Strategy to Carry Out Design Project Classes Smoothly

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Abstract

Higher education in Japan is split between universities and colleges of technology. Universities offer a 4 year program, following 6 years studying in elementary school, 3 years in junior high school and 3 years in high school. Colleges of technology offer a 5 year program, following 6 years in elementary school and 3 years in junior high school. Both universities and colleges of technology have the responsibility to teach students how to work as part of a team. For engineering programs in particular, it is important to help students develop these skills through design projects. Unlike university students, students at colleges of technology are not used to active learning style classes based on team activities. Therefore, team activities in the design project courses (DP1 and DP2) were not performed well. So during the summer break after DP1 had finished, a 3 day summer school was implemented. Instead of the whole class participating, only those who volunteered did. These students learned how to carry out projects during this summer school session. They then helped ensure projects ran smoothly in DP2. In this paper, we will discuss our strategy to carry out design project classes smoothly, which we have put into practice.

Keywords: *Design project, Team activity, Project pacemaker.*

1. Introduction

The Japanese school system comprises elementary school (elementary education), junior high school (lower secondary education), high school (upper secondary education) and university (higher education), with the respective terms being six, three, three and four years. Technical colleges are institutions of higher education, but can be entered with completion of lower secondary education. In other words, they include the three years of upper secondary education and the two years of a junior college. High education must equip students with "teamwork skills as a member of society. [1] [2] "For example, in the case of Kanazawa Institute of Technology (KIT) all students must take the Design Project courses in which they learn active learning through problem solving. At KIT, each year is divided into two semesters with 15 weeks each. The Design Project courses are completed in two parts – Design Project 1 for one semester (15 weeks) during the first year, and Design Project 2 for one semester (15 weeks) during the second year. Over the course of these two semesters, students learn how to facilitate projects, find problems and reach solutions through group work. Classes are 90 minutes long each week. [3] [4].

Experiencing problem-finding and problem-solving in a Project Based Learning (PBL) format is important for the development of generic skills required to function as a member of society [5]-[7]. Generic skills required to function as a member of society are those that are important in the workplace and communities. Students who enter technical colleges are 15 years old, three years younger than those entering universities. Therefore, it is not apparent whether students at technical colleges will benefit from the application of the same project-based learning conducted at universities. How, then, should a problem-finding and problem-solving class, similar to those held at KIT, be applied to Kanazawa Technical College (KTC)?

2. Transferal of KIT's PBL Education Program

KTC is managed by the same administrative body as KIT, and also shares a campus. KTC, however, holds classes through 1 year, in 30 weeks. Therefore, we attempted to create a 30-week Design Project course, based on KIT's Design Project syllabus, which would yield equivalent results at KIT. As shown in Figure 1, the lecture syllabus of KIT's Design Project courses is designed so that students can experience the process of engineering design through project work. The courses are separated into two parts so that students don't have to learn the process of engineering design all at once. The first year is an Introduction to Design Project with an emphasis on problem-finding, during which they become accustomed to project work. The second year is Design Project Applied with an emphasis on problem-solving, during which they manage projects. The horizontal axis is the process of engineering design, and the vertical axis is the skills that students acquire. The Conceive-Design-Implement-Operation shown on the vertical axis is the CDIO process defined by CDIO Initiative [8, 9]. From a different angle, we can say the horizontal axis shows the progress of student projects, and the vertical axis shows the quality of student projects. This relationship is important when transferring KIT's Design Project course to KTC.

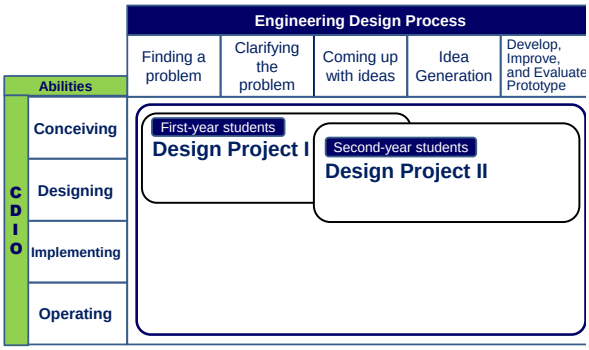


Figure 1. Relationship between KIT Design Project and the CDIO Approach.

The Design Project education was applied by Takemata, one of the authors, in a course called Business System for third year students of the Department of Global Information Technology. The Business System class is a comprehensive course on information technology. The 30 weeks were divided into three parts, Stage 1, Stage 2 and Stage 3. Stage 1 was an Introduction to Design Project (DP1). Stage 2 provided lecture-style learning on information technology. The reason for this was to prepare students for the following stage in which they would be using information technology to create prototypes. Stage 3 was Design Project Applied (DP2). The theme of DP1 was "Designing things and matters that make life convenient." The theme of DP2 was "Designing things and matters that contribute to the community." For DP2, officials from the nearby city hall (Nonoichi City, Ishikawa Prefecture) were invited to speak about issues for which the city needs solutions. The objective was to raise the standard of student projects by having them work on practical issues.

3. Preparations for Raising the Quality of DP2 Projects

KTC students, unlike university students, have less experience in team-based active learning. During DP1, it seemed that students were not able to proceed with teamwork very well. Therefore, we used the summer break after DP1 to hold a three-day summer school. We selected five active students out of the 28 students taking the course, and added three fourth year students. A total of eight students participated in the summer school.

Figure 2 shows the Design Project activities of the summer school's Monozukuri Project. Over the course of three days, students followed the CDIO approach to design a cup that is easy to use for elderly people. Students (1) conducted research on users, that is, elderly people, (2) discussed and elicited ideas on cups that are easy to use, (3) created prototypes, tested and improved the prototype, (4) created a final prototype, and (5) commissioned (ordered) the creation of the final cup. Step (1) to (4) represent the CD (What to

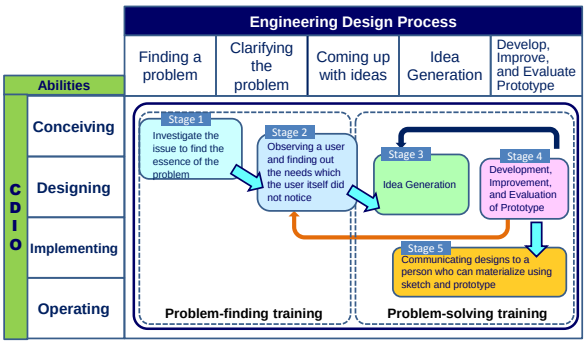


Figure 2. Design Project activities during summer school.

make) of CDIO and (5) represents the I (How to make it) of CDIO.

On the afternoon of the first day (for three hours), the KTC students wore suits that simulate the elderly experience and walked the neighborhood around the facilities. Through this the students experienced the physical level of the elderly (Figure 3). We tried to simulate the daily life of the elderly as much as possible—including using staircase handrails, shopping at local grocery stores, checking bulletin boards, and using buses—so that the students can understand the viewpoint of the target users. The purpose of this simulation was to inspire insight on what kind of cups are easy for the elderly to use, and to bring out potential needs.

Figure 3. Stu
wearing suits

On the morning of the second day (for three hours), the students separated into two groups and brainstormed ideas (Figure 4). This process was relatively smooth, as the students had already experienced brainstorming in DP1. The purpose of brainstorming as a group was to teach students that people notice different points in designs, and to raise the quality of the ideas by absorbing more ideas.

Figure 4. Students brainstorming in teams.

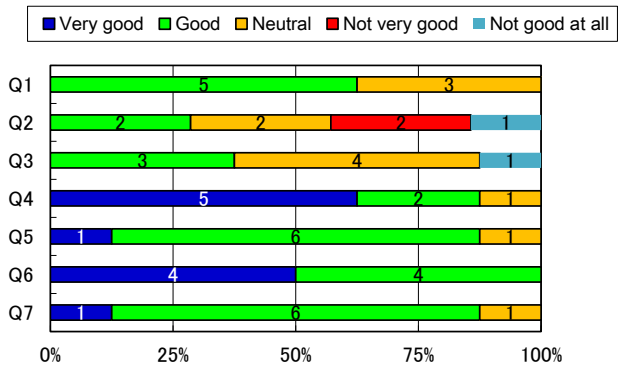
On the afternoon of the second day (for three hours), students created a prototype based on the cup they designed on their idea sheets (Figure 5). They then tested the usability of their prototype wearing the suits that simulate the elderly experience, re-examined their ideas, and created a second prototype.

Figure 5. Students creating prototypes.

In the evening of the second day (for three hours), the students created documents (design sheets) that explained the cup they designed (Figure 6).

On the morning of the third and final day (for three hours), the students met with craftsmen who possess the skills to create ceramics and commissioned the production of their cup using their prototypes and design sheets.

A questionnaire survey on all eight students produced the results shown in Figure 7. Questions 1 to 3 concern the cups they designed and their satisfaction with the results, so there are some



Q1: Were you able to understand how an elderly person feels when wearing the simulation suit?

Q2: Do you think you were able to design a cup tha is easy to use for elderly people on the first try?

Q3: Do you think you were able to design a cup tha is easy to use for elderly people after improvements to your first try?

Q4: Was creating a prototype from an idea (a desig drawn on paper) helpful in clarifying your idea (ir putting an abstract idea into a tangible form)?

Q5: Were you able to understand the process o monozukuri (think from the user's perspective design the product, make a prototype of the product, improve the product, offer the product to users)?

Q6: Did you learn anything from your meeting with a craftsman (potter)?

Q7: Has this training course changed your thoughts on your time at the technical college?

Figure 7. Results of the questionnaire survey after summer school.

that express disappointment or apprehension. Questions 4 to 7 concern the contents of the course, and received positive responses from all students. We concluded that the summer school successfully communicated to students the importance of designing from the viewpoint of the user.

4. Staring DP2

For DP2, the 28 students were divided into seven teams. The five students who learned the importance of designing from the user's perspective at summer school were all separated into different five teams. We decided to observe the difference in how those five teams managed their projects compared to the two teams that did not include a student from summer school. The theme of DP2 was "Designing things and matters that contribute to the community," so we invited an official from the nearby city hall (Nonoichi City, Ishikawa Prefecture) to give a lecture on "The city's desire for strategies that increase citizens' understanding regarding the city's historic ruins" (Figure 8).

Figure 8. Explanation of the issues that a city hall official wants to see solved.

In class, the engineering design process was explained in sequence, and the students were instructed to run their project according to the explained process. As expected, the students who attended summer school were highly motivated, and were quite proactive in working their projects. For example, as shown in Figure 9, some students visited and interviewed a city hall official in order to unearth problems. At the end of the project activity, a city hall official was invited for the final presentation. This official is also in charge of hosting and evaluating the final presentations of the KIT Design Project course, which is conducted at the city hall. The official similarly evaluated the KTC projects (Figure 10). According to this official, there was no significant difference in the results of the KIT and KTC Design Project courses. Although this comment is a qualitative evaluation, we judged it to be a sign that the Design Project course of KIT can be transferred to KTC with equivalent benefits to students.

Figure 9. Students interviewing a city hall official.

Figure 10. Final Presentation of the student projects, with a city hall official present.

5. Post-DP2 Questionnaire Survey

A questionnaire survey was conducted on 27 students (one student was absent) after the DP2 class was completed (Figure 11). Questions 1 to 6 concern the group work. The majority of responses were positive for all questions, and it can be concluded that the students learned how to conduct a design project. However, as shown in Question 2, some expressed apprehension regarding their own schedule management skills. We believe this will be reduced as the students accumulate experience in managing projects.

Questions 7 to 12 concern the contents of their design project. All questions produced over 70% of positive responses. We believe that involving community issues in the project theme helped raise the quality of the student projects. Particularly noticeable is Question 12 – approximately 90% of the students responded, "I now understand the importance of creating things and matters that are necessary from the user's perspective." This shows that this course was effective as a design project course.

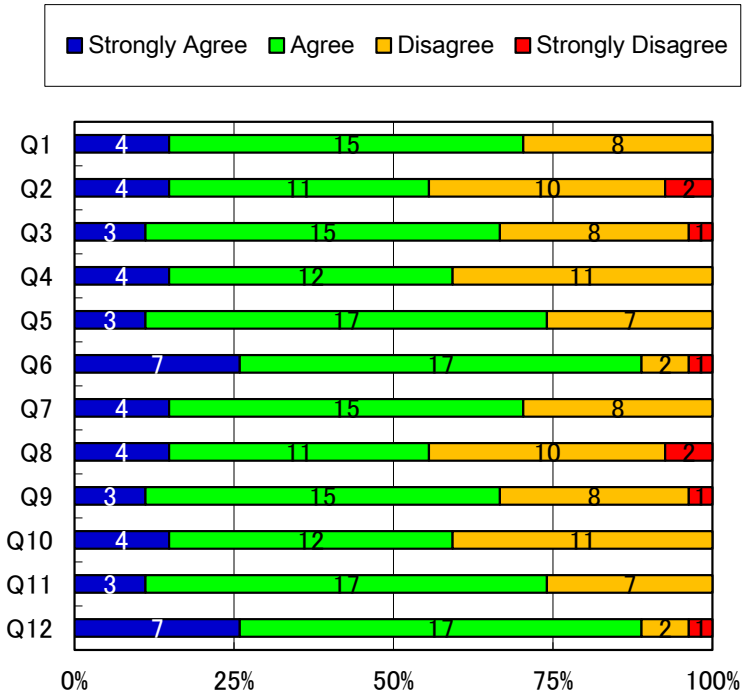


Figure 11. Results of the questionnaire survey after DP2.

Q1: I can design an action plan for achieving my team's goals.

Q2: I can manage my schedule in order to conduct my team's activities.

Q3: I can control my emotions and actions so that the team's activities go in a better direction.

Q4: I can unite the abilities of each member to achieve the team's goals.

Q5: When the team is having a hard time coming to a settlement, I can find common ground.

Q6: I can understand the opinions of other members and express my own opinions.

Q7: Was it beneficial to use the city's problems for the project theme?

Q8: Was it beneficial to hear an account of the city's problems from a city hall official?

Q9: Was it beneficial to receive an opinion on your project results from a city hall official?

Q10: Was the project of the second semester more difficult than the project of the first semester?

Q11: Were you able to understand the CDIO Approach?

Q12: Were you able to understand the importance of creating things and matters that are necessary from "the user's perspective" instead of "your own perspective"?

6. Conclusion

This paper explains a Design Project course conducted on third year students of a technical college. The course was conducted at KTC with reference to the Design Project course for first and second year students at KIT. Two projects were conducted over approximately 10 weeks each, as DP1 and DP2 of the year, before and after summer break, respectively. After the completion of DP1, a short-term project-based summer school was held in order to facilitate the progress of the second project. The purpose of this was to give each team at least one student who could lead the project. They then helped ensure projects ran smoothly in DP2. The teacher in charge of the course believes this helped DP2 progress better. Although this is a subjective opinion, it is based on the project results and questionnaire survey results. We decided to refer to them as project pacemakers. When conducting a design project course for third year students of a technical college, at a level equivalent to a similar course for first and second year university students, it appears to be effective to hold a summer school as modeled in this study. In addition, technical colleges must send their students out to the world at the age of 20. Project-based education, such as the third year course demonstrated in this study, promotes the development of generic skills required to function as a member of society. It should also have a positive influence on fourth-year specialized studies and fifth-year thesis studies.

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