New ICT Education Collaborating with Regional Agricultural Corporations

Efforts to Agricultural Innovation

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Conference Key Areas: University-Business cooperation, Engineering Skills

Keywords: Active learning, Learning by Teaching, Laboratory-Based Education, Region cooperation

INTRODUCTION

This paper introduces the new Laboratory-Based Education (LBE) applied to students of the Department of Information and Computer Science in Kanazawa Institute of Technology (KIT), Japan. The new LBE focuses not only on activities in the laboratory but also on field works collaborating with regional corporations. In this paper, the unique and practical example of the ICT education collaborating with industry and community is described, and the educational effects of the system are explained.

LBE is an education system emphasizing team research, which is usually carried out as the capstone course for seniors in Japan [1]. It is also studied to adopt LBE to a university in Indonesia [2]. In this study, the new LBE was carried out as the

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extracurricular activity collaborating with regional agricultural corporations. The project was supported as one of the “Center Of Community (COC)” projects by Japan’s Ministry of Education, Culture, Sports, Science and Technology.

The purpose of COC projects is to bring up the talented people who recognize the problems of the regional district and can act actively towards solutions, and to form the core universities of regional vitalization. Kanazawa Institute of Technology (KIT) has been selected as one of COC universities.

The educational goals of KIT are to nurture human resources, who can:

1. convert knowledge into wisdom (application force),
2. act by thinking, and
3. create an innovation under a variety of environments.

The goal of this agricultural project is to contribute education to meeting the educational goals of the KIT through the COC activities.

This paper explains the details of the practical project example which was carried out with the agricultural corporations. The largest agricultural corporation in Ishikawa Prefecture in Japan requested the development of the ICT system for rice cultivation management for the project. Students have achieved significant growth in the project.

1 SIGNIFICANCE OF PROJECT ACTIVITIES IN KIT

1.1 KIT pedagogical system

In KIT, students are educated in two wheels of curricular education and extracurricular education (Fig. 1). The Project Design Program (PD) is the backbone of the curricular education, which is carried out as a regular class for all students and has made great achievements [3-4]. Project-Based Learning (PBL) is applied in PD courses.

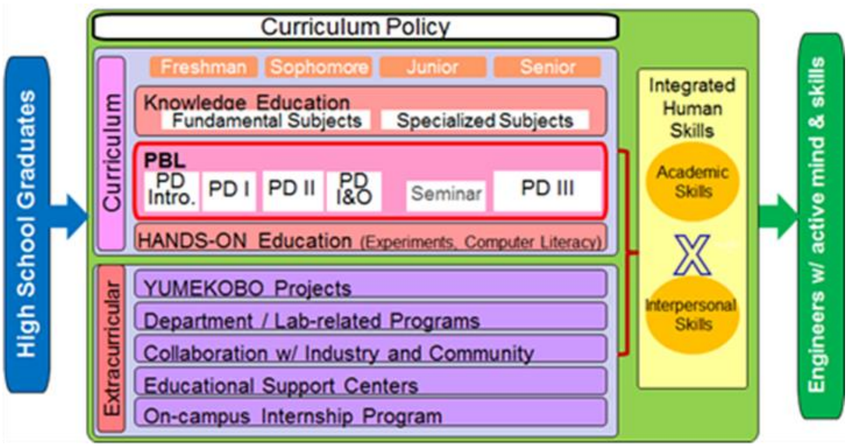

Fig. 1. KIT Pedagogical System

Extracurricular activities also play an important role in KIT. They include YUMEKOBO Projects (YUMEKOBO is a Japanese term which refers to the Factory for Dreams and Ideas), Department/Lab-related Programs, Collaboration Programs with Industry and Community, and Internship Programs. In these activities, students can set up objectives by themselves and learn from the successes and failures. For example, YUMEKOBO Projects are self-directed projects to develop students’ technical competence [5]. There are 16 YUMEKOBO Projects in 2016 [6].

1.2 Active Learning with LBE

The expert performance is closely related to the assessed amount of deliberate practice [7]. Since there is a limit to the class time in the framework of regular classes, it is difficult to carry out the education of deep active learning which repeats failure and success. It is also difficult to secure the opportunities for seniors to guide the juniors and students to teach each other in regular classes. In learning pyramid, the learning retention rate is high when active-ownership is higher [8].

To satisfy these pedagogical objects, the new Laboratory-Based Education (LBE) collaborating with regional agricultural corporation was applied to the project of 15 students. LBE is usually carried out in the capstone projects of seniors or graduate students. In this LBE, members consisted of four seniors, five juniors, two sophomores, and four freshmen. Seniors of the Department of Information and Computer Science worked on the project as their graduation works, whereas juniors, sophomores and freshmen joined the project as their extra-curricular activity. Some of them were from other departments, which made the project multi-disciplinary.

Seniors acted as researchers and project managers of the project. Freshmen, sophomores and juniors played roles as developers and operators. Activity image of the project is shown in Fig. 2. Students in the same grade worked to help each other. Higher grade students (sophomores, juniors, or seniors) gave instruction and guidance to the lower grade members. Through these activities, students learned skills and techniques. In addition, students learned the process of scientific inquiry.

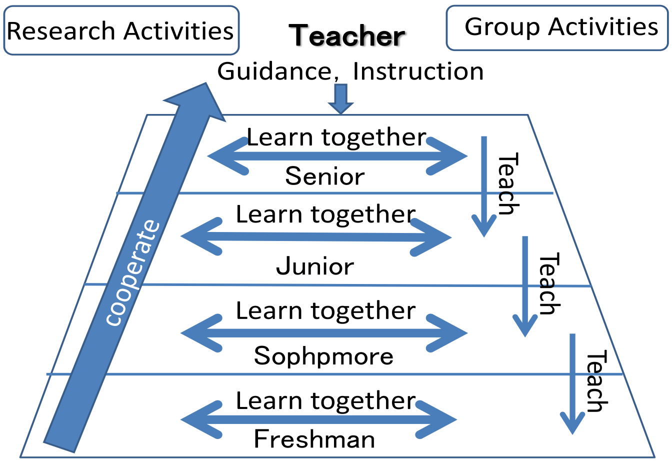

Fig. 2. Activity image of LBE

2 DETAILS OF THE AGRICULTURAL PROJECT ACTIVITIES

2.1 Project Objectives

We set the project objectives to realize an ICT system for rice cultivation management. The local agricultural corporation has a need to improve rice cultivation process using ICT. However commercially available ICT systems for agriculture are general-purpose and not focused on rice cultivation. They are equipped with extra features and very expensive, while some of the functions necessary for rice management are not provided.

2.2 ICT System Design

Students went to the field, had meetings with staff of the agricultural corporation and tried to find out necessary functions for the rice cultivation management system (Fig.3.). This required definition process is important in the company, but it is difficult to experience the process in the university context. Therefore, it was the valuable opportunity for students.

Fig. 3. Meeting with the agricultural corporation

Project members discussed the specification of the rice cultivation management system based on the requirements. From the investigation, they clarified the problem, created the ideas, and selected the final ideas. After that, they decided to set up a field server in the paddy field. Then as the implementation of the idea, they discussed the functions required in the field server, including:

1. Temperature, humidity, soil temperature, soil humidity sensor, and installed camera.

2. Compact size, which does not cause a hindrance of agricultural work.

Based on the specification, the field server prototypes were created and placed in the rice field to monitor the condition of the field. The prototype system is shown in Fig. 4.

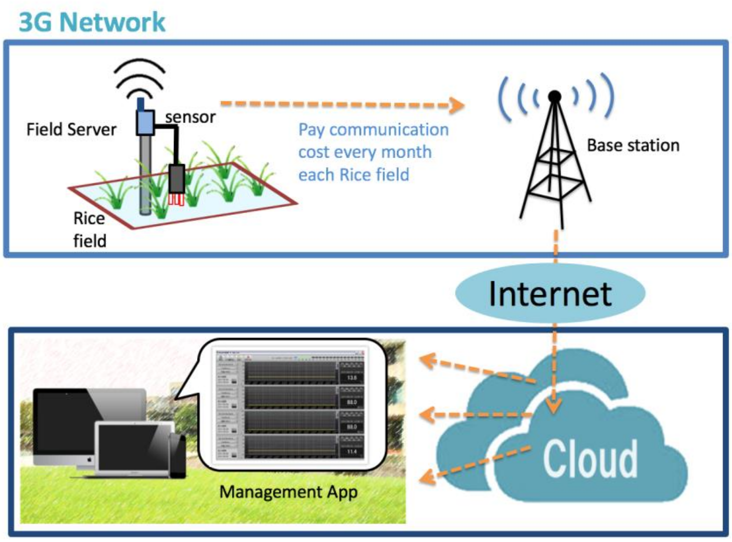

Fig. 4. Prototype system of the field server

2.3 Flow of improvement activities

We developed the field server based on the specification, and placed it in the paddy field. When we have met with agricultural corporation after the installation, the following problems have been found.

1. Farmers did not notice the sensor location. There was an accident that the mowing machine cut the sensor wiring.

2. The field server introduction was costly.

3. Operating costs occurred due to the use of 3G network

For these customer requirements, we made changes in further clarifying the problem, creating the ideas, selecting the ideas, and implementing the idea. For problem 1, we changed the sensor position (Fig. 5). For the problems 2 and 3, we developed a new field server which uses the local wireless network (Fig. 6) [9, 10]. Compared with the existing field server, introduction and operating cost is lower. The field server which was developed in the project has the portable size. In other word, this newly developed field server is superior to other existing field servers. In this project, students learned the importance of customer requirements.

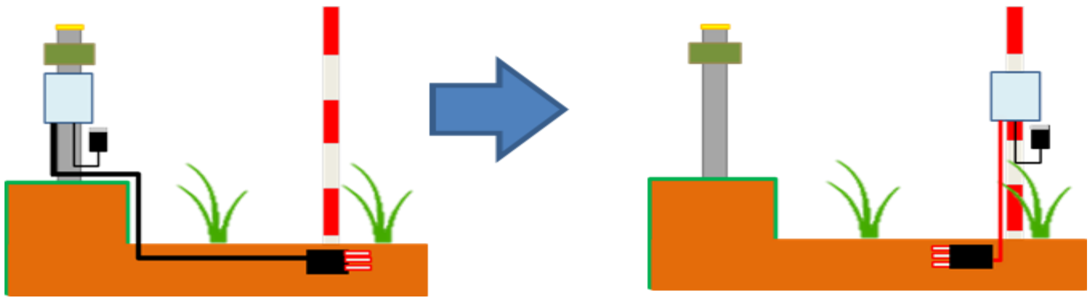

Fig. 5. Clarification of the sensor position

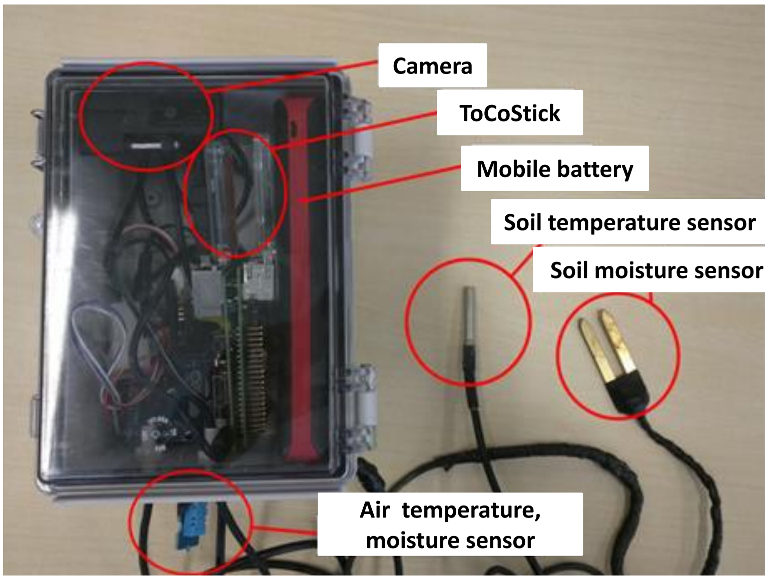

Fig.6. Field server which was developed

Fig. 7 shows the flow of the problem solving and improvement in the agricultural project. This flow is the same as the flow which is taught in the project design education of the regular classes in KIT. The difference between the regular curriculum classes and the project is that the flow is carried out repeatedly.

By repeating the improvement flow, students were able to examine the deep and difficult matters. By working in a team of different grade levels, senior students were able to learn the leadership. By doing the research, juniors learned the importance of the regular curriculum classes. Students learned to be able to use the product development of the knowledge.

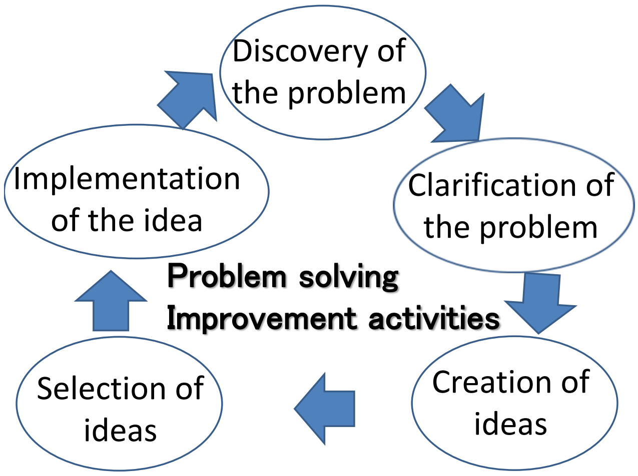

Fig. 7. Problem solving, improvement activities flow

The developed system is superior to other commercially available systems in five points. First, the developed system is easy to move. Second, the system has a monitoring camera. Third, it works with the mobile battery. Fourth, it uses free local network. And finally, the system can measure the water-level. The developed rice cultivation support system is an excellent system in terms of easy operations and installation. The developed system obtained highly positive evaluation from the agricultural corporation.

From the project, students learned how to listen to the farmer's request, how to analyse the requests, and how to create the system. They also learned how to do the operation test, how to solve extraction problems, and how to improve the system. They finally summarized the obtained results in a form of written papers.

3 RESULTS AND DISCUSSION

The students created a matching field server to the request of the agricultural corporation and were able to perform the operation in the paddy field. Through the development of the field server, students satisfied the request from the agricultural corporation, made the request analysis, and learned the technique to build the system. In addition, they learned the method of operation test, issue extraction, and problem-solving.

These practices are important because they do not have a chance to experience in the regular curriculum classes. These experiences that they have gained are useful to contribute to the society. And these are the experiences that will help in the society.

Fig. 8 shows a teaching session by seniors to the juniors. Students taught with respect to one another in the same school year and learned together. Throughout this project education, students were able to learn the ability that is required in society. Seniors gained leadership. Seniors and other project members improved their communication skills and acquired cooperativeness and a sense of responsibility.

Fig. 8. Learn together, each other teaching

By applying LBE, this agricultural project succeeded in realizing the ICT system superior to commercially available systems for rice cultivation management. The agricultural project has been useful in order to achieve the educational goals of KIT.

This project results in another collaborating project with the local government. The learning opportunities of students expand by LBE.

4 SUMMARY AND ACKNOWLEDGMENTS

This paper introduced the new Laboratory-Based Education (LBE) applied to students of the Department of Information and Computer Science in Kanazawa Institute of Technology (KIT), Japan. The new LBE focuses not only on activities in the laboratory, but also on field works collaborating with regional corporations. In addition, the unique and practical example of the ICT education collaborating with industry and community was described, and the educational effects of the system were explained. The project has provided great opportunities for students to learn and develop their abilities in problem clarification, ideation, idea implementation, teamwork, and leadership. All of these have made the project effective.

When implementing this agricultural project, we were supported by the industry-university cooperation office in KIT. We are very grateful to the member of the industry-university cooperation office. In addition, we are very grateful to the agricultural corporation that worked together.

REFERENCES

[1] Jica, “What is LBE?”, https://stream.jica-net-library.jica.go.jp /lib2/11PRDM002/contents_e/index.html, (March 12, 2016 reference).

[2] Amar, K., Ishiharada S., Ja’far M., Luthfi and Saksono B. (2014), The Adoption of a Laboratory-Based Education Model as the Foundation of a Research University: Relevance to a University in Indonesia, *Education Journal*, Vol. 3, No. 4, pp. 229-234.

[3] Furuya, S., Shin M. and Sentoku E. (2012), Formation of Active Attitude for Learning and of Habits of Scientific Thinking by Project Based Team Learning at Kanazawa Institute of Technology, Proc. of the 8th International CDIO Conference.

[4] Ito, T., Shin M., Miyazaki K., Iwata S. and Sentoku E. (2015), The Effects of Spiral Educational Method through PBL: KIT Project Design Program, Proc. of the 43rd Annual SEFI Conference.

[5] Matsuishi M. (2013), The Factory for Dreams and Ideas: Students’ Projects to Enhance Professional Technical Competence, Proc. of the 41st Annual SEFI Conference.

[6] YUMEKOBO (Factory for Dreams and Ideas), http://www.kanazawa-it.ac.jp/ekit/about/campus-facilities.html, (May14, 2016 reference).

[7] Ericsson, M.A., Krampe R.T. and Tesch-Romer C. (1993), The Role of Deliberate Practice in the Acquisition of Expert Performance, *Psychological Review*, Vol. 100, No. 3, pp. 363-406.

[8] Kåre Letrud, (2012), A Rebuttal of NTL Institute’s Learning Pyramid, *Education*, Vol. 133 Issue 1, p117-124.

[9] Furuta, T., Nakagawa H., Kitamura T., Kawakami Y., Kurosawa K., Kogami K. and Tanaka M. S. (2016), Agricultural support system equipped with short-range wireless communication system, Proc. of IEEE TIAR.

[10] Kawakami, Y., Furuta T., Nakagawa H., Kitamura T., Kurosawa K., Kogami K., Tajino N. and Tanaka M.S. (2016), Rice Cultivation Support System Equipped with Water-level Sensor System, Proc. of IFAC AGRICONTROL.