

# **A Learning and Teaching Model using Project-Based Learning (PBL) on the Web to Promote Cooperative Learning**

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## **Abstract**

This research designed a learning and teaching model using the Project-Based Learning approach (PBL) on the Web to promote cooperative learning of technical college students. The learning and teaching model designed was based on the PBL principles using the Web as a tool for learning management and the PBL activities to increase motivation and cooperative learning. As a result, the designed teaching model is the learning and teaching method that can promote real participation of the students in the learning processes. The students will be assigned to work cooperatively to create projects on the Web and put the completed projects on the Web into real practice in classroom. The model helps improve the students' cooperative learning skills which are useful for their daily and work life after graduation.

**Keywords:** Web-Based Instruction, Project-Based Learning, Cooperative Learning

## **1. Introduction**

Long distance learning is the learning method that enables interactions between learners and teachers living in different places. One of the most important tools used for long distance learning is the internet. The learning activities such as giving assignments, submitting assignments, giving advices, and many other interactions can be done long distance via the internet, making this method of learning becomes more and more popular in Thailand. Technical Colleges are among the institutions in Thailand that start to implement long distance learning via the internet to train mechanics for the labor market in the globalization era. The laborers during this era must be able to deal with various kinds of information and work, both face to face and through modern equipments, with different people. Due to the rapid advancement of technology, Thai Technical Colleges have to improve the learning and teaching method to produce qualified labors reflecting the labor market's demand. The learning and teaching method should promote cooperative learning and group working. The learners have more opportunity to design learning by themselves, while the teachers have to change their role to a facilitator or an advisor.

The internet should also be used to improve learning efficiency. Statistics shows that only 16.70% of Technical Colleges in Thailand use the internet for learning and teaching management. (Jeerungsuwan, Nilsook and Wannapiroon, 2009). The learning and teaching method used in most of the Technical Colleges is the traditional teacher-centered method. It generates learning competition rather than in-depth knowledge causing stress and lack of motivation (Raud and Vodovozov, 2010).

The students have low cooperative working skills, particularly the skill in working with other people via the internet. This problem has a negative effect on the students both at present and in the future. The students have low leaning efficiency. When they graduate, they become unqualified labors and unable to meet the labor market's demand. This will surely affect the development of the country as a whole. Many research documents revealed that to solve the problem, the student-centered method should be used in the learning and teaching management. Students should be divided into small groups and each member of the group takes equal duties and responsibility. The World Wild Web technology is used as a tool for learning promotion. This method enables students to learn independently at different time and place and cooperate, consult, and interact with others on the Web (Pumipuntu and Phromchanthuek, 2008). Project-Based Learning is the learning method that provides student-centered environment. Students are divided into small groups to cooperatively create an assigned project. Students have to search for information from learning resources, related organizations, or specialists to crate the project using the Web as a learning supporting tool.

Thus, the research implemented the project-based learning and teaching method on the Web to reinforce cooperative working, with technical college students. The students were divided into small groups. The members of each group worked together to create an assigned project through the Web. Each member had clear duties and responsibilities. Each also worked independently to search for needed information for the group consulted with each other, discussed, chose useful information, and made decision together until the project was completed. All activities were done through the communication tools on the Web. The application of the project to real practice was done in normal classroom, which was an extension of cooperative working on the Web. The research thus presents the learning method that reinforces cooperative working both on the Web and in classroom, which reflects the ways of life in the real world.

## **2. Background**

### **2.1 Project-Based Learning**

Project-based learning (PBL) is the learning method that places students at the center of the learning process. It is widely used to replace the traditional teaching method in which the teacher, who is the center, strictly follows the teaching plan. In a PBL classroom, the teacher leads the students to the learning that they desire or the learning following the project objectives. The PBL process thus involves an in-depth learning process with systematic learning management to get useful and applicable results, create motivation, and reinforce necessary living skills (Buck Institute for Education, 2010; Harris and Katz, 2001; Moursund, 1999). Project-based learning does not have a fix structure. It has complicated working procedure and requires more time for operation. However, it is flexible and the learning process involves interaction and cooperation among learners, between learners and teachers, or between learners and specialists. More importantly, when the teacher implements the project and the project is completed, the learners will feel proud of themselves. This generates motivation to the learners to create better projects in the future (Jung, Jun, and Gruenwald, 2001).

In the PBL classroom management, students are divided into groups of different sizes. For small groups, all students will have equal roles and responsibility in creating the project. The project enables the learners to deeply understand the ideology and standard of project-making. It can reinforce lifelong working skills and behavior. The project also provides the learners with an opportunity to solve community problems, survey future careers, consult specialists and communicate with the intellectuals using the internet technology. The learners can also present their projects to the target groups outside classroom. The project can also motivate other low-motivated learners, who view studying as boring and useless, to see the significance and value of learning (Buck Institute for Education, 2010).

### **2.2 Cooperative Learning**

Cooperative learning is the learning method that becomes very popular nowadays. It is suitable for all fields of study and educational levels (Pumipuntu and Phromchanthuek, 2008). Cooperative learning

consists of five elements including 1) Positive Interdependence, 2) Social Skill, 3) Individual Accountability, 4) Group Processing, and 5) Face to Face Promotive Interaction (Trytten, 1999; Johnson and Johnson, 1994; Slavin, 1987).

1. Positive Interdependence is linking members of the group together. The learners have to understand that he or she cannot succeed unless all group members succeed. As a result, all members work closely together for success.

2. Social Skills include effective communication, interpersonal and small group skills. The learners willingly work together without bias to achieve the goal.

3. Individual Accountability involves responsibility. Each members of the team is fairly assigned duties and responsibility, so the member must be responsible for himself and the other members of the group. The members help and support each other for the achievement of the goal. Personal responsibility is an important key to the success and strength of the whole team.

4. Group Processing refers to the reflection and discussion of the group members on their work aiming to refine and improve their efforts to achieve the goals.

5. Face to Face Promotive Interaction means close interaction among group members to effectively assist, and support one another. They may promote the success of the other members, exchange necessary information, tools, and resources, give moral support, create motivation, and make an effort to achieve the goal together.

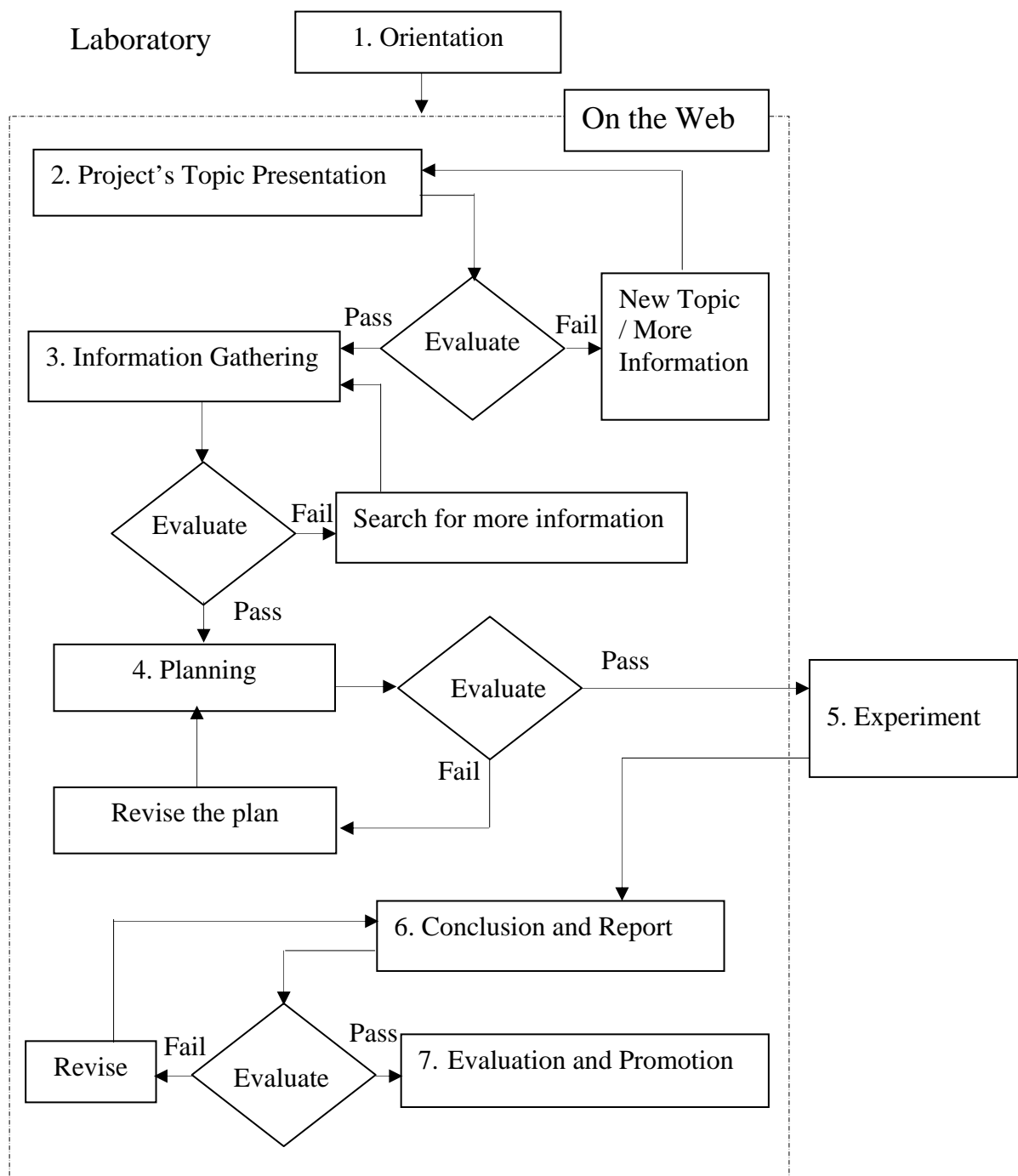
The designed teaching model used both PBL and Cooperative learning principles as the foundation. The outstanding feature of the designed model is that the learners can cooperatively create an assigned project both in the virtual learning environment through the internet and in the real life learning environment in classroom. Besides, the designed teaching model provides the learners to learn and gain knowledge by themselves through interaction during the project making process. The presentations of the lessons could be fully done through the internet, which included the presentation of objective of the course, course contents, additional learning resources, activities among the learners and between the learners and the teacher, communication routes, and multimedia presentations. The designed model also gives the learners to learn independently anytime and at any place without limitation.

### **3. Designing Principle**

Project-based learning nowadays can be designed using information technology, computer technology, internet technology, and multimedia (Chang, 2009). As PBL involves the integration of various skills to achieve higher skills (Martinez, Herrero and Pablo, 2010) , it is thus in accordance with the teaching and learning contexts of the Technical Colleges in Thailand, where students are trained to become qualified industrial labors and meet the labor market's demand. Project based learning on the Web encourages cooperative group-working through communication tools on the Web. The cooperative working in classroom provides real-life experience which can be found in the real work-life in the society.

Project based learning on the Web is the learning method that uses PBL principles and the Web to support project making activities at all stages. The learners learn cooperatively by communication and interaction via the Web and in classroom. The PBL on the Web model consists of 7 steps including 1) Orientation, 2) Project Topic Presentation, 3) Information Gathering, 4) Planning 5) Experiment, 6) Conclusion and Report, 7) Evaluation and Promotion (Moursund, 1999; Jung, Jun and Gruenwald, 2001; Lardizabal, 1970).

Figure 1 Procedure for PBL management on the Web



### Step 1 Orientation

The teacher meet the learners in class to explain and inform the learners about the learning objectives, scopes of the contents, learning activities, methods of Project-based learning on the Web, communicative tools on the Web, search engines, learning evaluations. The teacher also explains the significance of knowledge searching, knowledge acquiring and project creation.

### Step 2 Project's Topic Presentation

The teacher sets situations on the Web for the learners to motivate the learners to learn in-depth. The teacher presents video clips or virtual pictures of the real events relating to the studying subject and contents. After that, each member of the group writes his or her interested

topic and presents it to the other members within the group. The members of the group brainstorm and discuss the topic of the project presented by each member through the Web-board. The group members make decision on the topic of the project and the group submits the selected group topic together with the topics of all members to the teacher via the Web.

### **Step 3 Information Gathering**

When the topic of the project is approved by the teacher, each of the members searches for related information in all aspects and dimensions from websites, learning resources, and other sources on the Web to support the project. The members share the information they have, discuss and exchange ideas and make decision on the information to support their project, on the Web. The group submits the selected information and the individual information of each member to the teacher via the Web.

### **Step 4 Planning**

All members join the chatting program to brainstorm, share ideas, and plan their project. They have to set the procedure, experiment methods, data collection methods, use of tools and facilities, evaluation and testing tools for project experiment. The group members discuss, share ideas, and make decision on the procedure, experiment methods, and use of related resources. Then the group submits both group and individual information on these to the teacher via the Web.

### **Step 5 Experiment**

All group members work together to experiment the project according to the plan in a laboratory. This is a cooperative learning practice of the members. The group members study and discuss the details of the tools, facilities, and project procedure. When they all understand, they start the experiment and collect data from the experiment together.

### **Step 6 Conclusion and Report**

When the experiment is completed, all members collect the data from the experiment and present them on the Web to discuss, analyze, and conclude the experiment. The group members then help each other write a report of the experiment and the group submits the report and conclusion to the teacher via the Web.

### **Step 7 Evaluation and Promotion**

The group presents the report and conclusion on the class's website. The teacher and the group members cooperatively evaluate their own projects and the projects of the other groups. The group members use the results of the evaluation to refine and improve their project for highest result.

## **4. Experiment**

### **4.1 Participants**

#### **4.1.1 Population**

The population is 175 third year industrial mechanic students in 5 classes, majoring in Electronics in Yasothorn Technical College registering for the course titled "Industrial Electronics" (2104-2214) during the first semester of the 2010 academic year. More information is shown in Table 1 below.

Table 1: Details of third year industrial mechanic students majoring in Electronics in Yasothorn Technical College

Class	Class 1	Class 2	Class 3	Class 4	Class 5	Total
Number of students	32	35	37	38	35	178

#### 4.1.2 Sample Group

The sample group included 32 third year industrial mechanic students majoring in Electronics in Yasothon Technical College, who were taking the course entitled Industrial Electronics (2104-2214) during the first semester of the 2010 academic year, selected by using the Cluster Random Sampling technique as follows:

- 1) 178 students from 5 classes were assigned to take a proficiency test (50 points) to measure their knowledge on the foundation of Electronics.
- 2) The students were ranked according to their score within the class to which they belong.
- 3) A variant analysis of the scores was performed as shown in Table 2 below.

Table 2 : Results of Variant Analysis of the Students' Scores

Levene Statistic	df1	df2	p
.605	4	173	.660

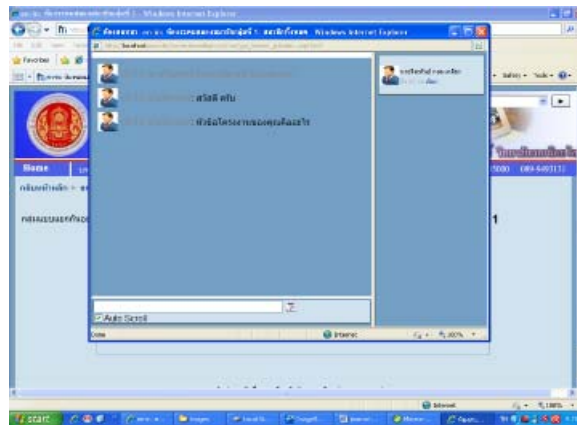
From Table 2, it is clear that there are no differences among the variants of scores of the students in all five classes.

- 4) 32 students from Class 1 were selected as the samples for the experiment.
- 5) The 32 students were ranked according to their scores from the highest to the lowest and then were grouped by using the 25% technique.
- 6) 25% of the students who have the highest scores, which includes 8 students in total counting the first from the highest, were grouped as the high proficiency group.
- 7) 25% of the students who have the lowest scores, which also consisted of 8 students counting the first from the lowest, were grouped as the low proficiency group.
- 8) The 16 students in between were grouped as the mid proficiency group.
- 9) The students were subdivided into 8 groups of 4 students. Each of the 8 groups consists of one student from the high proficiency group, two students from the mid proficiency group and one student from the low proficiency group. The 8 sample groups were taught by using the designed model which consists of 7 steps mentioned above.

Figure 2: Example of Project Based Lessons on the Web



Figure 3: Example of Brainstroming Conversations of Web



## 4.2 Methods of Assessment

The assessment of the designed model is divided into 3 parts.

### 4.2.1 Achievement Assessment.

The tool used for achievement assessment is the achievement test (50 points).

### 4.2.2 Product Assessment

The tool used for the assessment is the project assessment form (30 points)

### 4.2.3 Cooperative Working Assessment

The students are assessed individually. The persons who perform the assessment include the teacher, one non-group-member student, and one group-member student. The total score is 90 points: 45 points from the teacher, 22.5 from the non-group-member student, and 22.5 points from the group-member student. The assessment is performed twice. The first assessment is done during Step 2 (Project's Topic Presentation) while the second during Step 5 (Experiment). The assessment is performed after class for 30 minutes. The mean score of both assessments and the evaluation result during Step 7 are used for the analysis.

## 4.3 Results

4.3.1 Pretest and posttest on learning achievement were done and the tests' results are shown in Table 3 below.

Table 3: Pre-test and Post-test Results

Samples	Total Score	Pre-test		Post-test	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.
32	50	20.53	3.07	41.13	2.61

4.3.2 To show the difference between the pretest and posttest's results, dependent samples t-test was used to analyze the scores and the results of the analysis were shown in Table 4.

Table 4: Comparison of Mean Scores of Pre-test and Post-test

Scores	N	$\bar{X}$	S.D.	t-test	P
Pre-test	32	21.53	3.07	33.19*	.000
Post-test	32	40.12	2.61		

Table 4 shows that the mean posttest score of the students learning by using the designed method is higher than their mean pretest scores with the significance level of .05. This means that the students have better knowledge after learning by using the model.

4.3.3 The assessments of the product done by each of the 8 groups are shown in Table 5 below.

Table 5 Scores of Project Production

Group	1	2	3	4	5	6	7	8
Mean Score	28	27	26	27	28	27	25	27
Percentage	93.33	90.00	86.67	90.00	93.33	90.00	83.33	90.00

Table 5 reveals that the assessment scores of the products produced by each of the 8 group were from 83.33 to 93.33, which are all in the high level. The score emphasizes that the student' projects are of high quality and the students have positive view toward the products of the projects.

4.3.4 The cooperative working assessment is revealed in Table 6

Table 6: Cooperative Working Score

Cooperative Working	$\bar{X}$	Total Scores	Percentage
Positive Interdependence	27.14	30	90.47
Individual Accountability	25.98	30	86.60
Brainstorming and Opinion Giving	28.11	30	93.70
Total	81.23	90	90.26

It can be seen from Table 6 that the mean assessment scores of the students taught by using the designed method are at high level in all aspects. Out of 30 points, the mean score of the aspect relating to the assistance and support of the other group members is 27.14 points, which is 90.47%. For the aspect relating to responsibility to themselves and their group, the mean score is 25.98, which is 86.60% and for the aspect concerning the expression of opinion while working, the mean score is 28.11, which is 93.70%. The total score of all three aspects is 81.23 points out of 90 points, which is 90.26%. Thus the total assessment result is at high level. It shows that after using the designed model to teach the students, the student have improved their group working skills. They willingly helped each other to work in order to complete the project. They were responsible for the duties and responsibilities assigned to them shared ideas and brainstorm to reach the maximum resolution for the projects.

## 5. Conclusion

After the experiment, it was found that the project-based learning on the Web to promote cooperative working of the students in Technical College using student centered principle was efficient and effective. The learning achievement of the students after studying was significantly higher at the .05 level. The quality of the products was evaluated at the high level and the cooperative working of the students were also at the high level.

Thus the project-based learning on the Web designed here is the learning and teaching method that helps to train students to work cooperatively via the internet and provides the learners with an opportunity to work face to face. It also helps to create better cooperation and interaction among the learners, which is similar to the way they live their life in the society.

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