USING INTERNATIONAL WORK-PAIR IN ENGINEERING EDUCATION

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ABSTRACT

International student work-pair practices have been established between Helsinki Metropolia University of Applied Sciences, Finland and Tokyo National College of Technology, Japan. In this paper we introduce an innovative learning approach by matching Japanese students with Finnish working pairs and give them a Design-Implement project to work together. During the exchange period, the students work together on the project. After the exchange period, both students will finalize their contribution to the project and represent the results on network meeting. We have found this very effective method to organize student exchange.

KEYWORDS

Design-Implement-Experience, peer-tutoring, work-pair

INTRODUCTION

During the last three years, international student work-pair practices have been established between Helsinki Metropolia University of Applied Sciences (Metropolia), Finland and Tokyo National College of Technology, Japan. The institutes have a bi-lateral agreement, which enables 1-2 week long teacher exchanges and 2.5-9 months long student exchanges. Earlier, different timing of the semesters made exchange students attendance to regular classes practically impossible on shorter than a semester long exchange periods. To improve the situation, we introduced an innovative learning approach by matching Japanese students with Finnish work-pairs and giving them a Design-Implement project to work together.

The student-pair work starts after the student has been selected to the exchange program. First, the project topic is selected in the study field of the exchange student. Then we match a local student to the project and introduce the students with each other's and the first preparatory assignments age given. Both students will have some time to search for information about the topic, and the local student will assure that all required tools are available upon arrival of the exchange student. When the exchange student arrives, the local student helps him/her to get used to local customs. The students will work on daily basis together on the project. Weekly/bi-weekly internet meetings are held to monitor the progress of the project. After the exchange

period, both students will finalize their part of the project and represent the results on a network meeting.

A brief review of the existing literature shows that student pairing has been successfully employed for example in programming courses [1] and some recent studies has emphasized importance of understanding the compatibility issues [2]. You may find student pairing being used in foreign language classrooms [3], or mathematics problem solving exercises [4]. Metropolia has previously used a similar approach to accommodate new international degree program students to the multicultural learning environment [5].

In this paper, we first give a brief introduction to the institutes as a part of describing the environment. Then, we present the student-pair concept to offer a framework to follow for other institutes wrestling with the similar practical problems. After this, we introduce an example student-pair case, show the results, and discuss about our key findings. Finally, we discuss about our future cooperation and draw some conclusions.

ENVIRONMENT

The Finnish higher education system offers alternatively scientific (research University) and applied track (University of Applied Sciences). The universities of applied sciences focus on practical applications of research results in close cooperation with industry and they offer education in Bachelor's and Master's Degree Programs (level 5A in UNESCO classification [6]).

The Japanese higher education system also offers dual-track educational system for developing engineers; university and colleges of technology which are referred to as Kosen. Japan's Kosen school system was established to respond to a strong demand from industrial sector to foster engineers who sustain Japanese high economic growth in the 1960's. Kosen are hybrids of high schools and colleges, providing graduates from junior high schools who are still 15 years old and have flexible minds, with five-year integrated specialized education. As Kosen students do not need to study for university entrance examinations, they can focus on scientific experiments, practical training, and practical skills based on a theoretic foundation. Due to these characteristics of Kosen education, five-year graduates obtain very good reputation in industry [7]. The condition surrounding engineers have dramatically changed due to the rapid advancement of technology in industry since the establishment of Kosen system. So Kosen's advanced courses for an additional two years after the five-year regular courses were launched in 1991. Graduates in the advanced courses can receive bachelor's degrees from the National Institution for Academic Degrees and University Evaluation [8].

Helsinki Metropolia University of Applied Sciences (Metropolia) is the largest University of Applied Sciences in Finland. Metropolia offers education in the fields of Technology, Healthcare, Arts, and Culture [9]. Since 2008 Metropolia has used the CDIO principles in all study programs by introducing the first year orientation project and third year multidisciplinary CDIO project [10].

Engineering studies are offered in 30 degree programs for about 7500 daytime and evening students. Information Technology, Media Engineering, Environmental Engineering, Electronics, and Civil Engineering degree programs are taught fully in English, which enables the Metropolia students to learn on a truly multicultural learning environment. In addition to our own educational offerings, all members of the Metropolia community has excellent opportunities to visit our 200+ international partners and gain more international experiences [9].

Tokyo National College of Technology is one of Kosen which is located in the western part of Tokyo. Currently, Tokyo Kosen has five departments; mechanical engineering, electrical engineering, electronic engineering, computer science and chemical science engineering, and three advanced courses; mechanical and computer systems engineering, electrical and electronic engineering, and chemical science engineering. The total number of students is about 1070 [11].

Now that Kosen serves as the higher education to produce core or leading engineers in manufacturing industry in Japan. In order to ensure an internationally recognized quality assurance, Kosen has been eager in getting accreditation of JABEE (Japan Accreditation Board of Engineering Education) which has been a member of Washington Accord since 2005 [12].

Figure 1 compares Japanese and Finnish educational systems, which have some significant similarities. Both systems are based on a dual model, with partly separated for tracks research universities and applied sciences universities. Both countries are offering matching educational degrees at Bachelor's level, Master's degree, and post-graduate education. The applied university tracks are mainly similar, except that in Japanese system students are starting on Kosen at younger age, while in Finnish system practically all students are young adults.
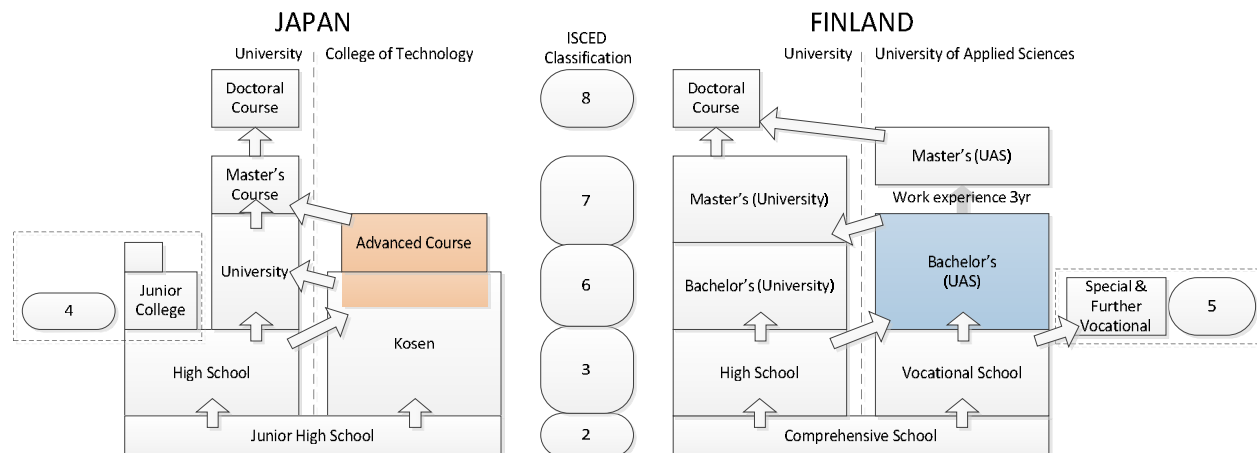

Figure 1. Japanese and Finnish education system comparison. Colored blocks show the student-pair target groups. Rounded block numbers indicate ISCED classification.

STUDENT EXCHANGE

Metropolia and Tokyo Kosen has long traditions on co-operation in forms of short term faculty and staff exchange, long term student exchange, and exchange of information. The agreement states that the volume of student exchange is limited to four students for one semester from each institution per academic year. The volume of teacher and staff exchange remains variable and each case is decided separately. However, all contextual or organizational details are not mentioned on the agreement leaving a lot of room for case-by-case customization.

In practice, teacher exchange focuses on offering of one week long intensive courses. In addition, we are arranging network meetings at least once a month to discuss practical co-operative matters. The student exchange has two forms in general. Metropolia students are usually visiting Tokyo Kosen for either one semester or a full academic year. Before the visit, they are attending Japanese language and culture classes in Metropolia. During their exchange period, they usually are attending research projects and language lessons.

Metropolia and Tokyo Kosen have a different academic calendar (see Figure 2). Metropolia has four terms and Tokyo Kosen has two terms. Therefore, the whole September is available for both schools to carry out work-pair practices, but there is a limit for Tokyo Kosen students to extend their staying at Metropolia for another month, because their classes in Japan start at the beginning of October. Under the current academic calendar, the most suitable period of sending students to Finland is thought to be about 2.5 months, that is, from the beginning of August to the middle of October. Additional benefit to Tokyo Kosen students is to be able to attend summer school courses offered by Metropolia in August [13].
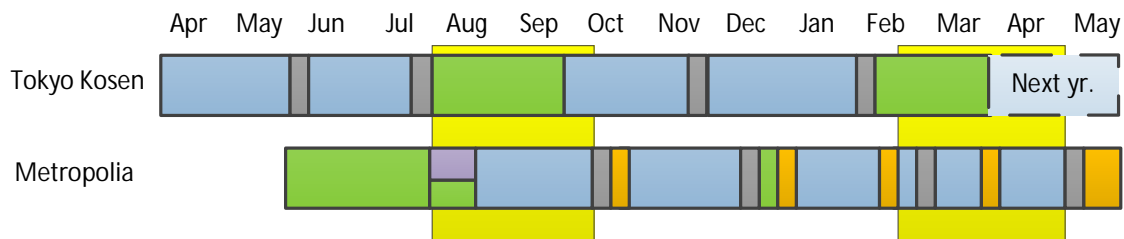
Figure 2. Comparison of academic year. Blue sections indicate contact teaching, grey sections are exam periods, green sections are holidays, orange sections are dedicated project weeks, and a purple block indicates summer school. Yellow blocks show the optimal timing for Tokyo students to visit Metropolia.

There is another condition to consider. The Advanced courses in Kosen must be constantly monitored and evaluated by outside institutions, the National Institution for Academic Degrees, in order to ensure the quality of the educational system. In addition, credits earned in the courses need to be approved by the institutions. Therefore, Tokyo Kosen started 2.5 months international work-pair project based on the current system and try to gain credibility from the institutions, which may lead to longer-term international student-pair project in the future.

Metropolia is accepting exchange student applications twice a year. Selection is based on the partner agreement and ability to provide requested support. Most students who would be attending regular courses are accepted. In case of special projects requiring supervision resources, the application will be first approved by a Degree Program before the final decision.

Metropolia is offering intensive orientation days for the transfer students on the beginning of each spring and fall semesters. During the orientation course, the students will receive a survival package on the learning environment, public services, Finnish culture, and other practical matters. Unfortunately, shorter than one semester long exchange timing has usually a mismatch to this transfer student orientation. However, peer-tutoring by student-pair can easily fix this problem.

DESCRIPTION OF STUDENT-PAIR CONCEPT

The student-pair project is one practical implementation form of the exchange agreement. Initially we tried to find a solution for the following existing problems of student exchange:
- How we can offer better support to incoming exchange students using existing resources?
- How to improve the learning outcome of the student projects done abroad?
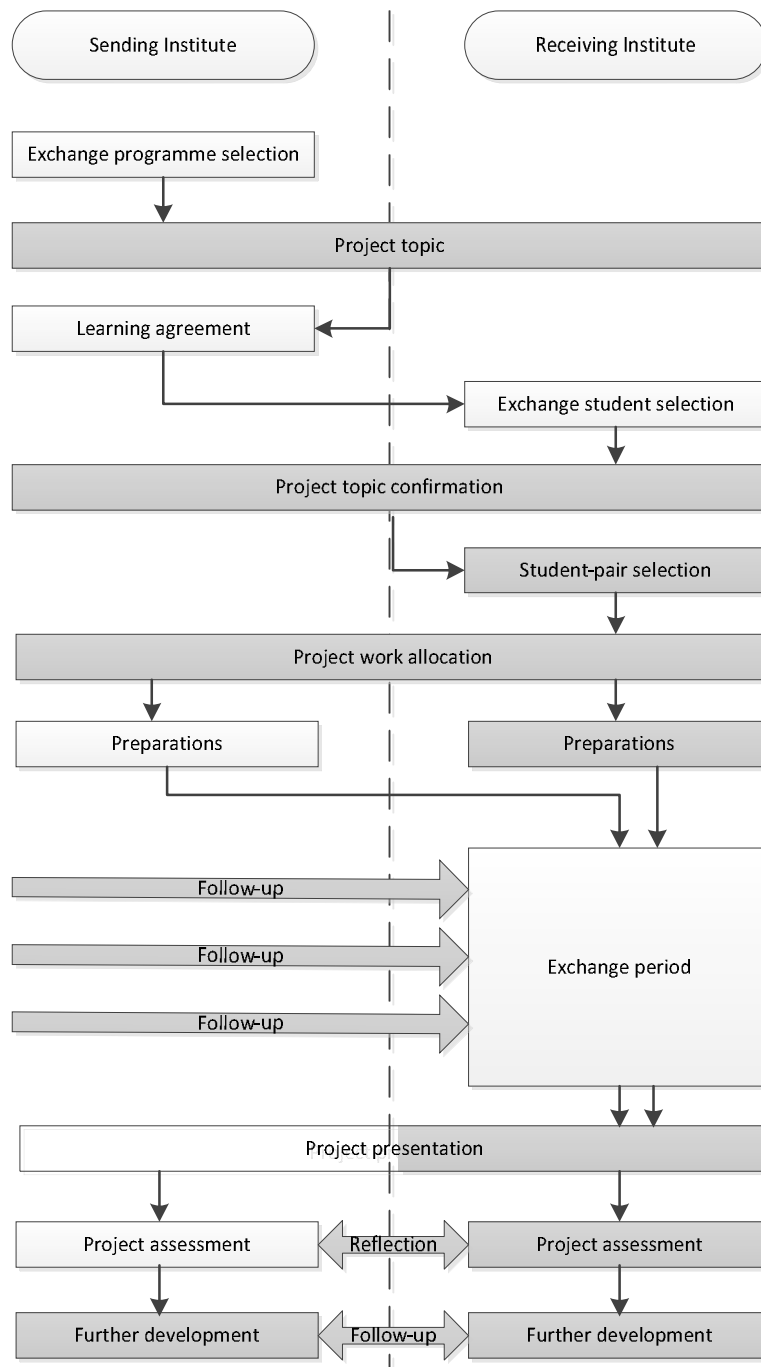- How to enhance the interaction between exchange students and local students?

Figure 3. Student-pair concept. Shaded boxes implicate the additional steps compared to regular student exchange.

During our regular network meetings we came up with the idea that paring of the exchange student with a local student can potentially offer solutions to the named problems. After some well spent working meetings we came up with a concept (shown in Figure 3), which fits into our operation environment.

The foundation for this co-operation lays on the existing student exchange procedures, which are based on bilateral student exchange agreements. Students first apply on their home institute for exchange abroad on their preferred partner institute. If student gets admitted to the exchange program, then the academic supervisor of the student will contact his/her colleague of the partner institute to discuss about the project topics, which would fit the students' skills and academic needs of both institutes.

After the initial topic is found, the student and home institute will sign a learning agreement, which states the contents and duration of the exchange period. Then the student applies to the partner institute student exchange program. After the final acceptance, the project topic is specified with more details and the partner institute will select the pairing student to work on the project.

The project kick-off network meeting will be held to assign preparatory tasks to make sure everything is ready for the transfer period. Usually the exchange student will focus on background research, and the partner student will concentrate on getting all required tools and other recourses ready. Students are also required to start communicating with each other and contribute to all tasks.

During the exchange period both students are required to spend enough of time on the common parts of the project and attend weekly on-line follow-up and steering meetings. The project progress is constantly monitored to maximize the impact of the exchange time. At the end of the exchange period, the students will give short presentations on the results and their contribution to the project.

After the exchange period, the students will get a final assessment of the project work on their home institutes. Although the academic part of the project has a clear milestone, it is quite usual that the students will continue on either the same or related project for example as their final year project.

If we compare the student-pair concept with the regular student exchange procedure, we find that with rather small amount of extra preparatory work we can enhance the level of co-operation and offer an active cross-cultural learning experience for both the exchange and the local student.

RESULTS AND DISCUSSION

In this chapter we describe a case project done by Mr. Joseph Wakooli of Metropolia and Mr. Kazuya Hayashi of Tokyo Kosen. The project topic was to develop a digital signal analysis system, which can handle audio, image and movie data, analyzing their spectrum and cross correlation using MATLAB [14]. Mr. Hayashi was responsible of designing and implementing the user interface, and Mr. Wakooli was focusing on the mathematical engine doing the calculations. An example of the complete system display is shown in Figure 4.

The system is capable of handling recorded and streamed data sets. Data can be either one- or two-dimensional, for example audio or video data. The system does both spectral and correlation analysis for the input. Usability and visual appearance are intentionally simple, since the tool is targeted to be used by engineering students.
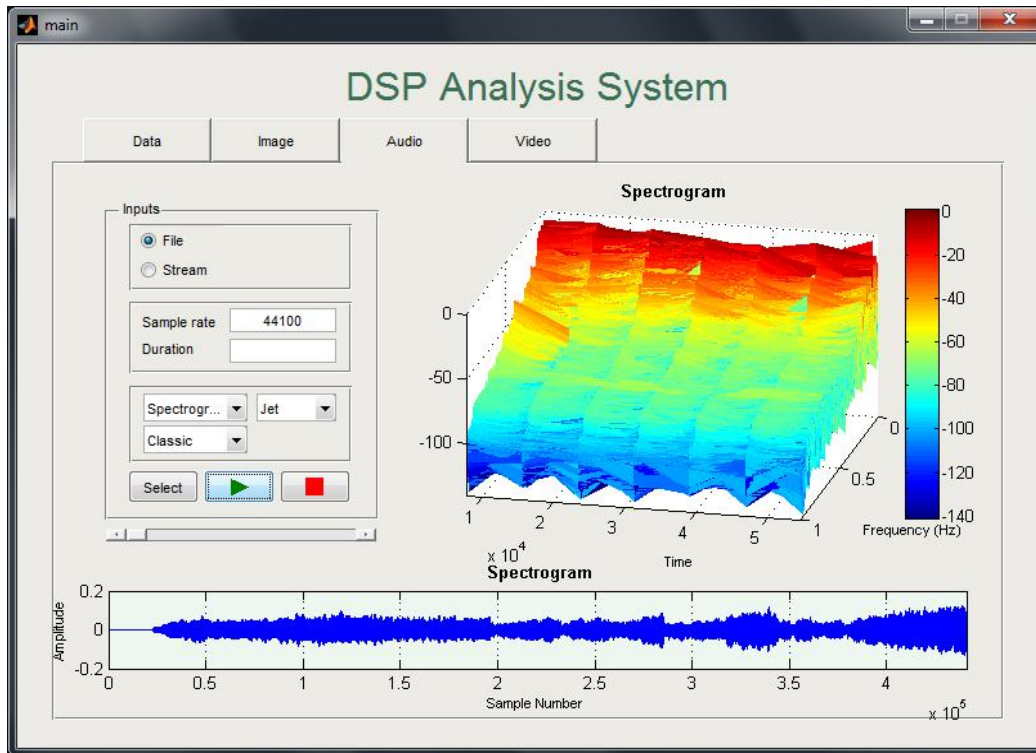
Figure 4. Signal Analysis System spectrum analysis window. User interface was designed and implemented by the transfer student and the mathematical engine by the pairing student.

Before the exchange period, Mr. Hayashi was asked to learn more about designing Graphical User Interfaces in MATLAB and Mr. Wakooli was instructed to learn more about signal analysis using MATLAB. The students worked together for 2.5 months and reported their progress on weekly or bi-weekly follow-up meetings. During this exchange period Prof. Aoki was visiting Metropolia as a Summer School teacher and as the supervisor of Mr. Hayashi. After his visit, we continued regular follow-up meetings on-line.

Regular follow-up meetings played a very important role on this project. We could see the progress, support both students together, and challenge the students to their best. At the end of the exchange period we witnessed a demonstration of fully functional signal analysis system. The final product met and exceeded the initial requirements, both students gained skills and knowledge of both interface and engine part, and learned how to work on a cross-cultural project environment.

Research activities such as graduation project are carried out in Kosen. In the process of graduation project, it is unlikely that students will discuss actively their subjects with each other, because a student usually works on it under his/her supervisor's instruction. Pair-work, however, enables students with each other to discuss deeply the details of the subject such as the design of the whole system and part module specifications to go on with their cooperative work. One of the big benefits of pair-work is to be able to make up for each other's weakness in knowledge and skills.

Work-pair gives students lots of opportunities to think about the same thing from a different perspective, and it stimulates to study more. Work-pair project is an effective way to notice blind

spots. In addition, when facing some difficulties, work-pair produces the feeling of efforts to overcome the problems by working together.

In the work-pair project, students are supposed to work together in English. But Japanese students, especially Kosen students, usually struggle with language barriers. Although it is often said that engineers must have English communicative skills in the era of globalization, learning English is not their first priority as long as they live in Japan, because for example usually science and technology books are available in Japanese. In addition, Japanese students do not have many opportunities to communicate with foreign students in English, because the transfer students are usually there to learn Japanese. As a result of the lack of opportunity to use English, it seems that many Kosen students fail to improve their English abilities. Moreover, they don't realize the importance of English communicative skills. The experience of work-pair strongly motivates them to study English harder to prepare them for the next opportunity to work together with foreigners.

The work-pair project gives students lots of opportunities to talk together in English, and therefore they are expected to learn thoughts, values, beliefs, and in general, culture of partners' country as well as English as a communicative tool. As of today, three Japanese students have experienced the work-pair project. There are some TOEIC scores to show how their English abilities have improved before and after the exchange [15]. Each of them has improved his TOEIC score from 500 to 705, 495 to 735, and 540 to 680, respectively. Moreover, one of the students finished the advanced course of Kosen this March, and found a job with a multinational corporation, which is the world's leading company, but not much famous in Japan. His priority in looking for a job is to work together with foreign people and share exciting experience with them. The experience of his work-pair project greatly helps broaden his horizons in his job-hunting. In the situation in which most of the Kosen students look for jobs among Japanese companies, he got out of the narrow world to find his job worldwide. We believe the exchange program using the work-pairing has a greater impact on their future career than the regular exchange program.

CONCLUSIONS

Metropolia University of Applied Sciences and Tokyo Kosen have started student-pair activities to enhance the level and quality of the student and teacher exchange activities. The implement of work-pair project is an effective way in developing both local and exchange students' ability to design and build a system. They need to share the goal of the cooperative work and discuss the subject deeply with each other. They are able to compensate for each other's lack of knowledge. Thinking ability and communication skills are strengthened in the process of doing pair work.

In order to maximize the outcome of the work-pair project, regular network meetings play an important role in preliminary survey and follow-up reports after the exchange period. If we compare our concept to the regular exchange student project work, we can conclude that with a small amount of extra effort both transfer student and local student can achieve higher level in personal and academic growth.

This far we have created a feasible concept which offers quick solutions to some problems of the exchange student project work. In the future we will add systematic qualitative evaluation on the effectiveness. As the first step, we will test written and oral English communication skills before and after the exchange period. Secondly, we will consider tests to evaluate the growth of professional and soft skills. We are also seeking for partner institutes with similar problems or tested concepts to co-operate.

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