

Students' Activities in Engineering Design Courses by Using Web Collaboration Tools

Kazuya TAKEMATA

Kanazawa Institute of Technology, Japan, takemata@neptune.kanazawa-it.ac.jp

Masakatsu MATSUIISHI

Kanazawa Institute of Technology, Japan, matsuishi@neptune.kanazawa-it.ac.jp

Toshiyuki YAMAMOTO

Kanazawa Institute of Technology, Japan, caitoshi@neptune.kanazawa-it.ac.jp

Tetsuro FURUKAWA

Kanazawa Institute of Technology, Japan, furukawa@neptune.kanazawa-it.ac.jp

Shigeo MATSUMOTO

Kanazawa Institute of Technology, Japan, matumoto@neptune.kanazawa-it.ac.jp

KEYWORDS: *Engineering Education, Project-based Learning, Engineering Design, Collaboration Tool*

ABSTRACT: *The purpose of this study is to consider how to use collaboration tools of the e-Learning system in the engineering design courses at Kanazawa Institute of Technology (KIT). Engineering Design I is taken by all freshmen during the second trimester, and Engineering Design II is taken by all sophomores during the sixth trimester. KIT's calendar has three 10-week trimesters per year. The courses require students to participate in a team project from the problem discovery stage to the concept design stage. As the first trial in the engineering design course, we introduced the collaboration tools of the e-Learning system to our Engineering Design I class. In this paper, we describe the students' activities based on collaboration tools of the e-Learning system.*

1 INTRODUCTION

At Kanazawa Institute of Technology (KIT), the engineering design courses are Engineering Design I, Engineering Design II, and Engineering Design III (TAKEMATA et al. 2002, MATSUMOTO et al. 2001, MATSUIISHI et al. 2002). We are teaching Engineering Design I and II, in which students identify and solve problems which are familiar to them. All freshmen study Engineering Design I, and all sophomores study Engineering Design II. Some teams identify an engineering problem related to a product on the market. Other student teams identify an engineering-related problem from daily life. Each student team proposes solutions to the problem. Students grapple with the project activities through cooperation. Some project activities are carried out in the study room, the library centre, and other areas on campus. Through these experiences, the students learn the challenges involved in team activities.

Because of the growing popularity of the Internet, one can connect to Web sites from home. By connecting to chat rooms, one can talk with other people in real time by the text information. By connecting to a discussion site (bulletin board), one can exchange opinions about certain themes with many people. The number of people who use such communication sites is increasing rapidly. A collaborative learning function recently has been added to the usual Web-Based Training (WBT). An e-Learning system has been developed that can build courseware which facilitates interaction among learners. Web communication tools such as chat rooms and discussion boards can be used in the courseware (TAMAKI et al. 2003).

In 2002, we tentatively introduced a Web-based communication tool, the WebCT Japanese standard edition, version 3.6, for teams to use in the activities required in Engineering Design I. WebCT provides the e-Learning system which includes collaborative learning functions. The reason that these functions were introduced for the team activities is that it is sometimes difficult for all of the members to gather. For example, perhaps one of the team members participates in another activity after school or has to commute some distance to school. In such a case, the students can not do enough team activities. With a

web communication tool, students can proceed with some project activities without worrying about meeting times and places.

In this paper, we describe the educational practice of Engineering Design I during the autumn term (2nd term) of 2002. KIT's calendar has three 10-week trimesters per year. First, research on how to use a web communication tool in team activities is discussed. Then we describe the necessity of a system which provides a web communication tool for team activities.

2 ENGINEERING DESIGN PROCESS

A learning flowchart for the engineering design process taught in Engineering Design I and Engineering Design II is shown in Figure 1. “Market Research” and “Report” refer to the activities carried out in each process:

- 1) Identify Problem. Students discover a problem to solve from the main theme which the teacher presents. That problem is the project theme.
- 2) Needs Assessment. Students investigate user needs related to the problem and explain the problem from the users’ position. The students receive suggestions to further develop their ideas.
- 3) Develop Design Specifications. The performance which is necessary for the solution is expressed clearly based on the needs assessment.
- 4) Generate Ideas. Ideas which satisfy the specifications are sought.
- 5) Develop, Improve, and Evaluate Prototype. Students choose the idea which best satisfies the users’ needs and then work to bring that idea to fruition, which involves the preparation of a detailed draft, the production of software, the production of a model, and so on.

The number of students in each Engineering Design I or Engineering Design II class is about 40, and several students are on each team. About 300 teams carry out project activities on campus because all the students study Engineering Design I or Engineering Design II in the same term. Students in Engineering Design I do steps 1 (Identify Problem) to 4 (Generate Ideas) in 9 weeks. In 10th week, students complete a questionnaire to evaluate the class.

In Engineering Design II, students continue the projects begun in Engineering Design I. During the first 6 weeks of Engineering Design II, they reconsider steps 3 (Develop Design Specifications) and 4 (Generate Ideas) based on step 2 (Needs Assessment). They then move on to step 5 (Develop, Improve, and Evaluate Prototype). A poster session is held in the 10th week.

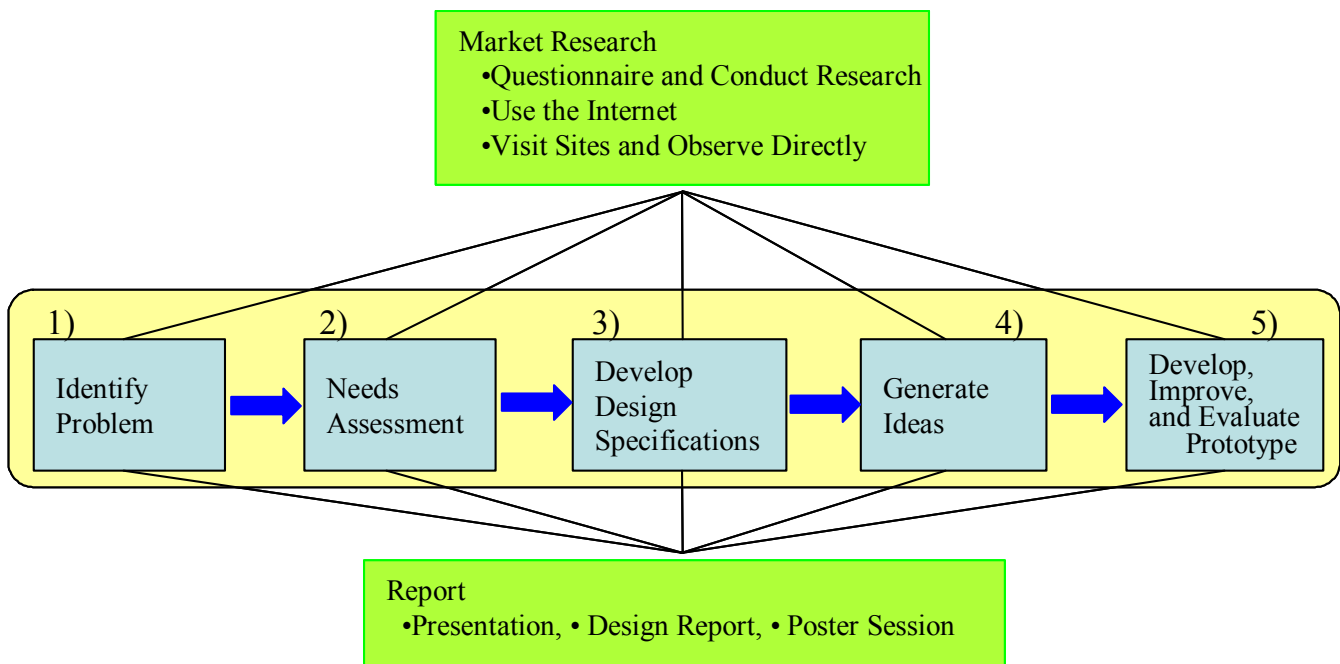


Figure 1 – Flow of Engineering Design Process and Activities

3 THE WEBCT TRIAL

We carried out the WebCT trial for Engineering Design I in the autumn term of 2002. Thirty-two students were divided into six teams. In addition to presenting the lecture, we met with each team for about 20 minutes per week to provide guidance. We called these sessions “office hour meetings.” We asked the students about the engineering design process, and we gave advice regarding their team activities.

(1) Use of WebCT

The communication functions of WebCT are a chat room, a white board, and a discussion site (bulletin board). Team 1 grappled with the assignment by using the discussion function. One of the members of this team commuted from a distance to school. Therefore, it was difficult for all of the members to gather after school. Figure 2 shows how often members of Team 1 posted to the bulletin board every week. During the second and third weeks, members posted their opinions about the selection of a project theme. The frequency of postings decreased from the fourth week to the sixth week, when the team was developing the project activities. Then the members gathered to brainstorm and discuss ideas, which were developed more fully by the members’ cooperation. The posting frequency increased again during the seventh week, when students were putting together ideas for the presentation to be given during the eighth week. One clear advantage of using WebCT for Team 1 was that they could use the bulletin board to clarify the focus of their topic before meeting with all of the members. The other five teams did not use the discussion function of WebCT for the team activities.

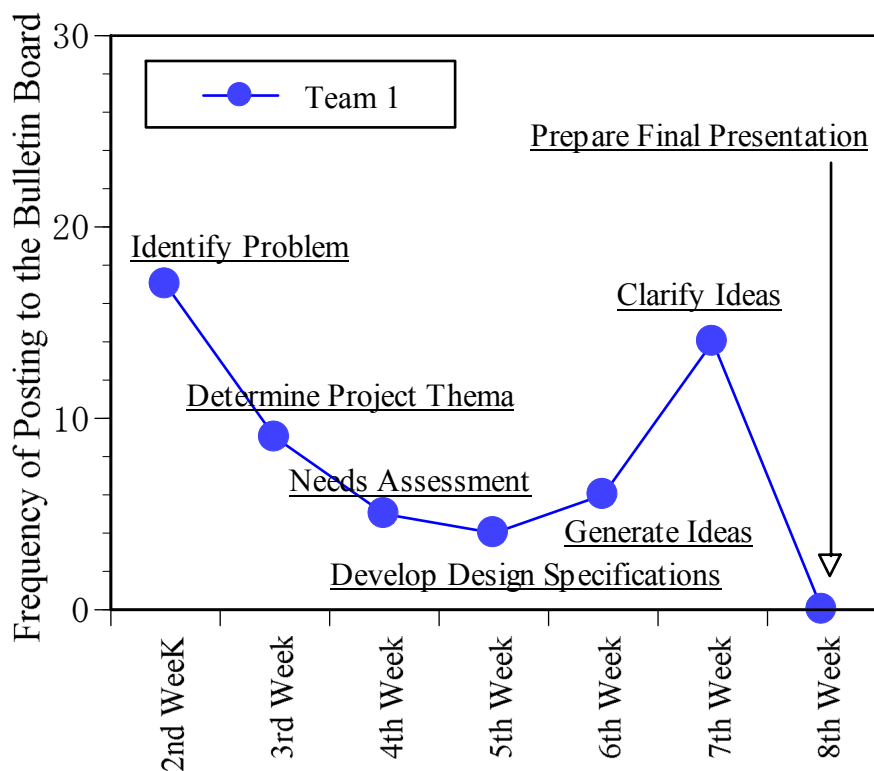


Figure 2 – Frequency of Postings to the WebCT Bulletin Board, Autumn 2002

(2) Time spent meeting for team activities

Team activities for Engineering Design I began in the second week. In Figure 3 is shown the total time that team members gathered every week for homework practice from the second week until the eighth week. Each team submitted a weekly report of the activities done during these meetings. The total time spent in meetings was as follows: Team 1, 16 hours; Team 2, 80 hours; Team 3, 48 hours; Team 4, 41 hours; Team 5, 45 hours; and Team 6, 20 hours. The average time was about 40 to 50 hours. The meetings of Teams 3, 4, and 5 fell within this average range, but Teams 1 and 6 met for shorter periods. We observed the activities of all teams in the classroom and at weekly guidance meetings. Though Team

1 worked eagerly every week, it seemed that the members of Team 6 were lazy. Before Team 1 gathered, they used the discussion function of WebCT to make arrangements for the upcoming activities; therefore, it was unnecessary for them to spend as much time in meetings.

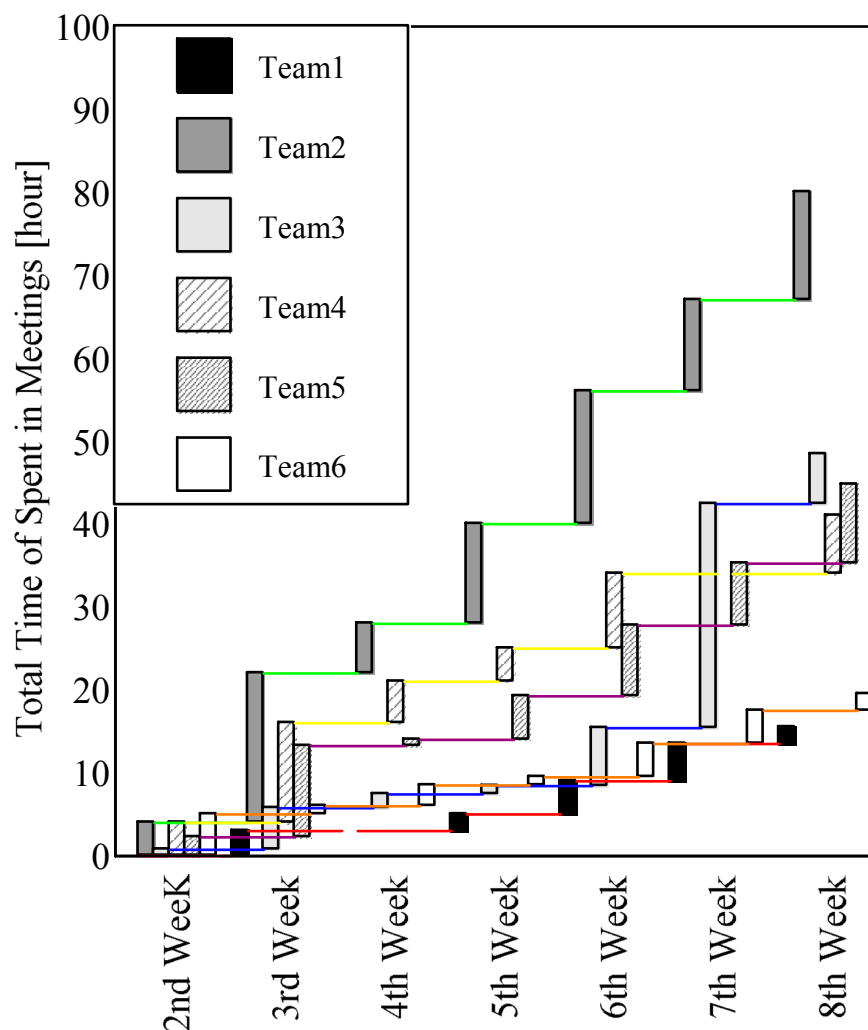


Figure 3 – Total Meeting Time for Team Activities, Autumn 2002

(3) Evaluation

Students in Engineering Design II took over the projects of Engineering Design I the following year. We evaluated students' design activities for Engineering Design I based on the guidelines mentioned in the teaching manual, focusing on the usefulness for Engineering Design II. The course evaluation is shown in Table 1. The evaluations for Teams 1 to 6 were B, C, B, A, A, and D, respectively. The results for Teams 1, 3, 4, and 5 were considered adequate.

Table 1. Course Evaluation

Grade	Criteria
A	Optimal for a project for Engineering Design II
B	Potential to be optimal for a project for Engineering Design II
C	Possibility to be optimal for a project for Engineering Design II
D	Unlikely to be optimal for a project for Engineering Design II
F	Inappropriate for a project for Engineering Design II

4 CONCLUSIONS

In this report, we have introduced a practical example of how an e-Learning system WebCT was used in students' engineering design activities.

Team 1 used the collaboration learning function of WebCT actively because one team member had to commute a long distance to school. Team 1 limited their meeting time by making use of a Web communication tool effectively. We evaluated the contents of the design activities of Team 1 based on its usefulness for Engineering Design II. This team's results were satisfactory as a result of Engineering Design I. On the other hand, the other teams were able to meet after school, so it was not as necessary for them to use WebCT.

Team activities may be facilitated by the use of the collaboration learning function of WebCT. Although, depending on their circumstances, teams may be able to work well even if WebCT is not used, we found that the use of WebCT never had a negative influence on the design activities of the team. It is important to prepare an e-Learning system for the team activities of Engineering Design I.

REFERENCES

- TAKEMATA, K., MATSUISHI, M., YAMAMOTO, T., FURUKAWA, T., and MATSUMOTO, S.: *Software Design Education for Junior Undergraduate Students*, International Conference on Engineering Education Proceedings, 2002.
- TAMAKI, M., KUWABARA, T., YAMADA, K., MUTO, M., and SHIMURA, A.: *Technology Trends in Human Interaction Conscious e-Learning*, The Journal of the Institute of Electronics, Information and Communication Engineering, vol. 89, no.11, pp. 826-833, 2003.
- MATSUMOTO, S. M., Kubo, T., and Matsumoto, S.: *The Courses of Engineering Design I & II at Kanazawa Institute of Technology*, Journal of Japan Society for Design Engineering, vol.36, no.8, pp. 25-31, 2001.
- MATSUISHI, M., TAKEMATA, K., FURUKAWA, T., and MATSUMOTO, S.: *Introductory Design Project in Engineering Design Course to Freshmen at Kanazawa Institute of Technology*, ASEE Session 2793, 2002.