Engineering Students: Enhancing Employability Skills through PBL

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Abstract. As a developing country, Malaysia faces challenging tasks to develop her economy just like many other countries. Nowadays, change involves many aspects like the economy from agriculture to manufacturing, technology from modern to more advanced ones; mindset from traditional to advanced and so on. Previous studies show that one of the major issues facing local graduates is the lack of employability skills. This problem concerns not only the government but undergraduates and institutions alike. From the pedagogical aspect, one of the more effective ways to improve this is through instructional delivery and in this case the use of Problem-based Learning (PBL). The need to adopt PBL should involved applied subjects undertaken by engineering students. Studies have shown that the use of PBL has been proven to make learning more attractive and effective. In this research, we studied the effectiveness of PBL towards enhancing employability skills among engineering undergraduates. This study adopted a combination of qualitative and quantitative approaches. Data was collected using documents analysis. Student samples comprised manufacturing engineering undergraduates from public institutions of higher learning in Malaysia. The results show that student’s employability skills can be enhanced using PBL. In addition, students become more competitive towards making them more relevance with the needs of the industry with regard to employability skills. In conclusion, PBL is a
very effective catalyst towards raising the employability skills among engineering undergraduates and should be adopted in all engineering education.

Keywords: PBL; Employability Skills; Learning model; Engineering; Engineering Education; Engineering Education Students

1. Introduction

Like any other developing nations, Malaysia also has her share of education challenges in engineering education. As a relatively young country, we try to bring change from one of agricultural to that of industrialized and developed. There are many negative comments about locally trained graduates who lack the crucial employability skills required by the industry. Education is undeniably one of the most important factors that contributes to the development of any country. And in order to be competitive in the modern economy Malaysia should reform her education towards a more competitive one. In Malaysia, every effort is being taken by the Ministry of Education (MOE) and the Ministry of Higher Education (MOHE) to improve and raise the education system towards producing competent manpower for the country [1] [11]. In many conventional education system especially at school level, teachers give as much guidance as possibly could while the learners merely play the role of passive recipients. With limited face-to-face classroom hours and what more the heavily exam-oriented education system not much time is allocated for active learner interaction among themselves and the teacher. Even though the conventional approach of merely listening to lectures can deliver but this approach has been criticised for producing students who are passive and do not take into account the different needs and abilities of the students [2] [9] [17]. In general, conventional learning merely requires students to go through rote learning where interaction, a most crucial element for effective learning, is absent. According to [11], there is clear evidence showing “mismatch” of skills required by the employer and the ability of the graduates. According to [4] [8], “The industry told us that we are teaching all the wrong things. They explained that the quality of our [locally trained] graduates is so bad that 100% of the incoming goods [they produce] require rework – that is, more training”. At university, it is important that students interact more often among themselves, with the lecturers and learning materials. [27] stressed the importance of students interacting frequently because study life at university or college is very demanding and requires high level interaction among the campus citizens and learning materials. Therefore, it is only appropriate that a better learning approach that provides more interaction and learning opportunity be adopted towards producing graduates with higher employability skills needed by the industry.

1.1. Research Problem

The economic scenario of Malaysia which was previously conventional has now changed to K-economy. Malaysia is now known as a New Industrialized Country (NIC) meaning we need fully and semi-skilled workforce who possess the necessary features of a k-worker as required by the industry. This is in tandem with the views of [12], President of the
Malaysian Workers Association, who said that today’s graduates must not treat their certificates and diplomas as the sole collateral for securing suitable jobs. Instead, our graduates must equip themselves with generic skills like interpersonal, information and communication technology, entrepreneurship, leadership and English language. In relation to that, [30] said that collaborative learning (CL) combined with Problem-based Learning (PBL) should be applied in the classroom as it helps to encourage active learning among the students. Both PBL and CL are student-oriented learning approaches and have been proven successful in engaging students to focus and learn more deeply on related subject matters. According to [7] [18], learning should be meaningful and purposeful because both are important elements for students to be fully engaged in their learning process. [29] was of the view that to force oneself to work harder in a group is crucial towards effective management of the working environment which is getting more sophisticated and challenging and PBL can deliver this. University curriculum should not only emphasize on technical knowledge but communication and collaborative skills should be infused among the undergraduates. Students who work well in groups can handle, solve problems and apply better communication strategy related to their study or work better. They also need to be given ample opportunity for sharing of ideas towards forming alternative solutions in problem solving. According to [10] [14], the sharing of knowledge helps to form better learning environment that would be otherwise difficult. PBL is thus a learning approach that uses current issues. Other than being able to increase student’s learning skills this approach also helps to expose students to real world problems that they would encounter at the workplace upon graduation later. In general, scholars are of the view that PBL is a group learning strategy whereby the students interact among themselves and help each other in the learning process. Using PBL, the different levels of learning abilities among the students (higher and low) can actually benefit both parties. The weaker students can get help from the better ones and at the same time the better ones can better consolidate their mastery of knowledge and skills. No matter what, both parties can also benefit in terms of development of generic skills like teamwork, leadership, communication skills, respect and deep understanding.

1.2. Statement

The [28] said that PBL has been proven to have the ability to deliver learning content effectively. This view is supported by [24], who felt that that PBL is an effective skills training method in problem solving at the work place. According to [23], PBL can help build the needed important realtionship between theory, application, education as well as professional practice expected of completing graduates.

1.3. Objectives

This research embarks on the following objectives: To identify the effectiveness of using PBL in teaching and learning; To identify the necessary employability skills required of graduates for employment in the industry; To identify the relationship between PBL and employability skills; To develop a model for the infusion of employability skills based on PBL for use at public institutions of higher learning in Malaysia; To evaluate the PBL model of development.
1.4. Importance

PBL can be seen as an effective alternative to the current teaching and learning strategies used in the learning classrooms. The outcome of this study should be beneficial to all especially the students, lecturers, university and stakeholders.

2. Methodology

2.1. Theoretical Framework

The framework of this study comprise elements of Manufacturing Industry, Employability Skills, PBL, Manufacturing Students, Manual and Facilitators of Public Universities. The Manufacturing Students are those undertaking a bachelor degree programme at public universities in Malaysia as primer data that using Multiple Regression. Employability Skills in divide by three sub area, it is Fundamental Skills, Team Work Skills, and Self-Management Skills according to [25] & [26]. The PBL element actually describes the learning process involved beginning with identifying problems, generation of facts and ideas, learning issues, independent learning, synthesis and application, reflection and feedback and the final solution. [16] [20] told that potential of PBL to support enhancement of employability skills among students. This research also study connection and function of PBL in student’s employability skills. This is very crucial when they try to adapt to real life, especially industrialisation world. If they had enough employability skills and be competence to industry needs that will help them better and more competitive.

2.2. Method

This study adopted the use of qualitative and quantitative approaches involving document analysis such as document by [21], [22], [25], [26], [3] and [13]. The combination of views from the industry and public sectors should contribute towards the development of a more accurate and comprehensive PBL manual for enhancing employability skills. It also helped the researcher in identifying a suitable design and delivery method for the manual to be developed. The research involved perusing the notes, syllabus and related learning materials for the purpose. As for sampling of quantitative approach, the samples of this study were collected from manufacturing undergraduates from Universiti Teknikal Malaysia Melaka (UTeM). This is using quasi-experimental approach.
Figure 1: Adaptation Embedded Concept PBL 3P from [5], [16], [15], [21], [22], [25], [26], [3], and [13].

Table 1: The chronological of Research Methodology

| No | Research Statements                                                                 | Research Methodologies                          | Result of Research                                                                 |
|----|--------------------------------------------------------------------------------------|-------------------------------------------------|-----------------------------------------------------------------------------------|
| 1  | What are the most important employability skills among the undergraduates?           | Literature and Document Analysis                 | the most important employability skills among the undergraduates student in Malaysia |
| 2  | To what extent are elements of employability skills infused in the teaching and learning process of the undergraduates? | Literature and Document Analysis                 | elements of employability skills infused in the teaching and learning process of the undergraduates student in Malaysia |
| 3  | Can PBL raise employability skills among the undergraduates?                         | Multiple Regression                              | PBL possible or not to raised employability skills among the undergraduates.       |
| 4  | Is PBL useful for enhancing employability skills?                                    | Multiple Regression                              | PBL useful or not for enhance employability skills                                |
| 5  | What is the most suitable PBL model for enhancing employability skills?              | Multiple Regression                              | Suitable Model of PBL to enhance employability skills through undergraduates student in Malaysia |
Table 2: Data Gathering Activities

| Weeks | Treatment Group (PBL) 50 students | Control Group (Conventional) 50 students |
|-------|----------------------------------|---------------------------------------|
| 1     | Test 1: Employability Skills     | Test 1: Employability Skills          |
|       | 40 minutes                       | 40 minutes                             |
| 1-10  | Treatment Level 1 (PBL)          | No Treatment Level 1 (Conventional)    |
| 11    | Test 2: Employability Skills     | Test 2: Employability Skills          |
|       | 40 minutes                       | 40 minutes                             |
| 1-16  | Treatment Level 2 (PBL)          | No Treatment Level 2 (Conventional)    |
| 20    | Test 3: Employability Skills     | Test 3: Employability Skills          |
|       | 40 minutes                       | 40 minutes                             |
| 40    | Summative data as support from   |                                       |
|       | Industrial practical supervisors |                                       |
3. **Results and Discussion**

Results from study show the potential of PBL to be the alternative method for enhancing employability skills among Engineering Students. From document analysis researchers have proven what [10], [19], [25] & [26] have discovered and claimed, categories of important employability worth. This means in Malaysia employability skills can be divided into three sections; Fundamental Skills, Self-Management Skills, and Team Work Skills. Findings from Document analysis also found that important employability skills required by employers in Malaysia as in Table 3 and [5].

Table 3: Skills Needed among Graduates by the Employer for the Post of an Engineer, [5].

| Skills                                           | F | %    |
|--------------------------------------------------|---|------|
| Effective communication skills                   | 18| 39.13|
| Interpersonal, personality skills                | 17| 36.96|
| Able to work independently                       | 13| 28.26|
| Able to plan, manage, organize a group (teamwork)| 12| 26.09|
| Computer literacy                               | 12| 26.09|
| Logical and strong analytical Skills             | 12| 26.09|
| Resourceful and knowledgeable                    | 10| 21.74|
| Strong leadership qualities                      | 7 | 15.22|
| Problem-solving skills                           | 7 | 15.22|
| Self motivated                                   | 7 | 15.22|
| Dynamic, enthusiasm, aggressive, and energetic   | 6 | 13.04|
| Proactive, initiative, and creative              | 5 | 10.87|
| Honesty, integrity and commitment                | 5 | 10.87|
| Good presentation (report writing) skills        | 4 | 8.70 |
| Able to work under pressure (tight schedule) with minimum supervision| 4 | 8.70 |
| Fast learner, quick learner, adaptability        | 4 | 8.70 |
| Output or result oriented                        | 4 | 8.70 |
| Professionalism                                  | 4 | 8.70 |
| Able to supervise a group                        | 2 | 4.35 |
| Responsibility                                   | 1 | 2.17 |
| Discipline                                       | 1 | 2.17 |
| Strategic thinking abilities                     | 1 | 2.17 |

Table 3 also shows other results obtained from document analysis concerning the important employability skills infused in PBL process. From the quasi-experimental study involving manufacturing engineering students at UTeM, researchers found that student employability skills improved better compared to the conventional or control group. This shows the possibility and effectiveness of PBL on engineering subject that can enhance employability skills. This is shown in Figure 2. Meanwhile, Figure 3 shows that increase of employability
skills in Team Work skills was up to 56%, followed by Fundamental Skills up to 30% and up to 14% for Self-Management Skills.

Figure 2: Employability Skills Level versus Employability Skills Test

Figure 3: Employability Skills Categories
4. Conclusion

It could be summarized that unlike the conventional learning approaches of merely lectures that has many limitations and restrictions for effective learning using PBL has helped the students to become more independent and active in their learning process. This is prove that PBL to Engineering Students can make better student employability skills. This is what industries need and student are develop a lot of competence to survive in real life. They also had that much opportunity to develop their employability skills like communication, leadership and problem solving. In this study, with one subject using PBL students performed better than the conventional group. Now we can ask ourselves wouldn’t it be better if we could allow all our students to learn using PBL. This study also cannot deny the possibility that PBL is the better alternative learning process. Conclusion can be made that this PBL model for Engineering Subjects have better connection, infusion with employability skills as depicted in Figure 4. For future study, the researchers would like to suggest 1) a qualitative study using PBL to gain in-depth views in this area; 2) a study to identify the best PBL model among the various models for Engineering and 3) a study to identify any other potentials of PBL in the learning processes. Finally, PBL has not only helped the students but helped the lectures to provide a more systematic student-centered learning environment towards producing better employable graduates. In conclusion, learning Engineering using PBL can better enhance Employability Skills.

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