LARGE SCALE BUSINESS-ACADEMIA COLLABORATION IN MASTER EDUCATION COURSE

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Abstract: The progress of Information Technology, which is the infrastructure of an advanced information society, is remarkable and has the enormous impact on our daily life. On the other hand, it has been pointed out by the industry in Japan that there is a lack of highly skilled Information and Communication Technology personnel who can lead the next generation. In order to address this issue, the Graduate School of Information Science and Electrical Engineering in Kyushu University has established Social Information System Engineering education course. Since April 2007, we have started practical education program with an objective to foster world class leaders who have extraordinary technical skill, basic knowledge and sense of ethics. This effort is steadily progressing by the collaboration with various companies through Nippon Keidanren with support of Ministry of Education, Culture, Sports, Science and Technology. There have been several findings in 1) Project Based Learning, 2) omnibus courses, 3) long term internship, and 4) curriculum improvements during the planning and execution of this program. This paper describes the content, method, interim result and evaluation of this education course. We also discuss the challenges that need to be resolved.

1 INTRODUCTION

Information and Communication Technology (ICT) is rapidly evolving and has a significant effect on the social infrastructure. On the other hand, there is a remarkable shortage of highly skilled ICT personnel who can lead the industry. It has been pointed out that the university education does not meet the requirements of industry. In order for Japan to be competitive in the globalized environment, it is imperative that the industry and university collaborate all together and foster highly skilled ICT personnel. To address this issue, the Graduate School of Information Science and Electrical Engineering (ISEE) in Kyushu University has started Social Information System Engineering (SISE) education course which is based on the large scale collaboration with Nippon Keidanren (Keidanren). It is the federation of economic organization and covers most of the big corporations in Japan. Its members include 1,315 major companies that represent various industries in Japan. Keidanren chose Kyushu University as the partner of its education program to foster highly skilled ICT personnel (Keidanren, 2005) and Ministry of Education, Culture, Sports, Science and Technology (MEXT) selected Kyushu University as the hub

university in the education program to bring up leading Information Technology specialist (Ministry, 2006). The characteristics of SISE are, 1) master education course through large scale business-academia collaboration, 2) practical education to meet social needs, 3) full support by Keidanren and its cooperating companies, and 4) alliance among partner universities. We have started the preparation on May, 2006, established project office on November, 2006, and started SISE education course on April, 2007.

This paper describes curriculum overview, interim results and lessons learned in SISE education course. Chapter 2 outlines the objective, contents and characteristics of this course. Chapter 3 describes the interim result and evaluation. Chapter 4 discusses the challenges. Chapter 5 is dedicated to the findings and Chapter 6 is the summary.

2 CURRICULUM OF EDUCATION COURSE

2.1 Education Course Overview

(1) Issues on Conventional Curriculum

The conventional curriculum at graduate school in Japan is based on classroom lecture and is mainly focused on learning the theory and technical knowledge, which is important. However, the conventional curriculum is not enough to develop the insight, communication, analysis, and solution capability to accommodate the rapidly progressing ICT environment. Especially, Project Based Learning (PBL), which is effective in developing the practical capabilities, has not been commonly introduced in the conventional curriculum.

(2) Objective of SISE Education Course

In this education course, we are trying to foster the students, who have 1) the professional skills that are required immediately in the software research and development, 2) the insights toward the changing ICT and social environments, 3) the flexibility to execute software development, and 4) the capability to lead the corporation or society in the future.

(3) Curriculum Overview

During the preparation phase of this education course, staffs and instructors from universities and cooperating companies got together and had through discussions about the curriculum overview and the details of each course. As the result, we have

decided to introduce the practical training, human skills development and ICT sophistication courses on top of the conventional basic technology and theoretical courses. Considering the strength and weakness of university and cooperating companies, it was agreed that the university instructors should be in charge of teaching the basic technology and theoretical courses and instructors from cooperating companies should be in charge of teaching the practical courses and omnibus courses. Figure 1 shows the curriculum overview and Figure 2 shows the curriculum schedule of this education course. In order to establish the alliance with other universities
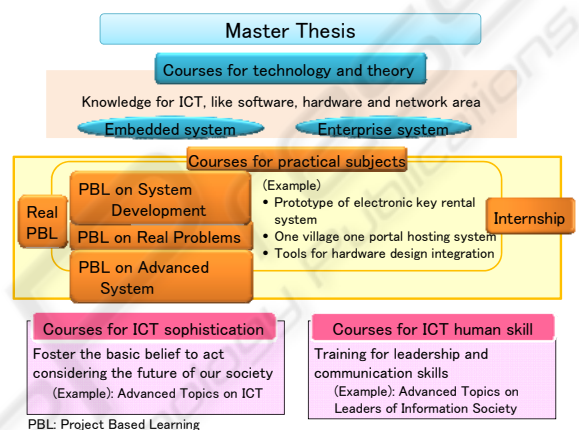

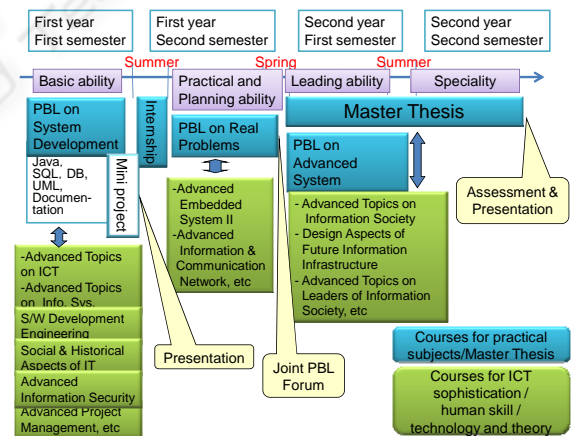Figure 1: Curriculum overview.

Figure 2: Curriculum schedule.

and to educate as many students as possible, we asked other universities in Kyushu area to join this education program. As the result, Kyushu Institute of Technology (KIT), Fukuoka University, Kumamoto University and Miyazaki University joined this education course as our partners. We also established the management structure to run this education course jointly with cooperating companies

under Keidanren. The management committee, which is held quarterly, is responsible for defining the strategy and giving the direction to this education course. The project office is responsible for executing the curriculum and running this education course. Advisory committee and evaluation committee, both of which are held once a year, give the advice and evaluation to this education course from broader perspectives. By establishing these management structures, we can improve our curriculum through the repeated Plan-Do-Check-Action (PDCA) cycle.

2.2 Project Based Learning (PBL)

PBL is the way of learning where students are assigned the actual project to execute and take the initiative in solving problems. It is very effective in developing the practical abilities. There are several papers which discuss PBL in ICT education (Matsuzawa, 2007, Itoh, 2007, Hanai, 2007). Here, we discuss the purpose and contents of PBL in this education course.

(1) Positioning of PBL and its Purpose

As indicated in Figure 1, PBL is positioned as the center of practical courses and is mandatory for the students. The purpose is to have students acquire the capabilities of problem-solving, logical thinking, insight and flexibility. Two systems engineers have been assigned as the full-time PBL instructors to this education course from the cooperating companies under Keidanren.

(2) Contents

In PBL course, students learn the project management process, starting from requirement definition, design, coding, testing and all the way to project maintenance phase. They are given the opportunity to develop abilities to define, prioritize, analyze and solve various problems that are encountered during the project. They also learn the importance of self-learning, teamwork, time management and communication. There are various projects, like the international project, actual project provided by cooperating local company, and advanced technology project to establish cloud computing environments. At the end of PBL course, Keidanren forum is held for the students to demonstrate their project result in front of many participants from cooperating companies and related universities.

As shown in Figure 2, PBL is performed in three stages, which are PBL on System Development, PBL on Real Problems and PBL on Advanced System. It was designed so that students can experience the project step by step depending on their abilities and can repeat the project management activities, which is unique in this education course.

2.3 Omnibus Courses

(1) Overview

In this education course, we offer five omnibus courses, where the executives, senior managers and technical leaders from cooperating companies give the lectures on various ICT topics. The lectures emphasize what is going on in ICT industry front end, how it is connected to the social infrastructure and how it is changing the world, in order to motivate the students and give them broader perspectives as the ICT engineers. In the first half of 2008, total 22 instructors from cooperating companies gave the lectures.

(2) Management Structures and Features of Omnibus Course

In omnibus lectures, we encourage interactive lectures by introducing the drills and discussion time. We also organize get-together after the lecture is over so that students and instructors can have casual conversation in the relaxed atmosphere, which is effective in motivating the students. At the end of the course, we conduct the panel discussion between students and instructors. All the omnibus lectures are broadcasted to the partner universities through the Internet.

We established a new way to manage the operation of omnibus courses. In order to avoid the duplication and to ensure the accuracy of lectures, we created a review team which consists of instructors from university and cooperating companies. The instructor, who is in charge of the lecture, prepares the class materials two weeks before the lecture. The review team reviews materials from the view point of 1) conformance to the course objective, 2) duplication with other lectures, 3) adequacy of terms used in the material. Then, it is distributed to the students a week before the lecture through WebCT (Web Course Tool) (Kyushu, 2008). Students can download the materials using their PCs. After the lecture, students and instructors are asked to fill in the questionnaire respectively. The results are shared among all the instructors to improve the quality of lectures. By

establishing this operation, we are able to 1) maintain the quality of lectures, 2) avoid content's duplication among the lectures, 3) have students prepare for the class and 4) provide instructors useful information beforehand.

2.4 Long–term Internship

In the summer of the first year, long-term internship is held, which is fully supported by Keidanren and its cooperating companies. In 2008, 24 companies provided 100 themes. This internship is the part of practical ICT education and aims to 1) acquire practical skills and knowledge, 2) enhance human skill, 3) motivate students as ICT specialists and 4) have students notice their weak points. This internship lasts for one to two months, which is more intensive than the conventional internship in Japan that is usually one or two weeks.

The students participate in the internship as the members of real projects and go through the system/product development, design, and quality evaluation phase. Themes of internship are published to the students through portal site on Internet and each student applies for his/her favourite theme. After the interview with company staff to understand the contents, all of the students start the internship when the summer vacation begins. During the internship, the Keidanren Joint Forum is held in Tokyo area to provide the chance for students, company and university staffs to get together and communicate each other. This is a very good opportunities for the students to talk with variety of people and broaden their sights.

Also, during the internship, university staffs visit the companies to see the status of internship and to motivate students. It is beneficial for the university teachers to understand how the internship is conducted in individual company and how the student is performing his/her theme.

The students' presentation session is held after the internship is over. We invite the cooperating companies' staffs and other university teachers to this session. All the students make presentations to demonstrate their achievement and the lessons learned during the internship.

3 INTERIM RESULT AND EVALUATION

Although it is only one year and half since we started this education course, there are many findings and outcomes which will be described in this chapter.

3.1 Project based Learning (PBL)

In this section, we discuss the PBL on System Development and PBL on Real Problems, which are held in the first semester and the second semester of the first year respectively.

(1) PBL on System Development

One of the big problems was the variety of skill levels and basic knowledge of the students. We have decided to teach project management, documentation, Java, SQL and UML during the PBL course. Actual project was conducted using a company's real case developed for their employee training. The students were given the source code of Web book store application programs and were instructed to create the project documentations, which we call the reverse engineering. By doing so, students could learn the necessary skills and knowledge depending on their technical level, which was very effective.

Before the team assignment, we conducted a programming test and preference inventory survey. Based on the result, the teams were created (4 to 6 members) so that each team has similar technical and communication skill level. This was very effective to promote active communication within the team. During the project, each student was asked to rotate their role, like project manager, quality manager, configuration manager, so that they can understand the importance of each role.

At the end of PBL course, we tried a mini project where students were given a task to improve usability interface of anything in everyday life and to create a prototype. All the teams decided their project and started to work very hard to solve the problems. Though it was only two weeks project, students had a precious experience to discuss and work together. The presentation session we had at the end of mini project was a success. 70 people participated including university staffs, students and cooperating company staffs. One of the programs was nominated as the candidate for patent application and the other program is now used as the online questionnaire system in this education course. The mini project proved to be very effective for the students to learn how to take initiative in finding and solving problems.

(2) PBL on Real Problems

This PBL course focuses on the real projects in the university and external company. A variety of themes were prepared like enterprise system project, embedded system project, international project. Students chose their favourite project and the projects were started. The instructor from cooperating company managed all the project teams and reviewed project status extensively. The university and local company staffs played roles of customers and took care of the technical aspects of the projects. At the end of the projects, we held a Joint PBL Forum on March, 2008, in Tokyo together with Keidanren, Tsukuba University and KIT, where the students made presentations and demonstrated their outcomes. Total 121 people attended the forum including about 60 people from cooperating companies of Keidanren. It proved that the students are making progress steadily. This forum was very effective for the students to acquire presentation and communication skills and to improve their motivation.

3.2 Omnibus Courses

After the ominbus courses were over, we conducted students' survey. All the courses scored more than 80 out of 100, which indicate students were satisfied with omnibus courses. Some of the typical comments were that 1) the lectures based on real business cases were very convincing and interesting, 2) the interactive group discussion was exciting, and 3) they could broaden their perspectives because of the various themes in the courses. The high scores and these comments show that omnibus lectures are highly effective in motivating students and broadening their perspectives. However, there was a concern on the disruptions of Internet lines to broadcast the lectures to partner universities.

At the end of each lecture, we asked the instructors from cooperating companies to let us know their insights. Their typical comments were that 1) students were very active in group discussion, and 2) students were very honest in the get-together after the lecture. They raised a concern on the lack of proactive questions from the students in addition to the disruptions of Internet lines.

We had several new trials during the omnibus courses, such as 1) joint panel discussions among students and company executives to discuss the future of ICT and society, 2) introduction of the instructors by students based on their preliminary exploration, and 3) publication of the lecture notes

through Intranet. All of these trials were very effective for the students to learn proactively and to enhance their communication capabilities.

3.3 Long–term Internship

All the 29 and 19 students participated in the internship in 2007 and in 2008, respectively. We tried several new approaches as follows.

(1) Encouraging Students to Take Initiatives

Before starting the internship, students were encouraged to talk to the company staff about nondisclosure agreement, terms and conditions, which was a good opportunities for the students to negotiate in the real business situation. At the Keidanren Joint Forum described in section 2.4, the students from Kyushu Universities, Tsukuba Universities and KIT discussed the current status and problems of this education course. They made proposals to this education course, which were highly appreciated by the university and company staffs.

(2) Visiting the Companies by University Staffs

During the internship, we visited all the companies, which accepted the students, in order to see the status of internship and to discuss with the company staffs. By doing so, we could obtain useful findings such as 1) matching is very important between student's skills and required skills, 2) more than two months are required to acquire professional skills, 3) basic business manner is required. These visits were quite beneficial for the university staffs to understand the problems and challenges as well as to motivate the students on site.

(3) Students Forum to Report the Result of Internship

The students' presentation session was held to share the experience and findings after the internship were over. The students gave positive opinions like 1) the importance of team work and time management, 2) skills that need to be enhanced, and 3) the importance of business manners. The long-term internship is quite beneficial and is a precious experience for the students, where they could work with professional engineers and students from other universities in the actual business environment.

(4) Evaluation by Company Representatives

We asked representatives of each company to evaluate student's performance. According to the evaluation in 2008, 95% of the students could

complete the projects in a given period. 90% of the students satisfied the required skill level. 53% of the students performed the projects as expected and 37% of the students exceeded the expectations. They rated 74% of the students were aggressive. Though it was pointed out that the students are not proactive in asking questions in the omnibus class, this evaluation indicates that students have developed aggressive attitude, which was one of the positive outcome of this internship.

(5) Benefits of Long-term Internship

Compared to the conventional internship in Japan, which is 1 to 2 weeks, the long-term internship can provide real project environment for the students to work with company professionals. The students were treated as the members of project team and they worked very hard to accomplish their mission. There were many findings from the students' side, too. The students became aware what is required in the real business environment, what skills are lacking to them and what they need to do in the future. All of these are the benefits of long-term internship.

3.4 Business-academia Joint Camp to Discuss Curriculum

A very unique approach in this education course is the joint camp to discuss the contents of omnibus lectures, PBL and internship in addition to the overall curriculum and outstanding issues of this education course. This camp is held twice a year and lasts for two days, where university staffs (about 15 people), instructors/executives from cooperating company (about 20 people) and the students (about 5 people) attend. By organizing this camp, 1) we can have the common understanding on the contents and objectives of overall curriculum, 2) instructors can share the purpose of omnibus courses and eliminate the duplication, 3) we can confirm the common challenges of this education course, and 4) acknowledge the sense of unity as a team. These are very valuable and essential in running this education course. This approach can be regarded as a new way of doing faculty development in the university.

3.5 Overall Evaluation

Since April, 2007, when this education course started, we have endeavoured to foster highly skilled ICT personnel by the continuous improvements of the curriculum, which were described so far. Table 1 shows the overall evaluation after one and half

year's experience. Five evaluation items were picked up as human resource development and three evaluation items were picked up as curriculum management. Eight major action items in this education course and their evaluations were summarized in Table 1. The establishment of large scale business-academia collaboration, which was implemented as management committee, project office, advisory committee, joint camp and various support from cooperating companies, was very effective in performing and enhancing the practical education. PBL and omnibus courses, which were taught by the instructors from cooperating companies, were very useful in strengthening the students' practical skills and broadening their perspectives. Long-term internship provided excellent opportunities for the students to experience the projects in the real environments and to improve their motivation. By utilizing WebCT and broadcasting the lecture, the students in the partner universities were able to participate in the omnibus classes.

Naturally, the evaluation of an education course should be done based on the performance of students after their graduation. However, we believe that the education course by large scale business-academia collaboration is very effective and can improve students' skills, execution capability and proactive attitude tremendously.

Table 1: Overall evaluation.

Major actions \ Evaluation item	Human resource development					Curriculum management		
	Specialty skill	Human skill	Practical skill and project experience	Broader perspective and flexibility	Student's motivation	Execution of practical curriculum	Inspiring unity as a education team	Joint education with partner university
1 Large scale business-academia collaboration					E	VE	E	
2 Instructors from cooperating companies	E	E	VE	VE	VE	E	E	
3 Joint camp and management committee						VE	VE	
4 PBL courses	E	VE	VE	E	VE	E	E	
5 Omnibus courses and get-together	E	E		VE	VE	E	E	
6 Long term internship	E	E	VE	VE	VE	E	E	
7 Partnering with other universities						E		VE
8 Utilizing WebCT and broadcasting to partner universities								VE

VE: Very effective   E: Effective

4 CHALLENGES IN THE FUTURE

We see the challenges in the future as follows.

(1) Time Management between PBL and Research Activity for Master Thesis

Most of the students have tendency to work hard beyond the PBL class hours extensively. Many students are suffering from the workload balance between PBL and master thesis. This issue should be considered including the structure of this education course.

(2) Establishment of Sustainable Education System

Although we spend much manpower and time on this education program, it is imperative to utilize our resources more appropriately so that we can continue this program and educate more effectively. Also, it is important to establish the way to evaluate the growth of the students.

5   FINDINGS

Here are the major findings that were derived from the experience in last one and half years' experience in this education course.

(1) The Importance of Information Sharing and Mutual Agreement on the Direction of Education Program

We believe that large scale business-academia collaboration in the university education like this program was the first trial in Japan. We knew that university staffs have strength in teaching the basic theory and technology. On the other hand, company staffs have strength in practical education. Through the repeated discussions, we decided to take advantages of both sides and designed the curriculum to achieve the common goal of fostering the internationally competitive ICT personnel. We found that it is very important to have common understanding and agreement on the direction of program in order to perform the large scale business-academia collaboration successfully.

(2) The Importance of Creating the Process to Ensure the Consistent Curriculum

In order to maintain the consistency of curriculum, we organized the management committee, project office and two days joint camp. In addition, we established the review process for the omnibus classes to ensure the consistency among the omnibus lectures. All of these processes proved to be very effective.

(3) The Importance to set up the Process to Enhance Students' Motivation

We found that the students are strongly motivated when they can contact with external communities and personnel. To this purpose, it was very effective to set up the get-together with instructors from cooperating companies, the joint forum during the internship and at the end of PBL.

6   SUMMARY

In this paper, we described the endeavour to foster the highly skilled ICT personnel in Graduate School of Kyushu University, trial of large scale business-academia collaboration, effectiveness and findings. We have a lot of challenges ahead of us to deploy this education system to other universities and to make it sustainable, but we are determined to improve this new approach.

ACKNOWLEDGEMENTS

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