hours
Online meeting with Indian student	Once	Once
	35 days before visiting India	5 days before visiting India
Real collaboration term	8 days	8 days
Daily report's theme	What are your today's activities and what did you learn from the activities?	Please explain about your today's activities and what did you learn from the activities.
Starting Report's theme	──	What is your opinion for International project?
Final report's theme	What is your learnt	What is your learnt * Using more than 400 characters

Table3. Schedule of real collaboration term

	2015 program	2016 program
First day	Meeting	Meeting
Second day	One day lecture	Half day lecture
Third day	Half day lecture	One day lecture
Fourth day	One day experiment	One day experiment
Fifth day	One day experiment	One day experiment
Sixth day	One day experiment	One day experiment
Seventh day	One day experiment	One day experiment
Last day	Final presentation	Final presentation

In this section, the results of comparing the two experiences are shown. At first, I counted the

description about learning objectives. Table 4 is the percentage of description about learning objective in final report. All of students write the learning objective, which is taken as 100%. Secondly, I counted the number of characters of students' report to analyze students' learnt (Table 5) for analysis the relationship between activities and learnt. It was difficult for us to analyze learning of students from a number of reports' characters, because it had a considerable amount of variance. At last, I categorized the students' report and counted the number of times each word was used in them for quality analysis. I divided the students' reports into three categories: learning objective, relationship with the team and emotion. Moreover, I distributed these descriptions into eight subcategories: intercultural and diversity mind, project management, design thinking, engineering knowledge and skills, contribution, be supported, motivation and incompetent. . Each subcategory's meaning and sample comments are shown in table 6. All of students write the word every day, which is taken as 100% in table 7.

Table4. The percentage of description about learning objective in final report

Leaning objective	2015 program	2016 program
Intercultural & diversity mind	100%	100%
Project Management	67%	67%
Design Thinking	67%	67%
Engineering knowledge & skills	67%	100%

Table5. The amount of characters in students' report

	2015 program		2016 program	
	Average	Variance	Average	Variance
First day	1091.3	568.2	521.7	150.6
Second day	1732.3	724.2	799.0	126.5
Third day	1002.3	211.9	731.3	211.5
Fourth day	779.3	341.0	633.7	75.8
Fifth day	505.0	349.8	864.7	170.7
Sixth day	605.7	373.1	745.7	135.3
Seventh day	540.3	195.7	638.0	272.5
Last day	1202.7	521.6	705.0	187.3

Final Report	653	534.6	407.0	22.1

Table6. The category for daily report analysis

Category	Sub category	Sample
Leaning objectives	Intercultural & diversity mind	I watched Indian style cooking.
	Project Management	I thought that sharing information was important.
	Design Thinking	From the point of view of radical collaboration,
	Engineering knowledge & skills	They had high level programing skill.
Relationship with the team	Contribution	I could suggest about layout of buttons.
	Be supported	He helped me to install new software.
Emotion	Motivation	I want to work with them in the future.
	Incompetent	I was discouraged.

Table7. The percentage of category in daily report

Sub Category	2015 program	2016 program
Intercultural & diversity mind	92%	67%
Project Management	75%	71%
Design Thinking	42%	25%
Engineering knowledge & skills	33%	63%
Contribution	4%	21%
Be supported	21%	46%
Motivation	42%	83%
Incompetent	63%	38%

Students learned about learning objectives through international PBL were confirmed from final report. Additionally, the number of students who wrote about all of learning objective had increase from the program on 2015 to 2016.

The cause of considerable amount of variance in distinguishing the difference of the writing styles among students is as follows: (1) a student wrote in her one of her reports such as

“9.00am breakfast. Today’s menu: bread, curry, strawberry yogurt”. (2) Another student wrote in his one of his report such as “I could study a lot of things from the point of view of intercultural project”. I did not set a format and minimum characters for the daily report, because I was interested in their curiosities. Consequently, the numbers of character of students’ report change depending on students' motivation to deliver a report..

All of students gave a detailed description of their activities in daily reports. It is assumed that students learned lots of things from their experiment. Moreover, we can confirm that students focused on their project more than the other learning objectives. In addition, students’ curiosity moved to “engineering knowledge and skills” and relationship with team by setting theme. All of students had to use engineering knowledge and skills in 2016 program. In case of 2015 program, one student did not use engineering knowledge and skills. He wrote about engineering knowledge only once.

Besides， descriptions of relationship with the team had increased from 2015 to 2016. One of the factors behind this was the 8th design principle of knowledge building. Japanese students did not have as much knowledge and skill as Indian students. They should ask about Engineering knowledge and skills to develop new product together.

On the other hand, descriptions of incompetent and Intercultural & diversity mind ware decreased from 2015 to 2016. There is a possibility that students could not make efforts to build rapport with the teacher. For example, participating students of 2015 used many young people's words and colloquial expressions when they wrote their report. Participating students of 2016 could not have other PBL before visiting India. Hence students could not write their thinking and emotion honestly.

Students learned leaning objectives of the PBL as follows: (1) Intercultural and diversity mind, (2) Project Management, (3) Design Thinking, (4) Engineering knowledge and skills through international PBL. In addition, My work suggests three design principles for International PBL as follows: (1) real problem to solve by the result of the project, (2) Opportunity for Sharing engineering knowledge and skills between participants, (3) Preparation team to build rapport with the teacher.

In this research, I could not analyze the result of learning by static, because participants were very few students. Hence， I analyzed students’ learning and activities using by framework of

DBR. We should analyze more detail of students' activities and descriptions from now on.

Ms. Ayano OHSAKI is an assistant professor at Okayama University. She also works as an assistant professor at the Innovation Center for Engineering Education, Tottori University since 2012. She is in charge of development new engineering education program. The objectives of the program are improvement of creativity, collaboration skills and problem solving skills. Students learn communication skills, project management skills, analysis, etc. by working on design assignments and projects in this program. More than 400 students are studying in this program. She is writing a textbook and developing an assessment system for this program.
She is pursuing her doctoral research in Computer Supported Collaborative Leaning (CSCL) and the Engineering Design. Prior to this, she also has over 5 years of experiences as a Production Engineer. She designed a jig, production processes and production systems for on-vehicle unit systems.

[1] Barab, S., & Squire, K. (2004). Design-Based Research: Putting a Stake in the Ground, *Journal of the Learning Sciences*, 13(1), 1-14

[2] Reeves, T. (2006). Design research from a technology perspective. *Educational design research,* 1(3), 52-66.

[3] Quality Assurance for education and Engineering education (1990). The Japan Accreditation Board for Engineering Education. http://www.jabee.org/public_doc/download/?docid=27

[4] Cross Border PBL (n.d.). Yamaguchi University. http://mot.yamaguchi-u.ac.jp/AIC/pbl.html

[5] Kumamoto, K., Zhou, H., & Yoshimura, T. (2015). International PBL in Osaka Institute of Technology. I*EICE Communications Society GLOBAL NEWSLETTER*, 39(2), 9-10

[6] The report of international capstone design competition (2014). Kumamoto University.
http://cedec.kumamoto-u.ac.jp/project/kokusai_mono.html

[7] Brown, T. (2008). Design thinking. *Harvard business review*, 86(6)

[8] d.school (n.d.). Stanford University. http://dschool.stanford.edu/

[9] i.school (n.d.). University of Tokyo. http://ischool.t.u-tokyo.ac.jp/

[10] Yuasa, K., Oshima, J., & Oshima, R. (2011). Characteristics and Effectiveness of PBLs : Problem-Based Learning & Project-Based Learning, *The research of information, Shizuoka University*, 16, pp.15-22.

[11] Barron, B., Schwartz, D., Vye, N., Moore, A., Petrosino, A., Zech, L., & Bransford, J. (1998) Doing With Understanding: Lessons From Research on Problem- and Project-Based Learning, *Journal of the Learning Sciences*, 7(3-4), 271-311,

[12] Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. *Liberal education in a knowledge society*, 97, 67-98.

[13] arduino. (n.d.). https://www.arduino.cc/