# A REVIEW ON THE PROCESS OF PROBLEM-BASED LEARNING (PBL) FOR LONG-TERM KNOWLEDGE RETENTION

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## ABSTRACT

We reviewed the various processes of problem-based learning (PBL) and their effectiveness in enhancing the students learning experience. It can be said that the studies based on the comparative effectiveness of PBL were seen concordant to the demonstration of superior efficacy for life-long knowledge retention and its application of learning in real life. When empowering student-led learning in higher education, they become leaders in sharing the learning and educational experiences. It has encouraged the students to be more innovative, open-minded and logical in their thinking resulting in developing a creative mind-set in approaching the issues confronting them. It also offers opportunities to collaborate with others in a hands-on, active way. PBL helps to overcome the limitations of traditional learning model which have an over preoccupation with content. It is important that real-world problems are designed for students' learning experience to achieve learning outcomes through the process of actively working on unstructured problems. The role of education is to help students to develop high capabilities and competencies to address the problems and eventually to solve it effectively. The problem-based learning certainly will the help students to have a "helicopter view" on issues confronting them and the ability to address a diversified combined knowledge in solving the problem. Having a better understanding of PBL process will certainly be useful for both the faculty and learners.

**KEYWORDS-** Problem-based learning; Learning processes; Small-group collaboration; Self-directed study; Effectiveness of learning

## 1.  INTRODUCTION

The Problem-based Learning (PBL) is an educational tool used to approach as it can help learn better while being involved or when participating in class activities in a meaningful way to solve problems. A collaborative approach in learning environment can help to create mental models for students' learning and experience. It enhances students' self-directed learning habits through practicing and reflection on knowledge acquired during class sessions (Schmidt & Moust, 2000); (Hmelo-Silver, 2004). The authors believe that learning through PBL can be said to be a "constructive, self-directed, collaborative and contextual" activity for students learning experience (Dolmans, et al., 2005). The fundamental principle of constructivism places the learners as active acquirers and co-developer who has the capabilities to organize their new experiences gained into their mind with the assistance of previous knowledge. (Derry, 1996); (Mayer, 1996). This kind of social interaction is considered as a cognitive development for the students. Many researchers has indicated apart from an individual behaviour and academic performance, they realized that the learners can develop their metacognitive processes and self-regulatory thinking to enhancing their future learning. From an educational perspective approach, PBL has been based on the constructivist approach of student's learning (Schmidt, 1993); (Savery & Duffy, 1995); (Hendry & Murphy, 1995). In PBL approaches (Figure 1):

1.  Learners' understanding was through their interactions in problem scenario and the experience acquired from the learning environment.
2.  When learners engage in handing problem, their problem inquiry process can help in the creation of cognitive dissonance that can stimulate individual learning.
3.  The collaborative process social discussion and negotiation helps one to assess the viability of an individual's viewpoint thus encourages the evolving of new knowledge.

**Figure 1 – Problem-based Learning Approach**
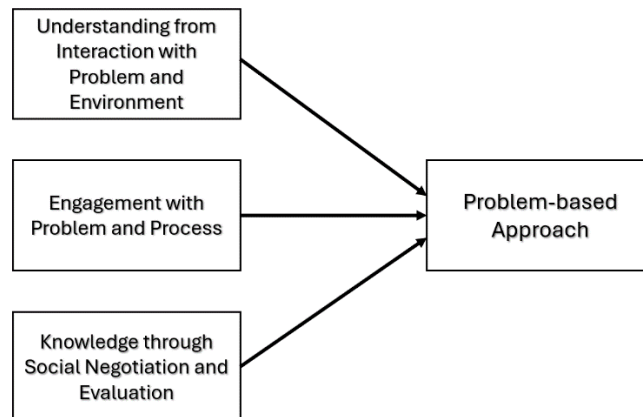


Constructivism has been a key concern highlighted by (Biggs, 1996); (Carlson, 1999); yet in teaching and training in classrooms, it is usually a didactic teaching approach with minimum space for any form of dynamic thinking and dialogue among the learners. PBL tool used in classroom is not only the infusion of problems, but also provide learners the opportunities to construct knowledge by interacting among the learners through a collaborative inquiry and this can encourage new knowledge. According to (Popper, 1992, p. 40), a well-known philosopher of science who dreamt about developing learning organization where the young students could develop learning with minimum boredom, which could stimulate problem development and discussion. It could have been a school in which no unwanted answers to unasked questions would have to be listened to. Not for the sake of passing examinations. According to Popper's dream, all learners will have the chance to find knowledge on their own to deliberate with other learners. In this manner the learners could fine tune and develop their own knowledge based on their previous experiences, combined with the new knowledge that they have acquired. Through self-directed and peer learning, with the help of team teaching, and engagement in classroom activities, the learners' cognitive processes can be further enriched. According to (Tan, 2003), learners could benefit from the several approaches of learning, and thinking, which can be developed through problem-based learning approach which includes the following:

**Figure 2 – Learning and Thinking Through Cognitive Function's in PBL**

1. Configuring (Systems and Holistic Thinking);
2. Relearning;
3. Rethinking;
4. Observing and Making Use of Observations;
5. Recognizing and Making Patterns;
6. Generating fresh Arguments and Explanations;
7. Analogizing;
8. Connecting;
9. Imaging;
10. Abstracting;
11. Empathizing;
12. Transforming Information;
13. Playing with Ideas

Figure 3 clearly has shown that there are several approaches of critical thinking and learning that faculties/teachers need to rethink to develop an effective innovative education system. According to (Bruner, 1960), problem-solver can be considered a knowledgeable person, who has the capabilities to interact with the environment to test the hypotheses, develop generalizations and engage in learning so as to arrive at solutions suitable to solve the problem. The author highlighted that the objective of education is to enhance the ability to develop the problem-solving skills, including the process of inquiry and discussion. As part of their learning experience. It is important to note that from the cognitive perspective, it is clear that all problems have three key components (Mayer, 1983); (Chi & Glaser, 1985):

**Figure 3 – Cognitive Perspective**
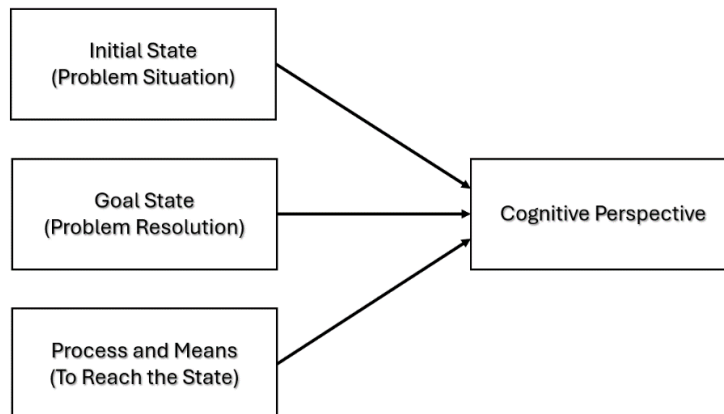


1. At the initial state, learners will have to learn the complexity of the problem situation.
2. At this stage, the learners will develop goals to solve the problem.
3. In the final stage, the learners need to understand the process and the means to get from initial state to goal state.

Problems solving not only enhance the cognition and learning aspects, it also does trigger the situation of learners' engagement, anxiety to acquire, inquiry mind, and in relating to the real-world issues. Therefore, problem solving pose a challenge in empowering the learners to capitalize on their wealth of knowledge.

**Statement of the Problem**
Education in today's time, is about the need to develop intelligences among the learners. Since the jobs are not permanent, there is no future in just depending on it. However, people do have a future, where people with intelligences design their personal careers and future through relentless pursuit and creative learning. This may pose great challengers for new learners and faculty members in developing and using a problem-based learning approach.

## 2. METHODOLOGY
The research conducts secondary methods and review of previous literature on the topic of problem-based learning, and collaborative learning. This review focuses on the implications of problem-based learning approach acquired from the various sources of academic published literature. The review highlights concepts and approaches that have been adopted and could be applied in other learning institutions in different locations.

**Understanding the PBL Process in Learning**
According to (Tan, 2003), the PBL's cycle of learning involves the student and the process of collaborative problem-solving, among the group of about three to five students who are engaged in the discussion. The PBL cycle was adapted from Tan's (2003) PBL schema with the following: i) in meeting the problem, ii) in initial problem analysis which could lead to the development of new learning experiences, with the integration of knowledge acquired, which provides a solution, and an overall evaluation as indicated in Figure 4.
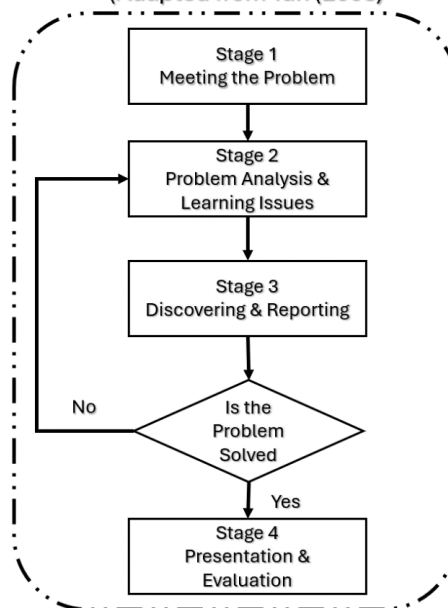
**Stage 1: In Meeting the Problem Learners** – these learners were provided with a real-life situation for them to solve the problem. The learners in the group demonstrate their ability to identify the facts involved in the situation. The main objective at this stage is to establish a clear understanding of the situation posed and on how to brainstorm ideas that may lead to acceptable solutions. Learners were able to address the given problem from multiple angles, thus helping them to create many more ideas to better understand the situation.

**Stage 2: Analysis of the Problem and Issues Confronting Learning Issues** – where group learners will have the chance to ask critical and relevant questions to establish meaningful association between the learner's previous knowledge and key concepts appropriate to the situation. This will help them in identifying the learning issues and objectives, before establishing a clear problem statement by the group. They will then engage in discussions and later appoint the learning tasks for each of the learner in the group. It helps learners to recognise the importance of making connections as a cognitive function.

**Stage 3: The Need to Discover and Report** – at this stage the learners would have identified some of the learning issues, compiles their findings and later share with the other learners within the group. Here is where the process of peer teaching, helps to amalgamate the information from the learners with the group. At this stage, the learners will steadily motivate their team member's collective understanding by clarifying some of the behaviours, through asking questions and challenging each other's views and ideas for better understanding of the issue and solution. Them, the learners were able to develop based on the different views and opinions of the situation.

**Stage 4: Presentation of Solution and Its Evaluation** – the group finally articulate and develop their problem statement, hypotheses for the research and proposed solutions to an academic committee of tutors and peers. The group can use different form of presentations such as mind-maps, journal used to develop their inquiry process, appropriate theories and other related information that contributed to the solution. This will help the group to explain to the tutors and peers of their proposed solution. This provides the learners to be motivated in identifying new opportunities for learning and in generating new ideas to be planned in a more systematic manner with progressive solutions.

**Figure 4 – The 4-Stage PBL Cycle**
(Adapted from Tan (2003)

Stage 1
Meeting the Problem

Stage 2
Problem Analysis &
Learning Issues

Stage 3
Discovering & Reporting

Is the
Problem
Solved

No

Yes

Stage 4
Presentation &
Evaluation

**Teachers' Efforts to Implement Problem-Based Learning**
It is important that support is given to teachers who are adopting new innovative approaches to teaching methods, example like the use of PBL in their classrooms. It has been suggested that that Problem-based learning (PBL) is a student-centric approach the engages learners to investigate and evaluate complex problems accounted in real-word (Levin, 2001). According to (Hallinger, 2005), students could learn the subject-matter content through the identification and solving the real problems of the discipline in PBL. Some authors suggested that the use of problem-based learning methods, has the potential in preparing the students to be more flexible thinkers, who productively work with other members of the groups to solve complex problems (Hmelo-Silver, 2004); (Kain, 2003). It has been proven that this PBL approach to learning encourages different types of problem-solving skills in students, such as the ability to describe a specific process that was appropriate to address a specific problem, thus, creating the ability to increase the depth and breadth of the solutions (Stephen, et al., 1993); (Dochy, et al., 2003).

Therefore, according to (Hmelo-Silver, 2004), it can help the students to develop self-directed learning skills, and positive attitudes toward learning (Simons, et al., 2004). According to (Bray, et al., 2000), students are repeatedly engaged in reflections and actions as they work together in a collaborative approach through group learning. Collaboration competency requires inter-and intrapersonal skills, and effective communication and socialization skills. PBL can be a useful tool to develop these skills in enhancing students' learning abilities.

**Challenges Faced by Teachers in Accepting Change**

According to (Krajcik, et al., 1994); (Grant & Hill, 2006); (Murray & Savin-Baden, 2000), teachers may face several challenges in introducing the problem-based learning in the classroom. Figure 5 shows the challenges teaches may face when using PBL. It is essential to understand the teachers' beliefs, their past experiences, pedagogical and subject knowledge that they teach, and their level of commitment to innovation in teaching. Secondly, whether there is sufficient classroom support by providing sufficient resources, the size of the class and the frequency of their teaching schedule. Finally, the need to understand the school/community needs in terms of their curriculum development and the assessment policies, the support from the community and their involvement. All these factors do influence the acceptance of change in PBL.

**Figure 5 – Challenges in Teachers Accepting Change**
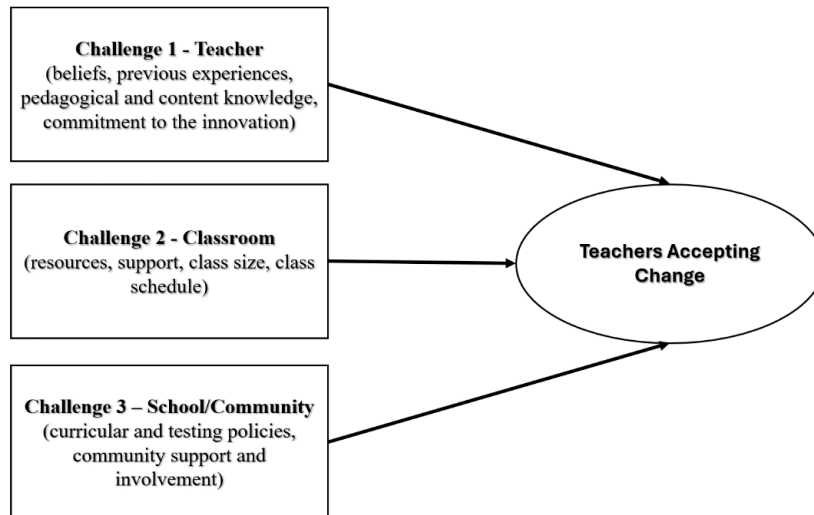


According to (Grant & Hill, 2006), he further expanded on some of the key components that the teachers will encounter such as the four factors that influences teachers' adoption and the five factors in using the problem-based learning as shown in Figure 6. Firstly, the teacher needs to recognize and accept PBL with additional new roles and responsibilities when teaching the students. Secondly, teacher needs to be comfortable with their new classroom setting when teaching using PBL. Thirdly, teachers must be ready to accept tolerance for lack of clarity and the need for flexibility in managing the new classroom learning environment. Fourthly, the teachers need to acquire PBL skills that will help develop their level of confidence in technological tools and resources in classroom.

**Figure 6 – Expanded Factors Influencing Teachers' Adoption of PBL**
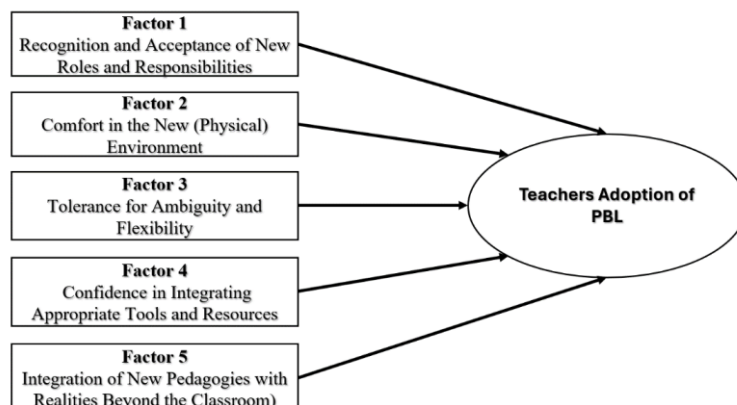


The fifth factor is the incorporation of new teaching methods with real situations based on the outside world rather than just within the classroom. Teachers may expect challenges from learners, staff and even the administration. Teachers' acceptance would very much dependent on the attitude towards understanding of learning.

**PBL Planning Efforts**

Designing a PBL method of teaching may not be a simple or straightforward, like planning a traditional instructional unit according to (Krajcik, et al., 1994). In Figure 7 its shows the three stages of planning when teachers decided to adopt PBL as their tool for teaching.

**Figure 7 – Key Tasks in Teachers' PBL Planning Efforts**
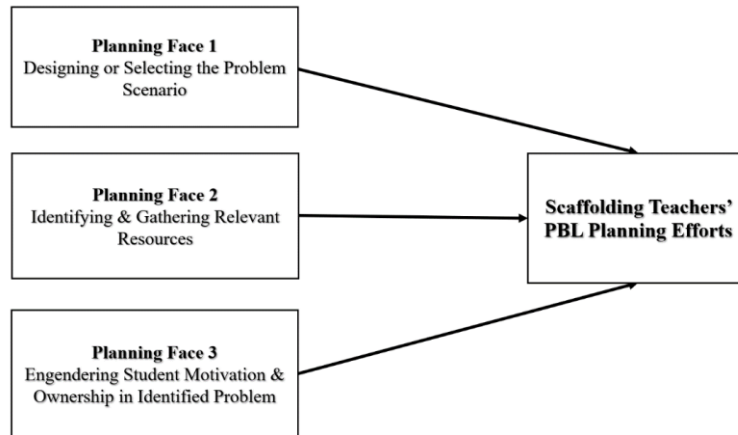


In the planning face it is important to select a real-world problem scenario that students can relate and apply all the competencies PBL to analyse and evaluate the problem. In phase 2 students can be guided to identify and gather appropriate information from the industries and academic sources to address the problem. In phase 3, it is crucial to ensure that level of student motivation and in taking responsibility of the problem is important. This would help them to lead the problem to a solution.

**Benefits of PBL in Learning**

There are several benefits when PBL is incorporated in the school's curriculum where students will have greater opportunities interacting and making decisions collectively. Figure 8 shows the various benefits when using Problem-based Learning.

**Figure 8 – Benefits of Using PBL**
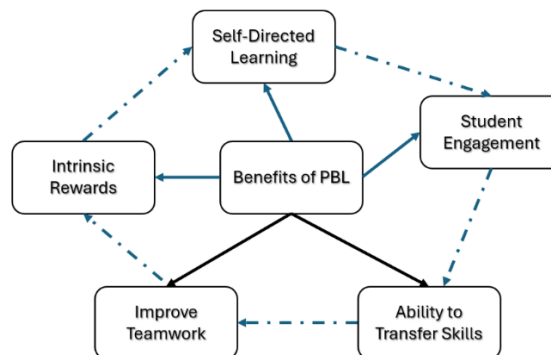


**Promotion of self-directed learning:** Being a student-centred approach, problem-based learning enhances them to take the lead and accountability in developing their personal learning. Since research and creativity will be used, they help in the development of skills that will be beneficiary to the learners in their adulthood.

**Highly engaging:** This clearly shows that the students are leading their learning rather than just sitting, listening and taking notes in class. This new approach of problem-based learning develops the students to be the driver of their lifelong learning journey. They need to be attentive, with the ability to apply critical thinking within and outside the box to solve more complex problems.

**Develop transferable skills:** The PBL approach helps in the development of students to go beyond the classroom or subject level. This is supposed to be applied across the school subjects, including the future life by taking important leadership role in resolving the real-world challenges.

**Improve teamwork abilities:** This PBL approach has developed students collaborative and interactive skills to work with classmates in coming up with effective solutions. Students also develop the ability to collaborate, communicate, compromise, and listen to one another.

**Encourage intrinsic rewards:** The reward students get is greater than just an 'A' based on their academic work. However, the PBL projects has helped students to develop self-respect and satisfaction in knowing how to solve the problem, through the creation of an innovative solution, or in manufacturing tangible products that would benefit the society at large.

## 3. CONCLUSION

In conclusion, the studies reviewed above suggest that PBL is an effective teaching and learning approach, particularly when it is evaluated for long-term knowledge retention and applications. There were several studies which has provided much evidence in terms of higher academic performance of students learning under PBL conditions, as compared to classroom lecture conditions. PBL encourages learners to be a self-directed or independent learning which can be challenging, even for a highly motivated student. In PBL, students' need to assess their level of readiness to learn, define learning goals, monitor their learning process, be self-motivated, be prepared to re-evaluate and alter goals as they go along their learning journey. Teachers can help to build a co-operative learning environment, which can help to motivate and direct the students' learning experience. Teachers can further facilitate the students' initiatives for learning and make themselves available for consultations by becoming as an advisor. Teachers need to be more practical and realistic when planning their PBL first few lessons in the classroom. One area that teachers could star with is by identifying areas in the curriculum that have problems or issues that have already been embedded within them. This can provide teachers with a reasonable comfort level when entering into the PBL process.

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