

# Instructional Study Design of the Application of BPBL in Engineering College in Mongolia

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## 몽골 공과대학교에서의 BPBL을 적용하기 위한 교수설계 방안 연구

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**Abstract** This study presents a model for blended problem-based learning (BPBL) for engineering colleges in Mongolia in order to efficiently train talented Mongolian specialists with problem-solving skills for the current information technology era. BPBL is learner-centered teaching method that promotes learning. Moreover, current teaching methods in the engineering colleges of Mongolia should change to novel and flexible teaching environments and methods that meet learners' needs. Thus, using BPBL for engineering education development in Mongolia will provide more teaching possibilities, which will assist the professors.

Over the past few years, universities in Mongolia have established the Center for Teacher Development, which provides training and gives advice to staff about teaching methods, although the majority of lectures are still fragmentary and anecdotal. Therefore, many professors teach the way they learned, and most teaching methods used up till now have been teacher-centered. However, modern college instructors and modern society demand different engineering teaching methods from teachers who are more familiar with old-fashioned methods. Furthermore, the methods should meet the needs of individuals and groups who prefer to apply technology in the engineering learning process. Using an effective engineering strategy in the development of a new engineering teaching method will lead to its success.

**요약** 본 연구는 현재 정보통신기술 시대에 요구하는 문제해결 능력을 갖춘 몽골의 인재를 양성하기 위하여 효율적으로 학습할 수 있도록 하기 위한 방안으로 몽골 공과대학교에서 적합한 Blended PBL 모형을 제시한다. BPBL은 학습자 중심의 교육 방법이다. 현재 몽골에서 빠르게 변화하는 교육환경과 학생의 요구에 부응하기 위해 공학 교수법의 변화가 필요하다. 따라서 몽골 공학 교육의 발전을 위한 BPBL 학습을 도입하며 공학 교수자들에게 더 많은 교육의 가능성을 제공 할 것이다. 최근에는 몽골에서 대학 내에 '교수학습센터'를 설립하여 '가르치는 방법'에 대한 교육과 지원을 교수자들에게 제공하고 있지만, 아직도 단편적이고 일회적인 특강 형식의 지원이 대부분이다. 이런 이유로 많은 교수들은 '그저 자신이 배운 방식대로' 가르친다. 아직도 공학 교수방법은 교수자 중심으로 이루어지고 있다. 앞으로 급변하는 미래 정보사회를 전망할 때, 몽골 공과대학의 목표해야 할 기본적인 방향은, 규제와 철폐, 완화를 통해서 진정으로 풍요롭고 활력 있는 사회를 형성하고 있으며 최근의 공과대학 강사와 사회는 익숙한 구식 방법 말고 다른 공학 교육 방법을 요구하고 있다. 새로운 공학 교육 방법의 개발에 효과적인 엔지니어링 전략을 사용하는 것은 성공으로 이어질 것입니다.

**Keywords** : BPBL, engineering college, engineering education development, learner-centered teaching method, promote learning, teaching possibilities

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## 1. Introduction

### 1.1 Research Needs and Objectives

An increasing number of online course instructors seem interested in adopting constructivist approaches for the design and delivery of online courses in Engineering Colleges in Mongolia. Modern technology provides multiple accessible forms of communication tools making this pedagogical change both possible and appealing. Compared with typical objectivist-based instruction, constructivist-based teaching and learning require more time and effort from both the instructor and the students[1].

Mongolia has outdated engineering educational administration and educational institutions that needed to be discharged in order to prepare democratic specialist on a par with other countries. Hence, new teaching methods that provide high qualified education are needed to apply in Engineering College in Mongolia. In order to make this kind of society come true, we need to focus on a good engineer which is suitable for this society. In this paper, we developed constructivist BPBL design about solving the Mongolian engineering College's problem, adapting the new society, ability of decision making and changing tendency. I believe that the way we teach and learn is at a once-a-millennium engineering turning point. Meanwhile, new technologies offer hope for more effective ways of teaching and learning about engineering, but also engender confusion and even fear; too often the shiny new technology is used as little more than window dressing[2].

The newest trend in engineering education may be a hybrid approach. In the early years, students are taught the foundational knowledge and skills required in engineering[3]. This paper contains Research needs in Chapter 1, Review of the Literature, the methodology in Chapter 2 and the summary in Chapter 3.

## 2. Main Body

### 2.1 Problem Based Learning

Problem- Based Learning is an exciting alternative to traditional classroom learning. With (PBL: Problem-Based Learning), teacher presents a problem, not lectures or assignments or exercises. Since not handed "content", students learning become active in the sense that they discover and work with content that they determine to be necessary to solve the problem. Moreover clear evidence for the effectiveness of PBL, the approach has been adopted in many other disciplines to include engineering. The engineering field, which continues to rely primarily on traditional teacher driven methods, Mills(2003), has looked to PBL to help fill the gap reported by industry in entry level engineers. PBL is currently used in many of the top engineering programs such as Rose-Hulman Institute of Technology, Carnegie Mellon, and here at the United States Military Academy. Effectiveness of PBL in engineering education, however, is also debatable. Comparisons of programs that heavily favor PBL to programs that heavily favor traditional approaches are mixed, Fink(1999). Programs that extensively use PBL graduate students with strong design and team skills while students from traditional programs are better grounded in the fundamental engineering sciences and mathematics. In the final years, PBL is favored to help integrate knowledge, reinforce self-directed learning, teach people and group skills, and apply the design process[3].

### 2.2 Main Features of Blended Learning

Blended learning is a combination of online and face-to-face instruction. The online instruction may occur synchronously and/or asynchronously[4]. Face-to-face time is designed to engage students and provide support for learning and varies in scope and frequency[5]. Blended learning referred to four different concepts[6].

- To combine or mix modes of web-based

technology to accomplish an educational goal.

- To combine various pedagogical approaches to produce an optimal learning outcome with or without instructional technology.
- To combine any form of instructional technology with face-to-face instructor-led training.
- To mix or combine instructional technology with actual job tasks in order to create a harmonious effect of learning and working.

### 2.3 BPBL for Engineering College in Mongolia

#### 2.3.1 BPBL in Engineering Colleges

Perrenet(2000) argues that while PBL is effective in medical education because of its “encyclopaedic structure,” it may be more challenging in engineering because of its hierarchical structure. Studies in the 1990s suggested that the engineering curricula and its graduates was generally deficient in addressing the concerns of the modern society, Mills(2003). Industry, accreditation boards, academia, and students echoed these concerns. Some of the key concerns, as listed in Mills (2003), included the following: engineering curricula are too focused on engineering science and technical courses, without providing sufficient integration of these topics, programs do not provide sufficient design experiences, graduates lack communication skills and teamwork experience, programs need to develop more awareness amongst students of the social, environmental, economic and legal issues, faculty lack practical experience, teaching and learning strategies or culture in engineering programs is outdated and needs, to become more student-centered[3]. With acceptance of these concerns, engineering programs starting in the 1990s realized a need for curricular change. PBL was adopted by many engineering programs as an approach to help graduates learn the skills required by their employers and to address many of the concerns listed above. In most cases the implementation of PBL, however, is at the course level within a traditional engineering program.

Only a handful of programs integrate PBL across the program because it requires the cooperation and integration of faculty from multiple departments[3]. The impact of PBL depends on the tutors’ quality and the students’ motivation. To enhance students’ motivation and satisfaction and to overcome the problems with the changing quality of tutors, online learning and face-to-face classes were systematically combined resulting in a blended learning scenario[7]. This study proposes that by bringing the concept into sharper focus, real insight will be gained into the nature of BPBL in Engineering College in Mongolia. (BPBL: Blended Problem Based Learning) will provide opportunities to examine and try out what you know, discover what you need to learn, develop your people skills for achieving higher performance in teams, improve communications skills, state and defend positions with evidence and sound argument, become more flexible in processing information and meeting obligations, practice skills that you will need after your engineering education.

#### 2.3.2 Instructional Model for Engineering College in Mongolia

In this study, we have designed BPBL model for engineering college of Mongolian after studying teacher-centered model which are presently used to prepare Engineer in Mongolia. The proposed BPBL instructional design model(Fig.1) is made up of demand, analysis, performance objectives determining, assessment tool designing, teaching strategies development, teaching materials preparing, implementation, formative implement assessment, final evaluation and formative evaluation.

##### (1) Demand phase

Phase to determine disadvantages of Mongolian engineering college changes in teaching and distance learning conditions. In other words, have to answer following questions, Why do we need to use BPBL in engineering colleges in Mongolia?, What is the

advantage of applying BPBL?, Could it be helpful for Mongolian engineering education-related legislation and maintenance of engineering educational plan?, Are there any difficulties in current engineering educational methods? Are engineering students looking for different learning methods?

## **(2) Analysis**

learner and teacher characteristics, learning the environment and learning process will be analyzed:

### **1) Teacher analyzes**

Student's problem-solving process based on sub-functions and study type after professor set goals. Professor plays tutor's role. It is important to determine tutor's ability to tutor or is tutor suitable for the job. If tutor's ability is not enough, he or she must be trained by specialized study or guidance[8].

Tutor must have basic knowledge of

- Engineering understanding and experience in BPBL
- Understanding of group classification goals and activities
- Techniques for conflict resolution in group activities
- Communication skills between tutor and students
- Questions and feedback skill

### **2) Learning curriculum analysis**

The Process of bringing out ideas to solve the problem and overseeing curriculum content, unit goal and characteristics to speculate curriculum content in BPBL problem.

### **3) Learner and Learning Environment analysis**

BPBL learners must be not only passive listener of professor's lecture but also learners that organize and accomplish the learning by themselves. Novice BPBL learners might experience some difficulties at first few lectures but it will decrease as they adapt to the teaching method. Mind mapping, questionnaires can be

used in order to figure out student's understanding of course content and what they want to acquire through the course. In a learning environment should be designed to target objective characteristics of the learner with scientific understanding and background[9]. BPBL 'Learning environment' is where the student has to demonstrate a sense of responsibility and ownership of the learning and be an initiative to gain knowledge by means of physical, social and psychological concept. Specifically, there are need to analyze the learning atmosphere, real challenges, learning the place, collaborative learning environment, learning resources, learning time, evaluation and role of students and teachers.

### **(3) Determining performance**

Deciding what the learner has mastered after completing the study. Learning objectives should be defined before choosing appropriate courses for BPBL in engineering. The Advantage of BPBL is to efficiently gain basic knowledge through problem-solving and the ability to apply when it's necessary.

### **(4) The assessment tool design**

Phase to develop assessment tools and items that can determine whether learners achieve learning objectives. Assessment is done to acquire learning objective and close relation, so BPBL assessment standard and object are based on BPBL objective. Professor will assess learning curriculum based on the result from self-assessment, assessment from learners and assessment from team members[10].

### **(5) Teaching strategies**

Teaching method should be determined and various material that is used during class should be prepared to achieve learning objective. Instructional method conditions required to execute engineering learning objective. It can be also called as teaching methods, teaching forms and teaching tactics in engineering[11].

**(6) Teaching material design**

When establishing a plan for BPBL in engineering, we should prepare all materials for before learning. The materials needed for class refers to all tools of learning and media data to be used for classroom activities. Teaching materials must be prepared in accordance with the steps and procedures necessary data for lesson progress[12].

**(7) Implementation**

Execution of BPBL in engineering. In the implementation phase, learner gains knowledge by self-direct choosing aside from seeing and listening. The Main purpose of activities are providing information, and execution activities are transforming the discovery, decrypt, analyze, checking, combination, debate, evaluation, summary and refinement, with the knowledge and skills, internalize the information, such as application specific activities that can be considered as variations.

**(8) Formative evaluation**

Program is evaluated by following steps, one to one evaluation, small group evaluation and on-site evaluation. One-to-one evaluation is evaluation of learning progress, advantage of participation, occurring trouble of individual students compared to one individual student to prescribe for individual students. Small group evaluation assess result of one-to-one evaluation, investigates trouble might occur to individual students and evaluates whether student can solve problem without professor participation. On-site evaluation evaluates experience, knowledge, learning style, tendency, motivation, demand and level of individual student.

**(9) Summative assessment**

Phase determining the result of engineering program's last study. Formative evaluation decides whether study program met the success criteria made at the beginning. This offers study privilege about engineering program execution result.

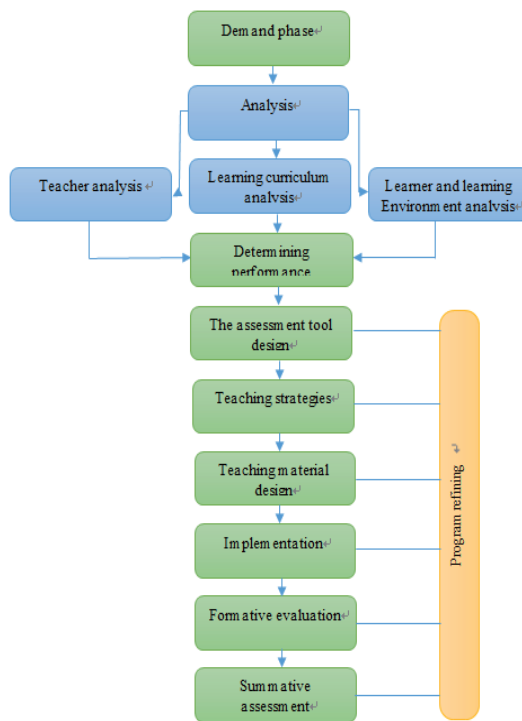


Fig. 1. BPLB Instructional Model in Engineering College in Mongolia

**(10) Program refining**

Refining phase with content made from formative evaluation phase. Refined BPBL is improved method version by combining of self and co-learners evaluation of the engineering program. Problems are refined during developing process but the problem will be ready after collecting final revision.

**2.4 The Compatibility BPBL Model in Engineering College in Mongolia**

Mongolia has a huge territory with the rich history, moving depending on seasonal changes since ancient times. Therefore, to apply in engineering college in Mongolia, it is important to refine BPBL model proposed in this study. Online learning still hasn't successfully carried out in Mongolia but several engineering teaching methods such as m-learning, e-learning and blended learning combining a variety of

study method have already started to implement[11]. During the BPBL in engineering, students have more time to collaborate with their peers to construct knowledge through problem-solving tasks. Implementing this approach in an intensive summer online course, however, presents a significant challenge for an instructor due to the time constraints. If time is an essential factor affecting the successful completion of a constructivist based intensive online course, a blended approach combining the strengths of constructivist and objectivist methods of engineering teaching and learning could be used for the design of the engineering course; thus, meaningful learning may still be achieved despite the intensive and abbreviated time frame[11].

### 2.5 Internet–Based Educational Environment in Mongolia

Mongolia has been experimenting various forms of distance learning after first using it in non-formal education in the early 1990s. Outside of Mongolia, e-learning is changing the face of distance education by leaps and bounds, making the learning environment of the distance learner, in spite of his physical isolation, much more supportive, rich, motivating and satisfying, with electronic-based synchronous and asynchronous tutor-to-learner and learner-to-learner interaction. In addition, to successfully accomplish the 'e- Mongolian project' experimental plan was proposed. In other words, programs such as e-Government, e-Healthy, e-Business and e-Learning were being carried out[11].

## 3. Conclusion

This study was made to determine the method to use and environment to prepare during the full process of PBL in order to conduct BPBL learning in engineering college in Mongolia. BPBL model was proposed using material acquired from designing engineering study model based on strategies, asking opinions on learning

the environmental usage of classes from participant students and analyzing characteristic of the problem among engineering college professors after making strategies by combining results from an online environment and classroom training BPBL research using engineering formative study method.

Therefore, it is time to introduce the system that gives engineering education by connecting to the Internet with regardless of time and space, in engineering college in Mongolia.

The combined use of interactive media and engineering BPBL is complicated, since on their own each demand that engineering staff and students possess a complex array of different engineering teaching and learning capabilities. BPBL promotes self-responsibility to learn, facilitates more enjoyable and more effective learning, encourages learning from experience, allowing students to use and organize what has been learnt to understand problems, integrates knowledge with practice, develops teamwork and communication skills, trains students to be reflective and assess their own and others' work, cultivates independence, curiosity, and skills for self-directed, life-long learning.

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