PBL Course for Leaders of Small Group in a Framework of Co-operative Education

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Abstract

A project utilizing PBL (Project Based Learning) for a group of small number has been executed to produce the leaders who can make a practical management of a concrete task in one’s company as a leader. The project started in 2006 based on the survey 2005. The project in 2009 has two themes, 1) the embedded software in machines, and 2) the evaluation of the energy conservation equipments in building. The project was executed to produce the leaders of a small group by PBL system for the themes above. This paper specifies the brief outline of the project, the function and the effects of the knowledge model, SECI model. The staffs consist of the members of local bodies, private companies and colleges including students. The program has main two stages in a sequence; 1) stage I: to learn the basic knowledge for a professional engineer in related fields and to provide the basic knowledge of MOT, Management Of Technology, 2) stage II: to provide the basic knowledge in the field related to each theme, to execute the practical experiment and/or learning. Each stage are to be efficient by the questionnaires, replies, discussions, etc. during all activities, where the participants and the staffs are involved in the process of transferring the tacit knowledge and/or formal knowledge among them.

Keywords: PBL, Human resource development, Energy conservation, Embedded system, A Leader, Project Management.

1. Introduction

Sendai National College of Technology, SNCT, formerly Miyagi National College of Technology, MNCT, have been executing the projects concerning to the promotion of human resource development, particularly for the employees who have worked within ten years in a new field and the industry in local area. The survey to the around 250 private companies in local area, Miyagi prefecture and Fukushima prefecture was executed to clarify the need of relatively small size of companies [1]. The result indicates that they need the human development education, and 42% for the fields to apply existing technology and 17% for the high technology. The expected talent is the ability to solve the problem that occurs in the company activities, i.e. need oriented rather than seed evolving.

In 2006, in order to acquire the capability of practical management while the task should be basic level according to the participants, two colleges together have proposed the PBL (Problem/Project Based Learning) with three themes as below considering the survey and available resources of both colleges [2],[3].

1) The performance estimation of material property,
2) The evaluation of the energy conservation equipments in building, and
3) Embedded system in machines

The project in 2006 indicated the performance for the above three themes and the discussions in the preparation phase for the next project in 2007 proposed that the group leader of several members is necessary in near future, considering the increase of the offices and factories of the fields related to 2) and 3) in local area. In 2008, the project to promote the human resources concerning to the themes of 2) and 3) at the above was adopted as a national project by Ministry of Ministry of Education, Culture, Sports, Science and Technology.

This paper describes the framework, content and some example of the project starting from 2008 based on the above background.

2. The Framework of PBL Project

The overview of the project is shown in Fig. 1. According to the previous project in 2006 and the surveys and discussions between many educational organizations that have work integrated learning system in Australia, China, EU, Finland, New Zealand, UK, and USA, the framework can be described with five bodies[4]: Steering committee, Advisory Committee, Teaching Staff, Center for enhancement and support of basic technology and private companies in Miyagi prefecture. As seen as the arrows, teaching staffs have surveyed the needs in local area and advisory...
committee makes plans under the advice and control of the steering committee. Private companies apply to advisory committee and will attend the educational course.

![Diagram: Teaching Staff of Two Themes and Steering Committee]

3. Overview of the Undergoing Project
   The actual project was executed with two themes listed above, and the participants and the brief contents are;
   1) Theme 1: the evaluation of the safety and energy conservation equipments in building
      Scope: The development, operation and management of the machines and equipments in factory and building needs the knowledge of the fields of mechanical engineering, architectural engineering, etc.
      Targeted level: The productivity in the industry is based on the safety, high efficiency and energy conservation of machines and equipments. It is necessary for the engineers to achieve them in practical field.
      Resulted talent and its role in practice: The capability of the analysis of required performance of the working and/or inhabitant space.
   2) Theme 2: the embedded system in machines
      Scope: The concerning field is where industrial devices and machines can be more efficient and have higher performance with implementing the control part, e.g. mobile phone.
      Targeted level: This theme deals with software but also the combination with hardware, while the recent evolvement of FPGA/CPLD (field programmable gate array/complex programmable logic device) enables mounting hardware on the product.
      Resulted talent and its role in practice: The capability of using software (micro computer) and hardware (FPGA/CPLD) to design the embedded system corresponding to the usage in practice is inquired.
      As there are different backgrounds among the trainees and many knowledge and requisite as for the engineer, the procedure consists of two phases shown in Fig.2;
      1) Stage I: The knowledge required as a member of the society and an engineer is learned, therefore, all trainees attend. Subjects are engineering ethics, business studies, intellectual properties, global environment and bioengineering. Also to acquire the capability as the leader, the subject on MOT, Management Of Technology was added.
      2) Stage II: This stage is subdivided into two sub-stages according to the themes as below.
         (II-1) Basic knowledge necessary in each theme is provided.
         (II-2) PBL is executed in each theme and there is a variety of learning methods.

4. Discussion
   According to the response of trainees and belonging companies, it is likely to approve the effectiveness of this project. And the points to be improved including the project in 2008 and 2009 would be;
   1) The number of trainees: The number of trainees of 10 for one concrete theme seems to be the maximum when the PBL is applied, according to the available equipments and teaching staffs. And the role of the leader should be shared in the practical working time in return.
   2) The questionnaires and interviews done at the application phase and each lessons allow the careful survey of participant’s and employer’s demand and support the understanding between teaching staffs and trainees. For example the teacher can provide the expertise and future direction based on each trainee’s need and capability at the lesson.
3) MOT lectures: They are newly introduced in this project adding to the previous one and are effective to acquire the capability as a leader of the group of several members. The trainee’s scope was extended to the upstream activity such as the meaning of the facing task and also to the downstream activity, e.g. the influence of the task achievement.

4) PBL Structure: The reason that this project can achieve the purpose can be explained with SECI model [5] shown in Fig.3 with comments provided here and corresponding stage in the project. In this project the cycle starts at the combination and ends at externalization. The combination is done by the lectures with textbooks and presentation slides, and through internalization and socialization processes in practical working on each theme, the knowledge and expertise are externalized in the form of report and presentation by the trainees. The cycle is rotated only once basically, however, some trainees may rotate a few times because the report was written at each lesson and the final report and presentation materials has been checked several times in some cases.

5) The effect of the whole project may depend on the capability of the teachers and staffs. The discussions among teachers show that the teacher should be able to answer the student’s question within a few days since the will to study tends to decrease after days because of daily business [6]. It means the teacher should have the broad expertise and the links of knowledge. The books and the introducing many related organizations to the trainees were helpful, and well prepared materials may help about this situation in the next project.

5. Conclusion

The PBL (Problem/Project Based Learning) project to cultivate a leader of small number of engineers was executed in the framework of professional education and it has two themes according to the survey performed in advance. The procedure has two stages and the first stage is for the literacy for an engineer. The second stage is for study of professional knowledge and PBL in a group, while the structure is similar to the previous project until 2007.

As the conclusion, this PBL procedure is effective to make the professional engineers since it is approved by participants and employers. A group of ten trainees for each concrete theme may be the maximum to execute the project, and the capability of teachers and staff is essential. The lectures of MOT allow the trainee’s scope to be wider and the longer period of PBL seem to be better to transfer the knowledge. All the activities may be explained by the SECI model that allows transforming the formal knowledge to the tacit knowledge and vice versa.
Fig. 3 SECI Model and PBL Project

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References
2. Yasuo UTSUMI, Akira SHOJI, Kimihiro SHIBATA, Akio KANOMATA, Katsuhiko SUZUKI and Senri IKEDA, “PBL Project to Acquire the Capability of Practical Management”, WACE Asia Pacific Conference, 2007

Biography
The first author graduated the doctorate course of Tohoku University in 1984, and is now the vice president and a professor of Sendai National College of Technology, SNCT, Japan, and the chief of the Regional Innovation Center of SNCT mainly devoted to the collaboration with the private companies and the sharing the profits with the students. His field is architectural environmental engineering and building equipment, and joins the project of the predicted auto-control HVAC system to achieve the low carbon society that is supported by the government. He serves as the president of Tohoku Branch of Society of Heating, Air-conditioning and Sanitary Engineering of Japan and also the member of IASO/SC1/TC163/WG10. According to the COOP education, He has been working on the projects of the training courses for the employee of private companies in the collaboration with local bodies since 2005 and the member of World Association of Co-operative Education, WACE.