# Creative Engineering Education in Collaboration with Local Community

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***Abstract*** **- The purpose of this study is to provide students with a creative engineering education in collaboration with local government. It is important for students to tackle problems of local community. Involvement of young people like college students in solving problems of local communities will contribute to their revitalization. Kanazawa Institute of Technology (KIT) created two introductory engineering design courses (Engineer Design 1: ED1 and Engineer Design 2: ED2). ED1 is taught in the second trimester of the freshman year, and ED2 in the third trimester of the sophomore year. KIT started a collaborative project with Nonoichi Town where KIT campus locates. Officials of Nonoichi Town supplied KIT students of ED2 real project themes, to which solutions were needed in order to improve town life. The officials provided students with valuable information and practical advice. As a result, students were able to generate excellent and viable design solutions.**

*Index Terms* - creative engineering education, local community, collaborative project.

## INTRODUCTION

Kanazawa Institute of Technology (KIT) has the course of Engineering Design 1 (ED1) for first-year undergraduate students and the course of Engineering Design 2 (ED2) for second-year undergraduate students[1,2]. Both courses pursue a 'creative engineering' program in engineering education to develop problem identification and solving skills while the students are involved in 'teamwork-based activities and projects' [3,4].

Since 2003, some classes of ED2 have been engaged in the projects proposed by the local government (Nonoichi Town, Ishikawa Prefecture, where the campus is located). This report was made on the projects [5].

## ED1 AND ED2

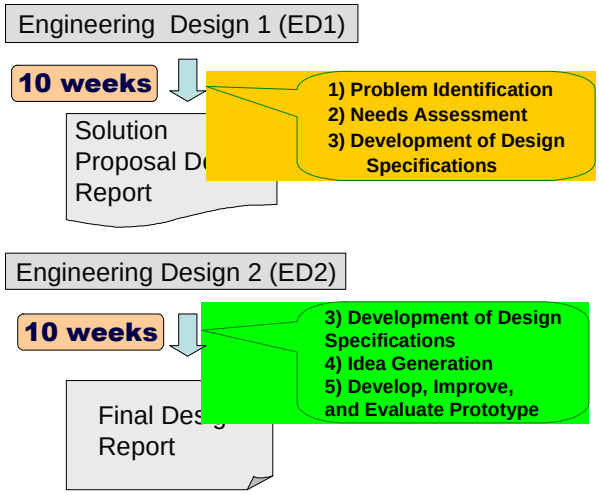


FIGURE 1
ENGINEERING DESIGN PROCESS IN THE COURSES OF ED1 & ED2

KIT employs a trimester system and each trimester is composed of 10-week sessions. All students take the course of ED1 in the second trimester of the freshman year and ED2 in the third trimester of the sophomore year. One class has approximately 30 students and both ED1 and ED2 have approximately 50 classes respectively. Since one class has 5-7 teams, almost 300 projects are carried out on the campus.

In ED1 and ED2 activities, what we call Engineering Design Process is composed of five stages: 1) Problem Identification, 2) Needs Assessment, 3) Development of Design Specifications, 4) Idea Generation, and 5) Develop, Improve, and Evaluate Prototype. Figure 1 shows this Engineering Design Process in ED1 and ED2.

In the course of ED1, the students are expected to identify the problem within main themes provided by the professor and set it as a project theme. At the stage 1) Problem Identification, if the students cannot identify what the problem is, their project lacks focus and subsequent activities will be blocked. At the stage 2) Needs Assessment, the students conduct interviews and questionnaire surveys

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while coping with uncertainties in 1). At the stage 3) Development of Design Specifications, they examined what product they are designing meets the user's needs, itemizing the factors, to draw up the Specifications. This seems a difficult challenge for first-year students. At the stage 4) Idea Generation, the students are required to sketch and illustrate their ideas to satisfy Design Specifications. They will experience difficulty in generating ideas to satisfy the Specifications. They may have to make every possible effort to illustrate what cannot be illustrated, for example, sound and smell. In this way, ED1 includes stages 1)-4) of the Engineering Design Process.

Based on the results of ED1, the students proceed to subsequent stages of the Engineering Design Process in ED2. They are free to choose a project theme but some of the professors will provide a certain range of themes. ED2 begins with the review of the Design Specifications drawn up in 3). Although they may restart at the stage 2) Needs Assessment, the project runs more smoothly now that they have completed the activities in ED1. After reviewing the Design Specifications, they proceed to 4) Idea Generation and 5) Develop, Improve, and Evaluate Prototype. While ED1 includes stages 1)-4), ED2 includes 3)-5) and there is some overlap between ED1 and ED2. The students in ED2 are expected to incorporate knowledge accumulated in one year of professional education into the project.

## PROJECTS IN COLLABORATION WITH THE LOCAL GOVERNMENT IN 2005

For the students in ED2 to tackle more practical problems in their projects, we picked up some of the problems the local government has as project themes. In pursuing projects in collaboration with the local government, the students are expected to identify 'a problem they can tackle as a team' and set it as a theme. Although there may be concern that enough activities are not expected in such a short period of 10 weeks, the students in ED2 will make the best use of their experience of the Engineering Design Process in ED1 to carry out the collaborative projects.

The professor selects teams from his class and assigns them to the collaborative projects. The professor has two options: 1) to assign all of the teams in his class to the projects, and 2) to assign some of them to the projects. In the option 2), the class has two different types of projects: ordinary ED2 projects developing ED1 projects and the collaborative projects. In either option, the professor should support the students in their projects, encourage them to achieve a certain level of results, and lead them to the successful completion, and that, without delay. On the other hand, the local governmental officers are expected to answer queries posed by the students.

The following are the results of educational practices conducted by one of the authors, Takemata, in 2005. Table 1 shows a list of themes proposed by Nonoichi Town. Takemata was in charge of 3 classes comprised of 18 teams (93 students) and asked the classes to select one of the 4 themes in Table 1: 1) Public Information Division; citizen participatory 'Nonoichi community portal site,' 2) City Planning Division; promotion of use of community bus, 3) Lifelong Learning Division: how to provide information to residents at community centers, and 4) Industry Promotion Division; Reinvigoration of 'Nonoichi Jonkara Festival.'

TABLE I

| | Proposed Themes | Division in charge |
|---|---|---|
| 1 | Citizen participatory 'Nonoichi community portal site' | Public Information |
| 2 | Eco-Town Nonoichi | Local Finance |
| 3 | Reinvigoration of 'Nonoichi Jonkara Festival' | Industry Promotion |
| 4 | How to provide information to residents at community centers | Lifelong Learning |
| 5 | Snow melting system on fire hydrant caps | Life Safety |
| 6 | Water quality improvement in the Pond in Nonoichi Central Park | City Planning |
| 7 | Promotion of use of public transportation | City Planning |
| 8 | Earthquake-resistant water pipes | Waterworks |
| 9 | How to ensure household lifelines | Waterworks |
| 10 | How to use public spaces (parks and squares) as evacuation sites | Waterworks |
| 11 | Models of apartment (rental) buildings with consideration for cityscape | Construction |

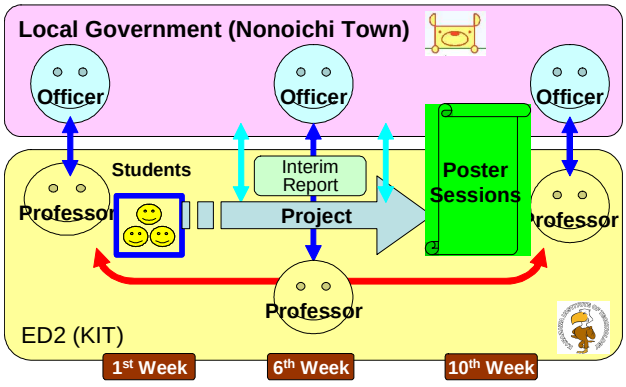



FIGURE 2
WORKFLOW IN ED1 & ED2 IN COLLABORATION WITH THE LOCAL GOVERNMENT

Figure 2 shows relationships between the professors in ED2 and the local governmental officers in Nonoichi Town. In the first week, all teams attend a presentation in which the local governmental officers explain the themes (Figure 3-a). This presentation will give the students some suggestion on their selection of a project theme. In the sixth week, each class presents an interim report on the project in front of the local governmental officers (Figure 3-b). Here, the students explain to the officers what they expect as final results. The officers in turn give the students appropriate advice. The advice motivates them to tackle the second half of the project more actively and here lies the true strength of the collaborative projects. Finally, in the tenth week, an open presentation (poster sessions) are held (Figure 3-c). Figure 3-d shows the results they students realized for 'the promotion of use of community bus.'

After the open presentation in the tenth week, a questionnaire survey was conducted targeting the 93 students concerning the collaborative projects (Figure 4).

*1) Students' commitment to the collaborative projects for solving the problems in their community*

To the question of 'it was significant for you to tackle the problem in Nonoichi Town as a project theme,' over 53% of the students answered 'strongly agree' or 'agree' (Figure 4-Q1). To the free-style question of 'what were significant for you?' most students answered 'to understand the community in which we live.' Also, to the question of 'it was helpful for you to listen directly to the local governmental officers concerning their on-site problems,' over 80% of the students answered 'strongly agree' or 'agree' (Figure 4-Q2). To the free-style question of 'what were helpful for you?' most students answered 'to understand in details the problems in our community.' It was therefore demonstrated that the students positively appreciated their commitment to the collaborative projects for solving the problems in their community.

*2) Students' presentation of the interim report on the project in front of the local governmental officer*s

To the question of 'it was helpful for you that the local governmental officers attended the presentation of the interim report,' 77% of the students answered 'strongly agree' or 'agree' (Figure 4-Q3). To the free-style question of 'what were helpful for you?' the students answered 'it gave me suggestion on the solution of the problem' and 'it made me aware of the problems of which I had not been aware before.' Their answers in general suggested that they were given valuable advice in preparation for the stage 5) Develop, Improve, and Evaluate Prototype of the Engineering Design Process.

*3) Local Governmental officers as Advisors for the Projects*

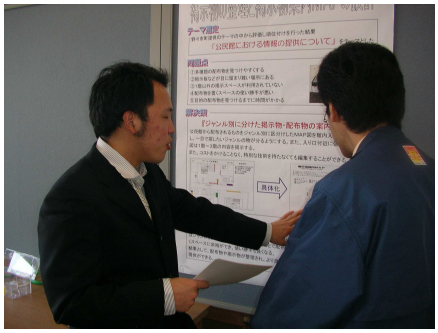
To the question of 'it was helpful for you that you could ask the local governmental officers questions every time you have some,' 58% of the students answered 'strongly agree' or 'agree' (Figure 4-Q4). Also, to the question of 'were the local governmental officers willing to answer your questions?' 65% of the students answered 'yes' (Figure 4-Q5). Most of the inquiries were made via email or visits. Among their free-style answers, there were descriptions like 'I received politely worded emails' and 'they responded sincerely to my visit' and their shared impression was 'the local governmental officers' response was agreeable.' It was considered that the local governmental officers gave their support for the projects so far as time permits.

## 4. CONCLUSION

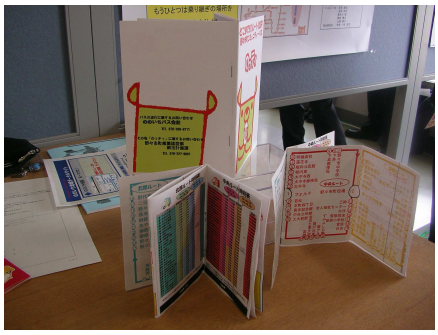
This report was made on educational practices in collaboration with the local government. The local governmental officers in Nonoichi Town participated in the practices as clients and advisors as well. Also, in the students' presentation of the interim report, they as clients encourage the students to review their solutions from a practical viewpoint. In this way, the students could tackle practical problems and it was a precious experience.

a) 1st week; the local governmental officers explain the themes.

b) 6th week; students present an interim report on the project in front of the local governmental officers.



c) 10th week; In the tenth week, an open presentation (poster sessions) are held.



d) Public Transportation Guide in Nonoichi Town made by students. (Theme: Promotion of use of community bus) Students explain their ideas with these prototypes in poster sessions.

FIGURE 3
SCENES IN THE COLLABORATIVE PROJECTS AND THE RESULTS

Especially, this time, the local government proposed to examine some of the results the students realized for adoption. Now, at the end of the third year of our collaborative projects, we could confirm that they began to take root in the community.

## ACKNOWLEDGMENTS

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## REFERENCES

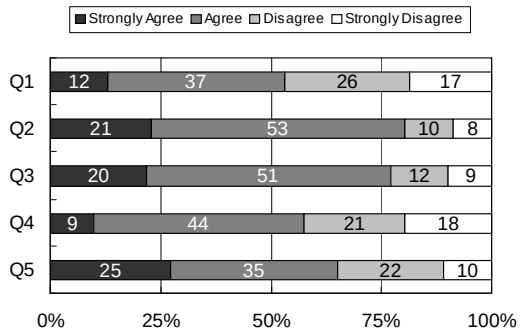
[1] Takemata, K. et al., "Evaluation of Team Activities in an Engineering Design Course with an E-Learning System", *Proceedings of 6th IEEE International Conferences on Advanced Learning Technologies (ICALT2006)*, 2006, pp. 510-511.

[2] Takemata, K. et al., "Trial of Team Activities in Engineering Design Course with Web Communication Tool", *Proceedings of 6th IEEE International Conferences on Advanced Learning Technologies (ICALT2005)*, 2005, pp. 873-874.

[3] Wakai, A. et al., "A Trial of Creative Education through the Communication with a Local Community ", *Journal of Japanese Society for Engineering Education* , Vol. 53, No. 6, 2005, pp. 75-79.

[4] Kasajima, Y. et al., "The Project Report and Estimation of University Education to Engage Area Problems and to Propose Student Generates Solutions ", *Journal of Japanese Society for Engineering Education* , Vol. 53, No. 5, 2005, pp. 101-106.

[5] Takemata, K. et al., "Engineering Design Education in Collaboration with Local Community", *Journal of Japanese Society for Engineering Education* , Vol. 54, No. 2, 2006, pp. 81-86.




Q1: Was it significant for you to tackle the problem in Nonoichi Town as a project theme?

Q2: Was it helpful for you to listen directly to the local governmental officers concerning their on-site problems?

Q3: Was it helpful for you that the local governmental officers attended the presentation of the interim report?

Q4: Was it helpful for you that you could ask the local governmental officers questions every time you have some?

Q5: Were the local governmental officers willing to answer your questions?

FIGURE 4
RESULTS OF QUESTIONNAIRE SURVEY ON THE COLLABORATIVE PROJECTS