Transforming Traditional Training Approach to Problem Based Learning in Delivering Engineering Technology Subjects

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Abstract

This paper will discuss the attempt by German Malaysian Institute (GMI) to improve its student generic skills. Typically, engineering technology subjects are delivered using traditional training approach i.e. lectures, demonstration, etc. Even though this approach works, but there are shortcomings. Students trained under this approach lack some of generic skills such as problem solving, critical thinking, communication and leadership. In order to overcome these, a more innovative approached using Problem Based Learning (PBL) is adopted. Using GMI as case study, this paper will describe the process of transforming an engineering technology subject delivered using PBL mode and discuss the outcome issues related to aligning the pedagogical changes by the Technical Training Officers (TTO) and students.

Keywords: Engineering Technology; Problem Based Learning

1. Introduction

Engineering technology education focuses primarily on the applied aspects of science and engineering aimed at preparing graduates for practice in that portion of the technological spectrum closest to product improvement, manufacturing, construction, and engineering operational functions [1]. In relation to this, engineering technology program are designed to meet the ever increasing technology revolution demand for college-educated problem solvers who can support the engineering process. Engineering technology students will have to acquire hands-on technical skills that enable them to solve industrial related problems. In realizing this, every subjects offered in engineering technology education are delivered through lectures and coupled with hands-on lab sessions. Lecture sessions cover the theoretical knowledge on a subject while hands-on lab session allows students to apply the knowledge.

Currently at GMI, teaching and learning are delivered using teacher centered approach for most subjects. Students sit and listen to lectures, while guided instructions are given to students during lab sessions. These approaches will not be adequate within the outcome based learning environment [2] and to produce graduates which can cope with the fast paced and ever-changing engineering technology field. Employers' employ graduates based on their problem solving and critical thinking abilities not what they had learned.

In order to overcome problems arising from teacher centered learning, GMI had take a proactive action in introducing PBL approach on January 2010 to complement the existing training approach to generate students who are creative, innovative with problem solving skills [3]. Innovative instructional approach in a Student Centered Learning (SCL) environment that allows for flexible adaptation of guidance through problem solving, project works and real life production are necessary in ensuring that the targeted learning outcomes are achieved.

2. Problem Based Learning

The origin of PBL can be traced to John Dewey (1916). Dewey believed that students should have experiential, hands-on and direct learning. It is generally accepted that students learn best by doing and thinking through problems [4], but PBL officially implemented at McMaster University in Canada in 1968 to help medical students perform better in their application of the large amounts of basic scientific knowledge required in their courses to clinical situation [5]. Since then the use of PBL has grown in many fields and has become an established learning strategy.

PBL is a student centered instructional method in which student learn through the experienced of solving ill-structured problems [6]. Students work in small learning teams, bringing together collective skill at acquiring, communicating, and integrating information. Problem-based instruction addresses directly many of the recommended and desirable outcomes of an education, specifically the ability to do the followings:

- Think critically and be able to analyze and solve complex, real-world problems
- Find, evaluate, and use appropriate learning resources
- Work cooperatively in teams and small groups
- Demonstrate versatile and effective communication skills, both verbal and written
- Use content knowledge and intellectual skills acquired at the university to become continual learners

[4]

With PBL, Technical Training Officers (TTO) and students are required to change roles. TTO acts to facilitate the learning process rather than to provide knowledge. Students have to engage in an active learning process to help them develop flexible knowledge, problem-solving skills, self-directed learning skills, collaboration skills and intrinsic motivation [6].

3. Implementation of PBL to GMI first year students

3.1 PBL Curriculum

In order to transform the traditional training approach to PBL, GMI had adapted the model introduced by Neo T K & Neo M, 2005 [7].
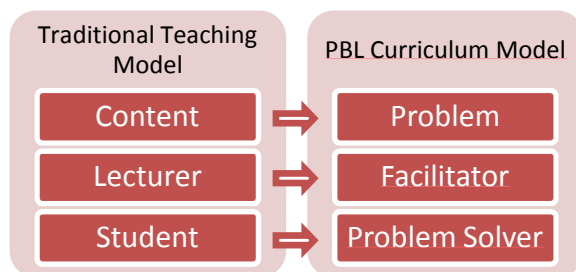

Figure 1: Curriculum Transformation Model

In PBL environment, the contents is transformed into ill-structured problems to provide more realistic approach to learning and to create an educational methodology which emphasizes real world challenges, higher order thinking skills, multi-disciplinary learning, independent learning, teamwork and communication skills [7]. TTO has to play the role of a facilitator to facilitate learning and no longer considered the main repository of knowledge. The students assume increasing responsibility for their learning and become a problem solver.

3.2 Problem Crafting

Crafting good PBL problems is one of the challenges faced by GMI TTO. These problems could not be easily found in most textbooks.

Therefore, searching related materials to assist problem crafting for a course is time consuming and also requires certain amount of creativity. PBL approach is very new to GMI TTO, because of that; workshops were organized to assist them in problem crafting. Apart from workshops, the following guidelines on problem crafting were introduced.

- Step 1: TTO list the learning outcomes and learning objectives expected from topic/subject. Problem statement should contain "cues" that will trigger the desired search for learning objectives;
- Step 2: Choose a central idea, concept, or principle that is taught in a given topic/subject, and then think of a typical end-of-chapter problem, assignment, or homework that is usually assigned to students to help them learn that concept;
- Step 3: Writing problem statements. Problem should have an appropriate level of complexity, ill-structured, requires integration of knowledge, skills and attitude, motivational and relevant, and promotes student activity [8];
- Step 4: Review problem with Problem Review Committee to ensure the problem reflect the course learning outcome and objectives;
- Step 5: Write a learning guide detailing the instructional plans on using the problem in the course;
- Step 6: Identify resources for students.

The guidelines for problem crafting were successfully implemented by GMI to produce problem statements for PBL curriculum.

3.3 Preparing TTO as a PBL Facilitator

GMI PBL facilitators have to serve the three primary roles of facilitator, resource and evaluator. To ensure TTO plays the role of an effective facilitator, GMI had provided workshop and training sessions to help building up their facilitation skills and techniques. Discussion sessions were frequently held among TTO and management to overcome arising issues and problems.

3.4 Preparing Students for PBL

Despite of all the well-planned and advanced preparation, it was anticipated that there will be a certain amount of apprehension and self-doubt accompanied the students throughout the PBL class.

In preparing the students with PBL, GMI had exhaustively explained about PBL as soon as the first week they arrive on campus. Information on PBL was disseminated in the form of flyers and short briefing during tutorial. All of these actions

were taken to make sure students were well exposed on PBL.

3.5 PBL tutorial process

Generally, the processes during tutorial sessions for one problem are as follows [3]:
1) Students in group of five will explore the problem by reading the problem statement carefully, identify key words and seek clarification.
2) Students with the guide of TTO acting as facilitators will list the "3 K's" that is:
   a) What you know: List all the information known in the context of the problem given;
   b) What you don't know: List all the information they don't know in the context of the problem given;
   c) What you need to know/find out: Identify the things that need to be researched or studied in order to solve the problem.
3) List actions to be taken according to timeline by preparing action plan and designation of task between group members.
4) Perform self-directed learning.
5) Exchange knowledge by discussing among group members. Students will brainstorm for possible solutions and organize these solutions according to learning issues.
6) Present findings to the class.
7) Reflect on learning process.

4. Reaction to the PBL implementation

Students and TTO were invited to provide feedbacks of their experience with the PBL via questionnaires and interviews. From the feedbacks, students reporting on their experience from positive perspectives indicated that they had learned more and having fun in the classroom using this approach. They are more active in class and can freely express their ideas during the tutorial session. However, some students commented that they are not sure what were expected from them and found it hard to stick with the steps of problem solving. Some students view the approach as intimidating and complained that they are paying tuition fees to be taught not to teach themselves. Other feedbacks are they were confused, lost, claimed that the TTO were not helpful and answer their question with more question, and they had difficulties in finding the right material and resources. All of the comments from the students were as anticipated earlier. These students were so used to teacher centered learning before entering GMI.

TTO indicated that in terms of classroom participations, students were more active and engaged with their learning. When working in groups, the students manage to show their communication skills and teamwork. However, since the TTO roles changed from being a teacher

to facilitators, they seek clarifications on how much guidance to be given to the students. They also mentioned that they require additional training on facilitation skills and techniques. Assessments issues were also brought up. There were many areas to be assessed such as knowledge, practical skills, social skills and attitude. Time was also an issue especially to the slow learners; they usually did not able to finish off their tasks during the given time. Some of the TTO also mentioned that sometimes some of the students were passive and reluctant to cooperate in class.

5. Implications and Next Step

Issues raised by students and TTO indicated that the PBL approach in GMI requires constant reviews and refinements. Several reviews had been done and improvements actions were taken. Numbers of problems statements for some subjects had to be reduced due to time constraint. The time planned did not reflect the actual time taken by students in solving problems. Reducing number of tasks was a temporary solution as further studies and monitoring had to be done to align between time planned and implementation.

TTO were suggested to monitor students closely especially the slow learners. If required extra worksheets were to be given and to some extent further guidance and extra tutorial session were provided to make sure all learning objectives were covered.

GMI is also enhancing the learning resources and facilities such as wireless internet, books and notes to make sure they are adequate for the student's independent learning. More talks and workshops will be organized to expose PBL to students and TTO.

6. Conclusion

GMI had embarked on its pioneering journey to adopt PBL to produce job competent graduates which covers learning, technical and social competencies. The development of human capital with multitude competencies is in great demand and personnel with only technical competency is no longer competitive and will not survive in globalization era [3].

From the experience, PBL can be adopted in delivery engineering technology subjects but there are key issues to be addressed such as:
1) Slow learners as they required more time to complete task as planned;
2) Discussion, workshop and training need to be held in order to adjust the transformation from teacher centered learning to PBL at initial stage;

3) Aligning the assessment method to PBL approach which was not discussed in this paper.

Continuous efforts and improvements are taken by the management to enhance the quality, to solve problems and addressing issues related to GMI PBL curriculum. Further studies on the effectiveness will also be carried out in the future.

Acknowledgements

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