

# The Strengths and Weaknesses of the Implementation of Project Based Learning: A Review

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**Abstract:** *Project Based Learning (PBL) as a learning model with scientific approach will accustom students to do the inquiry process which is believed to be able to improve the quality of education. By implementing PBL which belongs to constructive approach, it will enable the students-centered learning, so it will facilitate students to innovatively and creatively transfer their knowledges to the real world situation. However, there are only a few teachers who entirely understand on how the PBL with scientific method should be implemented. Therefore, teachers still get difficulties on its implementation. In the literature review, the writer would like to emphasize on the importance of improving PBL to increase the quality of education in order to prepare the human resources which have competitive and comparative superiority based on demanded quality standard of the 21<sup>st</sup> century era. Many researchers have conveyed their findings about the strengths of PBL to increase knowledges, skills and attitudes, yet the writer also considers the problems faced by teachers in improving and implementing PBL. It is highly expected that the problem discussed in this literature review is relevant to trigger the pre-service training in preparing the teacher candidates and teachers at school in order that they are willing and able to implement this learning model.*

**Keywords:** learning model; PBL approach; Project Based Learning; scientific method

## 1. Introduction

Project Based Learning (PBL) is one of the constructivism approaches in which the cooperation among the students in finding and building their knowledge through active learning (Yew & Schmidt, 2009; Zajkov & Mitrevski, 2012). This is a learning process based on the research, design, and anything engaging students' minds-on activity and students' hands-on activity.

PBL when compared to traditional curricula was inversely associated with perceived stress and that in turn had a strong impact on learning, assignment project appears in the more traditional learning concept but the project or problem is centered around the notion of learning which gives the learner the opportunity to be involved in learning process. Doing/creating projects is a long-standing tradition in education.

PBL is learning with the use of projects as systematic teaching method which involves students in learning knowledges and skills through research assignment, authentic question, and well-designed product. Projects within PBL as based on challenging questions and making students having central role in design, problem-solving, decision making processes so giving students the opportunity to work relatively autonomously. Meanwhile (Blumenfeld et al., 1991) explained that PBL is a model which organizes learning comprehensively based on challenging questions or problems, which involves students in designing, problem solving, decision making, or investigation activity of project assignments; giving opportunities for autonomous working over a particular period; and end up on a realistic product or presentation. PBL is sometimes compared to research based learning or experiential learning.

In Indonesia, PBL was firstly assigned only for vocational high schools, but there are finally a lot of studies which result in the fact that PBL does not only focuses on getting solutions for social issues related to economy and entrepreneurship, but also improving students' academic achievement, motivation, creativity/skills and attitudes. It is considered important for students to be given a wide chance to get experience and understanding on the information obtained from their findings or experiments. This kind of learning has a huge potential to give students interesting and meaningful learning experiment. Various researches showed that PBL has been used by western lecturers and it has been quite useful in designing an effective learning (Wrigley, 1998). With PBL, students can enrich themselves with the knowledge they found. (Zajkov & Mitrevski, 2012; Shih et al., 2010) further stated that PBL a learning centered on students. It does not require students to memorize any theory or formula, otherwise students are required to be more analytical and think critically by analyzing collected information to solve problems through project. This pragmatic approach concentrates more on the process rather than content.

Natural science is a science that studies natural phenomena including living things and non-living things, or a science about life and science about physical world. Science knowledge is obtained and developed based on a series of studies conducted by scientists in finding out answers of the questions of "what?" "why?" and "how?" of the natural phenomena and its implementation in technology and daily life. Science education emphasizes on giving direct experience to develop competence in order that students can explore and comprehend surrounding nature scientifically. Science education is directed to find out and carry out something so that it can help students to gain deeper comprehension about surrounding nature. Hence, the

approach applied in presenting science learning is that combining science process experience and science product comprehension in the form of direct experience.

Perhaps the question arises, why should we use PBL? In the learning of science in particular, perhaps this model is not new, however, "traditional science course focuses on presenting the results of the scientific process rather than the story of how the scientist arrived at these results". As a result, teachers / teacher candidates are accustomed to seeing science as a collection of facts and theories that have been finished. This situation led to the learning process of science to a mere transfer of knowledge from lecturers/teachers to their students, but in line with the Ministerial Regulation No. 81-A in 2013, which mandates that the principle of learning activities should: (1) centered on the learner; (2) develop creativity; (3) creating a fun and challenging condition; (4) containing values, ethics, logic and kinesthetic; and (5) provide a diverse learning experience through the implementation of various strategies and teaching methods which is fun, contextual, effective, efficient and meaningful. Everything which is stated in the above Ministerial Regulation contained in the PBL model. This PBL also focuses more on issues that are meaningful to students' lives, the role of the teacher in presenting a problem, ask questions and facilitate students in designing a project that they will work within the given time and also in accordance with the concepts taught. At the end, students will understand the concept of the projects they are doing, and this will improve students' creativity (Yasin et al., 2009).

Based on these arguments, in the implementation of learning as mandated in Curriculum 2013, science learning should be designed well so that teacher candidates/students are able to understand about "the story of how the scientist arrived at these results". This implies that, the lecturers/science teachers should develop the learning process which is in line with how science proceeds, "teach science as science is done". Therefore, science learning should be developed to by following the values and spirit of the Scientific Method.

Of course, at the initial stage of implementation there are many problems that occur when the teacher implement this model at school. The difficulties faced by teachers associated with the implementation of learning with scientific method approach are due to the teachers themselves who have not internalized the values and spirit of the Scientific Method itself. Understanding the overall PBL cannot be done immediately only through the Training Program conducted by Education Quality Assurance Agency or Ministry of Education and Culture with limited time.

Therefore, there should be an attempt to internalize the values and spirit of the Scientific Method to teacher candidates when they are studying in pre-service training. Teacher candidates should be accustomed to follow the learning at campus with the learning approach that can internalize the values and spirit of the Scientific Method. Students of education program who are already accustomed to doing Scientific Method through a course run with the PBL approach, when they are teaching at schools, they can develop more meaningful learning process.

Based on the background of the problem, then the problems that become the focus of study in this paper are: what are the advantages of PBL as a learning model with scientific approach as suggested on Curriculum 2013? What are the constraints faced by teachers when teaching students with PBL?

Studies on the advantages and disadvantages of the implementation of PBL are expected to have some strategic values to the development of learning both on the process and outcome sides. From the aspect of the learning process, this study can be used as a theoretical reference for pre-service training lecturers in developing learning strategies that can internalize the values and spirit of the Scientific Method to the teacher candidates. With the right and good strategy then optimization of students' potential is expected to happen. From the outcome side, it is expected that the students of education program who have been accustomed to do Scientific Method through a course run by the PBL approach, when teaching at schools, they will not find any problem as experienced by school teachers today. Similarly, for teachers who will implement the Curriculum 2013, by knowing the advantages obtained when applying this model, the teachers will be motivated to apply this model to the process of learning. In addition, by knowing the constraints faced when applying this model, it can be used as a consideration in developing this kind of learning model at school.

## 2. Characteristics of PBL in Indonesia

PBL in Indonesia can be said as the operationalization of the concept of "Production-Based Education" which was developed in Vocational High School . Vocational High School as an institution whose function is to prepare graduates to work in the business world and industry should be able to equip students with "standardized competencies" needed to work in the field respectively. By learning "production based" students in vocational high school are introduced to the atmosphere and the true meaning of work in the world of work. (Van den Bergh et al., 2006) states that the PBL is a learning environment that is congruent with the principles of the new education.

Characteristics of PBL by Thomas (2000) focuses on learning that involves students in investigations, problem solving, and other meaningful task activities, gives students the opportunity to work autonomously in constructing their own knowledge, and reaches the peak to produce real products.

Given that each student has a different learning style, then the PBL provides an opportunity for students to explore the content (material) using a variety of ways that are meaningful to them and conducted experiments collaboratively. PBL is an in-depth investigation on a topic of the real world; it would be valuable for the attention and effort of students. PBL is a comprehensive study involving students in collaborative investigation. PBL helps students to learn strong knowledge and skills built through tasks and authentic works. Learning situations, environments, content, and relevant tasks, realistic, authentic, and provides natural complexity of the real world can give self-

experience of the students toward student objects and information obtained by students bring strong enough suggestive messages.

Generally, PBL has some steps such as Planning, Creating, and Processing. PBL approach is the approach that has syntax: (1) Starts With the Essential Question, (2) Design a Plan for the Project, (3) Creates a Schedule, (4) Monitor the Students and the Progress of the Project, (5) Assess the Outcome, (6) Evaluate the Experiences. (Hung et al., 2004) found that the principle combination of project based learning, meaningful learning and learning with technology influences students' success and creativity, and improves students' motivation. Students' mentoring and coaching are very effective in developing students' skills and talents in project based learning environment. Teachers can also get feedback on their own teaching and learning.

Hugg and Wurdinger (2007) also stated that the PBL if it is applied together with the appropriate exercises and tasks, then it can be applied to a wide range of courses that will enhance students' life skills and provide real benefits to the community.

Principles of PBL in common are as follows:

- 1) Students work together in groups and collaborate on project activities. (Elam and Nesbit, 2012): the increases in the students' collaborative abilities, characterized with the existence of cooperation among students in groups or in pairs.
- 2) A real world problem that affects the life of the students is presented for investigation. The learning is design to help students develop their thinking skill, problem solving skill, and intellectual skill. Students are given a chance to think and create.
- 3) Students discuss findings and consult the teacher for guidance, input, and feedback.
- 4) Artifacts production and exhibition, in which students are required to make a particular product in form of real work or modeling which is then demonstrated to other friends.
- 5) The maturity level of students' skills determines the degree of guidance provided by the teacher.
- 6) Final products resulting from PBL can be shared with the community-at-large, thus fostering ownership and responsible citizenship in addressing real world problems (Chandrasekaran et al., 2012)

Today, different variations of PBL exist. For example, one version of PBL, called PBS (project-based science), includes five basic components: (a) driving questions, (b) investigations, (c) artifacts, (d) collaboration, and (e) technological tools (Krajcik et al., 1994). Based on an extensive review of the existing literature, the basic criteria for PBL appear to be the following (Thomas, 2000): 1) centrality: PBL projects are central, not peripheral to the curriculum; 2) driving question: PBL projects are focused on questions or problems that "drive" students to encounter (and struggle with) the central concepts and principles of a discipline; 3) constructive investigations: the central activities of the project must involve the construction of knowledge on the part of students; 4) autonomy: projects are student driven to some significant degree; and 5) realism: projects are realistic or authentic, not school-like projects.

Based on an exhaustive literature review, features of PBL projects are as follows:

- 1) A question and problem directs related activities that result in a summary report or product (Curtis, 2002);
- 2) A product, presentation or a performance can be improved and applied for practical purposes;
- 3) Real life problems that students are interested in are raised so that they can interact with real life circumstances through the projects (Gültekin, 2005);
- 4) Students can develop products or works to solve questions or problems raised during learning (Köse, 2010);
- 5) Students collaborate in a team to achieve certain objectives in a defined time period (Gültekin, 2005; Simkins, 1999);
- 6) Many disciplines are incorporated, allowing students to create multidisciplinary approaches to solve problems;
- 7) Students can define the problems, discuss views or forecasts, collect information, evaluate such information, make conclusions, create a product (Blumenfeld et al., 1991), and construct required knowledge (Köse, 2010).

### **3. The Advantages of the Implementation of PBL**

#### **3.1 PBL increases students' learning motivation**

PBL increases the motivation of students. When teachers successfully implement PBL, students can be highly motivated, feel actively involved in their own learning, and produce complex, high-quality work (Blumenfeld et al., 1991; Elam & Nesbit, 2012; Doppelt, 2003; Wrigley, 1998). The students who are educated by multiple intelligences supported with project based learning method are more successful and have a higher motivation level than the students who are educated by the traditional instructional methods. (Baş & Beyhan, 2010; Ergül & Kargin, 2014) argue that with the increasing of students' learning motivation, it will boost students' ability to do important works, and they deserve to be appreciated.

#### **3.2 PBL increases students' academic achievement**

With PBL, students get knowledge (including insight and meta-cognition), skills, and attitudes. Students create tasks or problems which are more concrete, and arrange potential solutions by using theoretical and practical knowledge). PBL provides productive environments for the development of meta-cognition (Downing et al., 2009). PBL appears to be an effective model for producing gains in academic achievement (Erdem, 2012; Ergül & Kargin, 2014 ; ChanLin, 2008; Gültekin, 2005; Yalçın et al., 2009; Baş & Beyhan, 2010)

#### **3.3 PBL increases cooperation/collaboration ability**

With PBL, students work in teams and they collaborate (Elam & Nesbit, 2012; Barrs, 2012; Wrigley, 1998). Learning effectiveness was assessed based on the students' perceptions and their group discussions, collaboration and communication behaviors. (Shih et al., 2010). All students have the opportunity to interact and develop skills with the incorporation of cooperative or collaborative learning (Marx

et al., 1997; Wrigley, 1998). Collaboration in the learning process is a higher level of cooperation. The PBL has several characteristics that would stop the students from monotone activities and make them more dynamic. PBL supports students in learning and practicing skills in problem solving. Therefore, it also provides an opportunity for interdisciplinary study for completing the various stages of the project. All students have the opportunity to interact and develop skills with the incorporation of cooperative or collaborative learning (Marx et al., 1997). The PBL helps students develop real-world skills such as the ability to collaborate well with others, make decisions and take the initiative, and facing a complex problem solving, communication, and self-management. (Yalçin et al., 2009; Wrigley, 1998). The route to the end-product brings opportunities for students to develop their confidence and independence and to work together in a real-world environment by collaborating on a task which they have defined for themselves and which has not been externally imposed (Blumenfeld et al., 1991). PBL thereby helps students to improve their social skills, often lead to reduced absenteeism and fewer discipline problems in the classroom. Students also become more confident to talk to a group of people, including adults.

### **3.4 PBL increases the ability to communicate**

With PBL, students learn how to do research as presented by Yalçin et al. (2009), how to organize a team, and how to communicate. It is also important when students learn to articulate their thoughts, they learn how to explain, and how to convince. The PBL helps students develop positive communication skills. Students learn to advocate, to defend their ideas, but at the same time they learn to listen to their opponents and open to the opinions of others. PBL overcomes the gap between knowledge and thinking. Students "know" and "do".

### **3.5 PBL increases students' skill in managing learning resources (improve library research skill)**

Morgil et al. (2008) states that in finding the solution for project tasks, students can look for from a variety of sources such as online, library, field trips and observations etc. Through the application of web-based project, the lecturer does not present the knowledge to students yet; otherwise the students have learned how to achieve the knowledge and use this knowledge in the solution process. Thus the PBL will improve students' skill to seek and obtain information.

### **3.6 PBL creates fun learning**

PBL makes learning fun atmosphere, so that students and teachers enjoy the learning process. (Yalçin et al., 2009; Jumaat & Tasir, 2013), stated that during the project work, PBL created different teaching environment by getting students out of the boring routine in the classroom. This teaching environment is more interesting, fun, and useful for students and allow them to build knowledge in an authentic context (Papanikolaou & Boubouka, 2010; Eskrootchi & Oskrochi, 2010; Gültekin, 2005) found that project based learning made students happy during the learning process by providing them with rich learning experiences increased.

### **3.7 PBL increases students' attitudes toward learning**

Morgil et al. (2008) found that there is a relationship between students' attitudes toward chemistry with their performance. Students will be learning a lot with web-based learning compared to traditional methods. In the application of web-based project, the students benefit from simulation experiments by determining questions of their own projects. Simulation experiment becomes their visual resource and also they can look back on when needed. The same thing as the findings obtained by (Erdem, 2012; Chang et al., 2011; Gültekin, 2005; Yalçin et al., 2009; Baş & Beyhan, 2010) that PBL appears to be effective model for producing gains in an attitudes. (Baş, 2011) found that at the end of the research, it was revealed that the students who were educated by PBL was more successful and had higher attitude levels towards the lesson than the students who were educated by the instruction based on student textbooks.

### **3.8 PBL increases students' creativity**

PBL develops the habit of lifelong learning. PBL meets the students' needs with different levels of skills and learning styles. According to Zhou (2012) PBL is one example of a curricula that prepares students by helping them to acquire the skills necessary to exercise their creativity. The conclusions of this study include 1) the development of Group creativity is a socio-cultural activity because it is influenced by many factors introduced in the learning given by the environment, as well as the broader socio-cultural context. 2) In the PBL environment, the project task is a center to build a learning community. 3) Stimulation with project tasks will motivate the emergence of individual creativity and group creativity. 4) In the PBL community, long-term collaborative relationships between students is established and expanded.

### **3.9 PBL lowers students' anxiety level in the learning process**

Erdem (2012) stated that at the end of the research, the anxiety level of the teacher candidates were found to be decreased. PBL also increases enthusiasm for learning. When the children are excited and enthusiastic about what they are learning, they often get more involved in the subject, the level of anxiety is reduced and then expand their interest to other materials. Enthusiastic students tend to retain what they learn, not to forget it as soon as they have passed the test.

### **3.10 PBL increases problem solving ability**

PBL can improve the ability to solve problems, make the students more active and successful in solving complex problems. PBL also requires students to develop skills such as collaboration and reflection.

### **3.11 PBL increases resource management skills**

PBL gives students learning experience and practice in organizing project and makes the time allotment and other resources such as equipment for finishing tasks, providing

learning experiences that complexly engage the students and are designed to develop according to the real world.

#### 4. Weaknesses in Implementing PBL

Researchers have shown that behind the advantages possessed by PBL, of course, there also found many deficiencies in the implementation affecting the success of PBL, especially when implementing project based learning approach in a large class. Although generally PBL can increase students' motivation, but many researchers revealed that if the PBL is applied in large classes, teachers experience difficulty in improving students' motivation, difficulty in making the students to concentrate on learning tasks, difficulty in helping students to connect new content with their prior knowledge, and difficulty in performing cooperative learning activities efficiently (Blumenfeld et al., 1991; Gülbahar & Tinmaz, 2006; Marx et al., 1997; Lee & Tsai, 2004).

Other disadvantages encountered in the implementation of PBL are as follows.

1. PBL requires a lot of time that must be provided to solve complex problems (Grant, 2002). This will lead to a lack of time available for the material/content.
2. Many parents of students who feel aggrieved, because it adds to the cost of entering the new system.
3. Many instructors/teachers feel comfortable with traditional classroom, where the instructor/ teacher play a central role in the classroom. This is a difficult transition, especially for instructors/teachers who have little or no control of the technology (Scott, 1994).
4. Applying project based learning in the classroom may be intimidating for some experienced teachers and will be even worse for beginners (Grant, 2002).
5. The amount of equipment to be provided, so that the demand for electricity increases.
6. Almost all examples of successful project based learning capitalize on the success of cooperative or collaborative learning (Land & Greene, 2000; Marx et al., 1997). Students who have a weakness in the experiment and the collection of information will have trouble (Grant, 2002; Kurzel & Rath, 2007).
7. Students who are not experienced with working in groups may have difficulty in negotiation and compromise (Grant, 2002; Kurzel & Rath, 2007). If this method has not been used before, it may be necessary to teach students how to interact in a group and manage conflict within the group. There is a possibility of students who are less active in group work.
8. When the topic given to each group is different, it is feared that students cannot understand the topic entirely (Grant, 2002; Kurzel & Rath, 2007).
9. For a self-assessment survey, the data may have been influenced by a slight inconsistency (Elam & Nesbit, 2012).
10. Lack of student interest in the subject, including methods of teaching (Kurzel & Rath, 2007).

By referring to the deficiencies in the implementation of PBL, those can be minimized by the use of team teaching in the learning process, and it would be more interesting if the classroom atmosphere is not monotonous, a few examples of

the lay-out changes in the classroom, such as: traditional class (theory), discussion group (drafting and distribution of group tasks), laboratory tables (for independent assignment), circle (presentation). Or create a fun learning environment, even for discussion can be carried out in the park, meaning that learning does not have to be done in the classroom. The role of the instructor or teacher in PBL should be as facilitators, coaches, advisors and intermediaries to obtain optimal results in accordance with the power of imagination, creativity and innovation of students.

To overcome the weaknesses of PBL above, an educator should be able to cope in a way to facilitate students in dealing with the problem, limit the time for students to complete the project, minimize and provide simple tools available in surrounding environment, choose a location that is easily accessible so that research does not require a lot of time and cost, create a pleasant learning atmosphere so that instructors and students feel comfortable in the learning process.

#### 5. Conclusions & Suggestions

Through the literature reviews that have been done, PBL which is applied has the following characteristics: cooperative learning, have a facilitator with the characteristics and psychological motives, and have other elements of lifelong learning, and student-centered. However, seeing the of self-directed learning elements in this program, to increase creativity among students, then in implementing the PBL, the teacher should give more freedom to the students to explore their own learning and construct their own meaning. This program will pay more attention up to the end of the process in producing innovative products rather than just concentrating on knowing the facts.

In order to implement the PBL, it is highly required lecturers/teachers who are also creative. The ability to solve problems and to improve the content knowledge and skills is a challenge, especially to deal with students with low ability, lack of motivation and lack of focus, the lecturers/teachers should be more patient and should try to improve the lecturer-student relationship. PBL is an approach that has these three characteristics, they should be evident in the verbal interactions of students in the process of PBL (Wrigley, 1998).

With PBL, then the ability of students has increased in those things as follows: (1) Making a combination of several parts to form a new thing; (2) Using the random characteristics of an object resulting in a change of the existing design into a new design; (3) Eliminating a part of something so that something new is obtained; (4) Thinking about alternative uses of something in order to obtain new uses; (5) Developing ideas which are contrary to the ideas that are commonly used by people in order to obtain new ideas; (6) Determining the usefulness of an extreme form of an object that is found a new use for the object. From these PBL activities, four components, namely: fluency, flexibility, originality, and elaboration will be increased. Fluency characteristics are: (1) sparked many ideas, many answers, many troubleshooting, many questions smoothly; (2)

Provide many ways or suggestions of doing things; (3) Always think of more than one answer. The characteristics of flexibility are: (1) Generate ideas, answers, or various questions, can look at a problem from different perspectives; (2) Look for many alternatives or different directions; (4) Able to change the approach or way of thinking. Originality traits are: (1) Able to give birth to a new and unique expression; (2) Think of unusual ways for self-expression; (3) Able to create unusual combinations of parts or elements. Elaboration traits are: (1) Able to enrich and develop an idea or a product; (2) Increase or specifies the details of an object, idea, or situation so that it becomes more attractive.

To the lecturers of education department and school teachers, it is recommended to develop a learning process which based on PBL approach, since this approach could theoretically be used for the internalization of Scientific Method to the teachers candidates and students in secondary schools. This practice will have a long-term effect because the students are now internalized Scientific Method, so later on in the classroom when they are teaching, it is expected that they will teach their students in a more meaningful way.

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