International Project-based Learning by Using the Internet

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Abstract

This paper discusses methods to equip students with abilities to be able to work globally with a good understanding of different cultures, and proposes an international project-based learning where teams, consisting of students in different countries, do projects mainly at their own university under the guidance of coaches with using Internet. One trial is presented, which was carried out with cooperation of VAC (Volvo Aero Corporation), KTH (Royal Institute of Technology, Stockholm) and Osaka University. The advantages of this method are: 1) good training for communication skills in English; 2) good training for international collaboration working with people of different cultural backgrounds; and 3) good motivation for learning various disciplines related to the project.

I. Introduction

With increasing globalization of economy, global problems such as the global warming and environmental problems, and increasing economic gap between the developed and underdeveloped countries, it has become more and more important to equip students with abilities to work globally with good understanding of different cultures including customs. Although the best way might be to give students chances to do projects in various countries, it is too expensive, resulting in limited number of students who have such experience. This paper presents an alternative way with using Internet, namely international project-based learning (PBL), and a trial.

II. Considerations

A. Abilities and Skills to Be Educated

The following abilities and skills are required for the engineers to work globally:

1) *Communication Skills in English:* Because English is the common language in the engineering world today, these abilities are crucial. However, it is not easy and requires a lot of time for people in non-English speaking countries, especially in Asia. Students often give up learning communication skills because they don't feel the learning is so urgent or don't feel the necessity.

2) *Teamwork Abilities:* The team working with people from various countries with different cultural background requires good collaboration skills and understanding various cultures with open-mindedness.

3) *Self-learning Ability:* Because real world problems usually require new knowledge, engineers should have a self-learning ability.

4) *Basic Knowledge:* Acquiring proper knowledge and applying it requires sound basic knowledge such as mathematics, physics, and chemistry, which should be educated to some extent before this PBL.

B. Educational Methods

The biggest problem, at least in Japan, is the decrease in students' motivation to learn. The author feels that students have been losing more and more of their motivation and it is difficult to attract many students with traditional lectures. Further, the abilities and skills mentioned above are difficult to teach with traditional lectures.

The best way to motivate them again would be to give them a chance to tackle real world problems as an international team. This would show them the necessity for their contributions and give them motivation through their achievement. At the same time, the students can develop such abilities during the project because it requires those abilities and skills, namely, they have to communicate in English and work collaboratively. If the problem is an interesting and new one, their motivation becomes better and they make more of an effort to obtain the knowledge. Therefore, they can develop such abilities and skills if they can get proper supervision and coaching.

Although some universities are doing this kind of PBL abroad, it is expensive and very difficult to apply to many students, in particular in developing countries, even in Japan. Alternatively,

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it might be possible in the future to develop a virtual system where they can enjoy the project as an international team, just like a game. However, is it so fascinating for students? Can they learn during enjoying the game?

The author is not so optimistic to use the virtual realities for this purpose. It may be the same question if the virtual system can replace the real experience. The greatest drawback of the virtual system is its lacking in real risks or danger to life. Although it seems that there are no risks in such a PBL experience is that real PBL has risks, such as useless expenditure of money and people's effort, and the everlasting hostile feeling in and between the teams. Whether they are aware or not, these risks put pressure on the people involved to succeed in the project. In the virtual system, they can reset their efforts if they fail or dislike the results. A virtual thing is a virtual thing and a kind of seeing at best; the results may be quite different. We easily forget what we just saw, despite what they say about "seeing is believing" or "one seeing is worth a 100 hearing." It would be more likely that one involvement is worth a 1000 seeing. We are deeply moved with real experiences but we are not so moved by the virtual system.

Although I don't deny the possibility we may develop very sophisticated virtual systems that provide risks through the development of psychological science, it would likely take a very long time and require a lot of resources to maintain it. We cannot we wait until such a time and we can use the present and more certain methods as follows.

C. Various International PBL with Using Internet (IPBL)

The basic concept of the IPBL is that teams consisting of students in different countries tackle real world problems collaboratively at their own university under the guidance of coaches using the Internet. It is better to give students a chance to meet each other at least once.

Various schemes may be possible as shown in Figure 1. The simplest case is (a) where the team consisting of two students from two countries carry out a project under the guidance of their coaches. One of the coaches is an engineer or researcher in industry in one country and the others are faculty in universities. The case for (b) is where the team in a country has many students. In this case, students can collaborate not only with the students in different countries but also with those in the same university. The case for (c) is where the team consists of members from three countries. It is also possible to set multiple international teams and to compete with each other as shown in (d), just like real world or global competition.

Although it would be better to select an engineer or researcher in industry as the main coach, it would be possible to select a faculty if he or she has enough competence. The number of coaches in each university doesn't have to be just one and people in industry or a TA could help the team.

III. Trial

One international PBL trial was carried out with cooperation of VAC, KTH and Osaka University. Namely, one master student at KTH and one doctoral student at Osaka University worked on projects under the guidance of an engineer, Mr. Göran, working at VAC.

A. Project Themes

The inlet manifold tourus and inlet pipe of the hydrogen pump for the launching rocket, Vulcain rocket engine, of the satellite, Airiane 5, is made from a supper-alloy (Inconel 718) through electron beam welding of wrought and flat-rolled materials and is requested to reduce the production cost. One of the cost reduction methods is to replace the welding with the precision casting. The VAC undertook the design of the parts of a new hydrogen pump and was requested to guarantee the reliability of the parts made by the precision casting, especially for hydrogen brittleness, because the parts are exposed to severe conditions such as 900 degrees Celcius and 1000 atm hydrogen atmosphere.

From such situation and the backup conditions in the universities we decided the following project themes; modeling of hydrogen absorption into the super-alloy for the Japanese student and examination of the relationship between hydrogen content and mechanical properties for the Swedish student. The Japanese student did it as an exercise and the Swedish student did as his master thesis.

B. Progress

The project was carried out mainly under the guidance of Mr. Göran Sjöberg, using e-mail and fax from April to December of 1998. At Osaka University, the author and Prof.Yasuda took the role of coaching and Prof.Fredriksson coached at KTH. Between the guidance of Mr. Göran, the students discussed with his partner and university coaches occasionally. At the end of the project the Japanese student visited KTH and the Volvo Aerospace Co. for one week and the students presented their achievements.

C. Results

The following were observed from the trial:

(1) It motivated students a lot and was good training for communication skills in English.

(2) It gave a chance to train students to work with foreign people and to become friends.

Figure 1. Various schemes of the IPBL.

(3) It gave good motivation for learning various disciplines related to the project and to develop their self-leaning ability.

The problems we had were as follows:

(1) It was not easy to discuss the details with e-mail and fax. It was necessary to have systems where we can show and point to the figures just as we do in face-to-face discussion, although it is possible today if we use the broadband system and a digital camera.

(2) Often we did not have enough time to discuss issues. We should select a proper problem also in terms of time.

(3) The problem was too research-oriented and there was not enough collaborative work. A better problem should have to been selected. It was not easy to select an appropriate problem in the field of materials science.

IV. Concluding Remarks

Even the small trial of the international PBL showed that it was very promising to equip students with the abilities and skills to work globally as described in Section II, namely, to improve their communication skills in English and to develop better teamwork abilities with persons from different countries and different cultural backgrounds and self-learning abilities. Further, it increased the motivation to study. It also helped prepare a lot of them for their project work in industry in the future because they then will already have had a similar experience.

When this kind of education is included in the regular educational system, we should consider the followings:

(1) Setting a proper project, which depends on the affordable time and students.

(2) Good collaboration between the industry providing the project theme and university educators.

(3) Time difference between countries and difference in semester system. It seems more convenient to do such IPBL with European countries than with USA, because the semester starts in April or October in Japan and many European countries.(4) Evaluation of the outcomes and how to give credit. It is desirable to have a substantially equivalent credit system and discussions about the evaluation methods are necessary.

(5) Good coaching.

Together with the further development of the IT, such as a broadband system, this kind of education would play a big role even today. Although it seems better to give students a chance to meet each other at least once, this causes a cost and its necessity should be examined.

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Author's Biography

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