Implementation of a Problem-Based Learning in Teaching Principle of Vocational and Technical Education

Weerayute Sudsomboon¹ (weerayute.sud@kmutt.ac.th)
Sak Kongsuwan²
Pinit Pajantavanit²
¹Department of Mechanical Technology Education,
²Faculty of Industrial Education and Technology, King Mongkut’s University of Technology Thonburi, Thailand

ABSTRACT

This paper deals a comprehensive problem-based learning approach to the second year of principle of vocational and technical education subject at King Mongkut’s University of Technology Thonburi. The instructional system design attempted cover the Thai vocational and technical education management areas. Students must use their cognitive skills in order to share the knowledge representation to an acceptable discussion. The effectiveness is enhancing to compare this course with a traditional parallel course. Furthermore, lecturers can be derived and assume the role of cognitive coach rather than knowledge-holder and disseminator.

Keyword: Industrial Education, Problem-Based Learning, Learning Reform, Vocational and Technical Education

INTRODUCTION

In the recent year, best practices to educational reform are changed to rapidly respond and adapt to new challenges in the era of knowledge-based society. A trend can be observed in the field of higher education with new ways of thinking about instructional strategies (Achtenhagen, 2001; Bandura, 1986; Fullan, 2005; Levesque, Lauen, Teitelbaum, Librera, & MPR Associates, 2000; Marzano, 2003; Murray & Savin-Baden, 2000; Schmoker, 2004). Many in industrial education have partially adopted the problem-based learning (PBL) as a pedagogical approach.

Problem Based Learning (PBL) is a teaching and learning strategy used widely in higher education as a means of engaging students with material, developing collaborative learning, building independent learning and encouraging deeper learning. The term problem-based learning (PBL) was developed by Howard Barrows and Colleagues as a curricular approach to medical education (Barrow & Tamblyn, 1980). PBL is among the most important educational innovations of last few decades. Problem-Based Learning is rooted in progressivism. Problem-Based Learning “is identifiable by the use of typically ill-structured problems which precede and motivate learning, and act as a vehicle for encouraging student ownership of the learning environment” (Greening, 1988, p. 2 as cited in Koul, 2007). Problem-solving is “a goal directed sequence of cognitive operations” (Anderson, 1980) which require mental manipulation of mental model. A mental model consists of structure knowledge, strategic knowledge, reflective knowledge, and reasoned knowledge.

According to Schunk (2004), PBL promotes higher order thinking with the ill-structured problem scenario. Henson (2003) explained that PBL promotes meta-cognition and self-
efficacy learning by asking students. They are encouraged to work the answers out for themselves by drawing on past knowledge and experiences; this is considered the best known critical thinking teaching method because the educator avoids revealing related information to the students. Knowledge acquired through past experiences, must be assessed for relevance, brought together and synthesized for use with the novel problem stimulus.

In PBL teaching, a collection of carefully constructed problems is presented to small groups of students. The problem usually consists of descriptions of sets of observable phenomena or events that need an explanation or a solution. The task of the student group is to discuss these problems, produce tentative explanations of the phenomena in terms of some underlying process, principle, or mechanism, and to come up with a group solution to the problem. These results in the development of critical thinking by students which is a desired outcome of problem based learning (Oermann, 2004). For this reason there is a strong relationship between PBL and critical thinking theories.

PBL in principles of vocational and technical education is also a new concept. This is the first time that constructivism has implementation and is student focused. Researchers hope that the constructivists view education as a way for promoting students to build meaningfully during the active learning process. Moreover, lectures can provide a stimulating learning environment and assist the student to negotiate meaning. The constructivist learning environment is designed to allow lecturers to interact with the students and inquire about their perspective.

THEORETICAL FRAMEWORK

Principle of vocational and technical education is a subject which is teaching segmented disciplines versus integrated or interdisciplinary curricula. Segmented disciplines divide two types of distinct knowledge: declarative and procedural knowledge (Gagne, 1985). Declarative knowledge is the “know what.” It includes facts, concepts, and principles. It is the content-specific or factual knowledge within a discipline or skill domain. Procedural knowledge is often represented on a continuum from well-structured, through moderately-structured, to ill-structured (Newell & Simon, 1972). The position of a problem on this continuum determines the way it is taught and learned. Though, steps to guide the students through the process of responding to a vocational and technical education management problem in Figure 1.
In preparation for conducting the session, lecturers create the problem-based learning procedures into two categories:

**Declarative knowledge**

In table 1, explains the three types of declarative knowledge.

<table>
<thead>
<tr>
<th>Declarative Knowledge Type</th>
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<tbody>
<tr>
<td><strong>Facts</strong> (“know what” - simple associations)</td>
</tr>
<tr>
<td><strong>Concepts</strong> (“know that” - ability to identify and cluster examples)</td>
</tr>
<tr>
<td><strong>Principles</strong> (“know why” - ability to predict and explain the behavior of a system)</td>
</tr>
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**Procedural Knowledge**
Most real-world jobs include a mixture of problems that vary in degree of structure as well as solution strategy required. For this reason, table 2 shows the contrast of implications for teaching and testing.

Table 2
The implications for teaching and testing on procedural knowledge

<table>
<thead>
<tr>
<th>Implications for Teaching and Testing</th>
<th>Well structured problems</th>
<th>Moderated structured problems</th>
<th>Ill structured problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implications for Teaching and Testing</td>
<td>Depend on declarative knowledge, but with the least depth of knowledge. The skills for these are limited to similar types of problems. Transfer is poor. Learner simply memorizes the procedure; tasks often become automated with practice. Easily incorporated into job aids and performance support systems.</td>
<td>Require more declarative (context) knowledge. Requires skills of mental modeling, problem representation, analogical/abstract reasoning, and evaluation, all within the context. Transfer is strong. Learner must invent a strategy which suits the context</td>
<td>Requires extensive declarative knowledge and experience. Uses heavy abstract/analogical/symbolic reasoning and cognitive flexibility. Transfer is strongest. Must help the learner define the context and goals of the problem. Provide opportunities for divergent practice (many right answers).</td>
</tr>
</tbody>
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IMPLEMENTATIONS

Principle of vocational and technical education is a course for 5th year undergraduate students majoring in industrial education in civil technology education, mechanical technology education, electrical technology education, and production technology education, Faculty of Industrial Education and Technology at King Mongkut’s University of Technology Thonburi. It usually involves 30 hours of lectures. At the end, there is a final assessment that is carried out by written examination.

The main course objectives are to:
1. Provide a fundamental of Thai education system, the principles of vocational and technical educational management as well as the contextual conditions (e.g., current, trend, and issues);
2. Enable students to understand, analysis, and synthesize into the philosophy of vocational and technical education;
3. Propose current issues in Thai manpower demands, quality and standard of vocational and technical students;
4. Comparative study on the leading countries to conduct vocational and technical education;
5. Selected topic in vocational and technical education;
6. Provide an educational research methodology;
7. Provide innovations in vocational and technical education.

**Teaching Method**

Firstly, The assignment of students are providing the analogical of ‘the state and problems on vocational and technical education management of Thailand’, which included to selected topic, such as quality and standard, manpower planning, social demands, demand driven, and current and trends in the next decade (The Office of the Thai Education Council, 2006; Thoranin, 2006).

Secondly, in trial of problem-based learning strategy, researchers plan that the effectively conduct will be required for grading as follows:

**Section 1: Introducing Problem Based Learning**

The students’ orientation is a diagram of the basic difference between subject based and problem based learning.

**Subject Based Learning (SBL)**

- Told what we need to know
- Memorize it
- Problem assigned to illustrate how to use it

**Problem Based Learning (PBL)**

- Problem assigned
- Identify what we need to know
- Learn and apply it to solve the problem

**Section 2: Developing the problem based learning - a step by step - Problem Solving**

**Step 1: Explore the issues.**
What do I already know and believe about this topic and how can I share that with my teammates?

**Step 2: Define the problem.**
What do I think is the problem we have to solve and how can my team agree on a problem statement?

**Step 3: Investigate solutions.**
What do we have to know and do to solve this problem? This step requires much discussion. Play around with the problem statement and your knowledge and experience. Search for links, uncover assumptions, and identify what your team knows and what it needs to know. Make sure you agree on a solution.

**Step 4: Research the knowledge and data that supports your solution.**
Your team needs to plan the work, assign tasks, and set deadlines.

**Step 5: Write your solution and submit.**
Use your best communication skills to state your solution clearly and support it with relevant arguments and evidence.

**Step 6: Review your performance.**
This step is easy to overlook, but it is crucial to improving your problem-solving skills. When you get an evaluation of your solution go over it individually and as a team to see what you did well and what mistakes you made. Mistakes are opportunities for learning. Discuss them to plan improvements on the next problem.

**Section 3: Problem based learning in action - Arguments - a fast introduction.**
Here are some basic forms of arguments to get you started:
1. Categorical arguments
2. Predictive arguments
3. Change arguments

**Section 4: Managing large groups - Tips on Organization**
“What do I have to do to get an A?”
That is the worst question you can ask on a PBL assignment. There is no one right answer when you have to frame a problem and solve it, because it is your problem and your solution. If follows that you have come up with a plan of organization that presents your work in an interesting and compelling way.

After you have brainstormed, read, researched and put together a pile of information and data, how do you turn that into a report that will have impact on your readers or audience? There are many ways to do it. The main thing is to pick a way and to stick to it. Here are some tips on organization to get you started.

Problem based presentations require four basic parts: 1) a statement of the problem; 2) a statement of the proposed solution; 3) supporting arguments; and, usually, 4) a conclusion (Facione, 2006). The model is:

<table>
<thead>
<tr>
<th>Problem Statement</th>
<th>Solution Statement</th>
<th>Arguments</th>
<th>Conclusions</th>
</tr>
</thead>
</table>
Introducing your presentation with a startling, whimsical or compelling statement of the problem (and maybe the solution) will get your reader’s attention. For example:

**Section 5: Evaluation of the problem based learning - Where’s your evidence?**

At the end of the 3-h session, lectures sought a level one evaluation from the students that evaluated student satisfaction with the session. A level one evaluation is a subjective measurement of satisfaction that participants feel about the education program (Kirtpatrick, 2005). Summative assessment techniques used to assess learning after PBL sessions include written examination. In some cases, student will need to make other claims (sub-claims or supporting claims) to make a strong case. A diagram of an argumentative essay supporting a problem solution would look like this:

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  Premise 1  
  | Major claim | Evidence (sub-claim) | Evidence |
  |             |                     |          |
  |             |                     | Evidence |
  |             |                     |          |

  Premise 2  
  | Major claim | Evidence (sub-claim) | Evidence |
  |             |                     |          |
  |             |                     | Evidence |
  |             |                     |          |

  Conclusion (Solution)
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**Finally: What about Grades?**

Problem based learning provides learners with the opportunity to become self-coaching. It helps you learn to evaluate your own performance and figure out how to improve. That should be your goal as developing information scientist and technician - to use lecturers’ evaluations and their models of expert performance to develop your own theory of coaching.

The assessment criteria relating to PBL will be as follows:
1. Effectiveness of the report;
2. Responsibility and independence;
3. Information processing skills;
4. Analytical thinking and reasoning;
5. Problem solving skills; and
6. Interpersonal communication skills

Furthermore, the final examination questions will be adapted ‘real world situation’ from the assigned problems, so the students are encouraged to work on them in conjunction with lecturers and to discuss them in their groups outside the classroom.

DISCUSSION AND CONCLUSION

The traditional lecture-based method is intermediate not active to learning unless augmented by activities which involve students directly, and which give them opportunity to acquire the procedural knowledge by other means besides lateral thinking. This active learning is, to a large extent, what students do in a PBL environment.

Moreover, the summative assessment method used in the lecture-based approach of teaching encouraged surface learning due to the significance on student achievement. Learning, however difficult, is developing and rewarding. In fact, when the brain learns something it releases the peer learning that produce the same delirious happiness sometimes get from research. Learning is also frustrating and demanding.

Problem based learning is a teaching and learning strategy that is well established in industrial education curricula to develop critical thinking and problem solving skills. The acquisition of knowledge, skills and attitudes change is major goals of the approach (Albanese, 2000). Problem based learning was invented to promote a passion for learning. This paper demonstrated how problem based learning strategy can be implementing in the lecture theatre environment of principle of vocational and technical education.

The implications of this study can be applied to change teacher education systems which place too much emphasis on teaching method and domain knowledge and which should try to promote mental model, cognitive skills and interpersonal skills in prospective teacher education program

REFERENCES