

Optimizing Student Conditions in Pre-Implementation of Project-Based Learning in the Junior High School Mathematics Curriculum

Moh. Mahfud Effendi^{1*)}, Windy Tunas Putri²⁾

^{1*2)} Mathematics Education Program, University of Muhammadiyah Malang
Email : ^{1*)} mahfud@umm.ac.id

Abstract

The purpose of this study is to describe the optimization of students' conditions (SC) Pre-implementation of Project-Based Learning (PjBL) in the Junior High School (JHS) mathematics curriculum, and how the teacher's efforts to optimize it. Optimizing student conditions is focused on activities, communication, and formulating mathematical concepts. The subjects are students and math teacher in three JHS in Batu – Malang – Indonesia. This research includes ex-post-facto with a causal comparative study, because the incident happened in the past, and tries to find information about causal relationships in the implementation of PjBL in the JHS mathematics curriculum. Data was obtained from documents, questionnaires, and interviews, then analyzed and described qualitatively. Based on the results of the analysis that the SC which includes activities, communication, and linking concepts, is a good category with optimality of 69.2%, and the lowest is relating mathematical concepts (63.0%). This affects the achievement of learning objectives (LO), with an optimality of 87.3%. To improve this optimality, teachers develop teaching materials, mathematics learning objectives, and utilize school facilities and environment in learning.

Keywords: JHS mathematics curriculum; Optimization, Pre-project-base learning; Student condition

INTRODUCTION

The 2013 curriculum (C-13) suggests a scientific approach in the learning process, this approach can develop students' knowledge, attitudes, and skills simultaneously. In scientific activities, it has the same characteristics as constructivist learning in solving problems, therefore PjBL as learning with a constructivist approach in problem-solving (Agustina, 2016), can be used in the C-13. PjBL is student-oriented, and students must be active in learning (Movahedzadeh, Patwell, Rieker, & Gonzalez, 2012). Thus, PjBL implementation can encourage students to connect knowledge, skills, values, and attitudes and to build knowledge through various learning experiences (Sari, 2018). Previous research stated that the implementation of PjBL can create effective learning (Movahedzadeh et al., 2012), increase student creativity (Lindawati, Fatmariyanti, & Maftukhin, 2013), increase students' positive attitudes towards mathematics (Koparan, 2014), improve communication skills students' mathematics and students' positive attitudes (Kusumawati, 2012) (Susilawati, Hernani, & Sinaga, 2017), and can foster student motivation (Remijan, 2016). However, there has been no study on SC that must be met before implementing PjBL.

Before the learning process, the teacher must pay attention to the reasons for choosing the learning model, media and learning resources, and evaluation. Good learning management can develop students' abilities to the maximum, by creating good situations and conditions, removing obstacles in learning, providing and arranging appropriate learning facilities for learning, and creating a socio-economic-cultural atmosphere (Darmadi, 2017). The selection of learning models needs to consider teaching materials, LO, student abilities, teacher abilities in using learning models, using and supporting facilities (Darmadi, 2017) (Mukra & Nasution, 2016). Therefore, the non-achievement of LO may be caused by inappropriate conditions of pre-implementation of the model. This condition is a foundation which is an initial requirement that must be met before implementing the model (Supriadi, 2011).

SC must comply with the requirements for the implementation of PjBL. Students must be actively involved in learning, actively thinking, actively formulating concepts, and giving meaning to what is learned (Sugrah, 2020). Constructivists assume that students have abilities before acquiring new knowledge, and constructing their own knowledge. In PjBL students must build their own knowledge based on previously acquired knowledge. Students are asked to acquire new knowledge through their own efforts, so that each student gets different results. Therefore, PjBL can meet student learning styles, because the completion of project assignments is determined by the students themselves (Agustina, 2016).

The LO are not in accordance with the learning model if the teacher does not understand the model and knows the students' initial conditions. The teacher must master the PjBL model that will be used by knowing the purpose of the model, the steps, the weaknesses and strengths of the model. In addition, PjBL uses authentic assignments, therefore teachers must be creative and productive (Kristanti, Subiki, & Handayani, 2016). PjBL uses group learning, collaboration between students and teachers. The teacher must understand the task, helping each student produce a superior project by facilitating learning. In addition, teachers must be able to choose the media and learning resources that will be used. PjBL based on active students, able to build and relate concepts that are adapted to the characteristics of the material (Dwi Ariani, Addiin, & Redjeki, 2014). If the teacher understands the SC then he can determine the appropriate material in PjBL.

If the requirements for implementing PjBL in learning are fulfilled and well prepared, it will achieve results in accordance with the LO (Yulianto Aris, Fatchan A, 2017). The implementation of PjBL in mathematics learning will be successful if the SC is supportive or optimal. Based on this description, the purpose of this study is to describe the optimization of SC Pre-implementation of PjBL in mathematics learning in JHS, and how the teacher's efforts to optimize it.

RESEARCH METHOD

In accordance with the purpose of this study, the approach used is qualitative and the type of research is ex-post-facto with a causal comparative study (McMillan, 2004) (Gay, L., Mills, G., & Airasian, 2006). This research was conducted in three JHS in Batu, Malang, Indonesia, with 111 students and 4

mathematics teachers at the JHS as respondents. Apart from being favorite schools, these schools implement PjBL. Data obtained from documents include learning design and math ability scores, and questionnaires from teachers and students, related to SC pre-implementation of BjPL, and their efforts. The questionnaire instrument was developed to explore SC pre-implementation of BjPL, including activities following activities, communication, linking concepts, and efforts to optimize them (Darmadi, 2017) (Mukra & Nasution, 2016).

Mathematics score data (m) shows the percentage of achievement of LO using PjBL which is categorized into 5, namely not good, less, enough, good, very good, with intervals: $0 \leq m \leq 20$; $20 < m \leq 40$; $40 < m \leq 60$; $60 < m \leq 80$; and $80 < m \leq 100$. The questionnaire instrument for activities (a), communication (c), and linking concepts (g), uses a Likert scale and is categorized into 5 categories, as shown in the following table:

Table 1: Intervals and Category SC

Intervals	Category
$a/c/g = 100$	Very active/communicative/good/optimal
$66,7 \leq a/c/g < 100$	Active/communicative/good/optimal
$33,3 \leq a/c/g < 66,7$	Active enough/communicative enough /good enough /optimal enough
$0 < a/c/g < 33,3$	Less active/less communicative/less good/less than optimal
$a/c/g = 0$	Inactive/not communicative/not good/not optimal

For the validity of the data using triangulation of techniques and sources (McMillan, 2004). After the data has been collected, it is analyzed and described qualitatively (McMillan, 2004)(Gay, L., Mills, G., & Airasian, 2006) (Sugiyono, 2019).

RESULTS AND DISCUSSION

A. Students Condition (SC) and Learning Outcome (LO)

The success of BjPL implementation depends on the pre-implementation conditions. Therefore, this condition must be a major concern, especially the SC. SC pre-implementation of BjPL that must be fulfilled is participation in learning activities, and communication. In general, the results of this study stated that the SC pre-implementation of PjBL was good with an optimality of 69.2%. Students are used to scientific activities, discussing, expressing opinions, communicating, so that activity and communication are higher than activity linking concepts, where activity linking concepts is the lowest element, with an average of 63%, as well as in each school. Linking concepts is not easy, because it requires the ability to classify objects based on concepts, and link between concepts and present concepts.

Table 2: SC and LO in Percent

No	Aspect	JHS1	JHS2	JHS3	Average
1.	SC				
	1.1. Activity	75	74	68	72,3
	1.2. Communication	76	74	67	72,3
	1.3. Linking Concept	69	64	56	63,0
	Average	73,3	70,7	63,7	69,2
2.	LO	88	90	84	87,3

Success in learning depends not only on the teacher but also on the students. The appropriate pre-implementation conditions must also exist for students before the PjBL model is applied. If these conditions are met, it will affect the LO of PjBL (Figure 1), meaning that the more optimal the SC, the more optimal the LO (Sawawa, Solehudin, & Sabri, 2018). For this reason, efforts must be made to fulfill these conditions. Teachers must find ways for students to actively carry out activities, actively think, formulate concepts and give meaning to the things being studied (Sugrah, 2020). PjBL requires students to have initial abilities or mastery of prerequisite material, so that it is easy to acquire new knowledge. In PjBL students must build their own knowledge, by linking concepts so that they find new concepts or knowledge. This is easier if done in groups and collaborate in completing project tasks (Almulla, 2020). Project-based learning can address a variety of student learning styles because the completion of project assignments is determined by the students themselves (Agustina, 2016). If these conditions are met, then PjBL's goals will be easily achieved

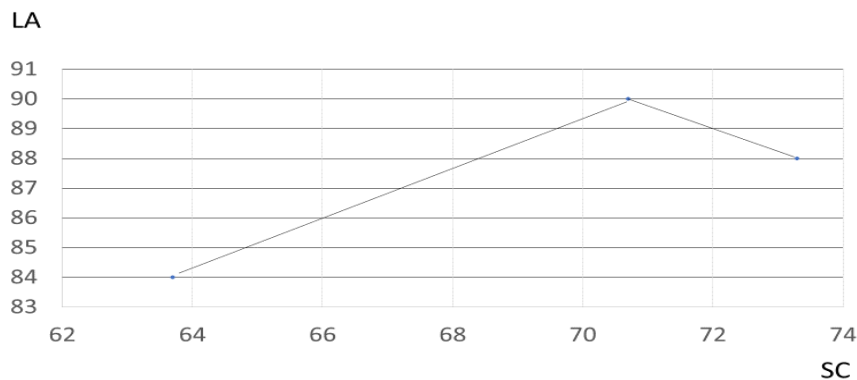


Figure 1: Graph on Relationship between SC and LO

B. Teacher's Efforts to Optimize SC

Optimizing SC is not easy, because many factors affect it. Teachers are designers and managers in learning, so teachers must be creative, communicative, and productive. Teachers must understand what and how PjBL is, so that they understand the conditions that must be met in implementing PjBL. There are three aspects that are sought so that SC becomes optimal, two of which are very optimal (100%), namely: 1) designing teaching materials that contain facts, concepts, principles, and procedures; 2) develop mathematics

learning objectives which include communication skills, reasoning, problem-solving, linking ideas, and forming positive attitudes. Meanwhile, the utilization of school facilities and environment in learning mathematics is quite optimal (66.3%). The following is the optimality of the teacher's efforts in optimizing SC in the pre-implementation of PjBL

Table 3: Optimality of Teacher Effort in Pre-PjBL percent

No	Aspect	JHS1	JHS2	JHS3	Average
1.	Designing materials	100	100	100	100
2.	Develop LO	100	100	100	100
3.	Use of facilities and environment	70	68	61	66,3

PjBL is problem-solving based so that material development must include facts, concepts, principles, and procedures. Problem-based learning requires mathematical communication skills, reasoning, linking ideas, and a positive attitude towards mathematics. Mathematical communication ability is the ability to communicate mathematical ideas orally and in writing (Choridah, 2013) (Hodiyanto, 2017) (Ramellan, Musdi, & Armiati, 2012) . The PjBL model can stimulate students to think and convey their thoughts well (R, Dwijanto, & P, 2015) (Fitrina, Ikhsan, & Munzir, 2016) (Kusumawati, 2012). Learning to reason is learning to think creatively, communicate ideas, and solve problems (Fitrina et al., 2016). Learning to solve problems in the PJBL model is that students are active in learning, work together to solve problems using their knowledge, then present the results (Kusumawati, 2012) .In addition to these four abilities, learning mathematics can also build students' positive attitudes in mathematics (Koparan, 2014) (Remijan, 2016). Students dare to express their respective ideas, ideas or opinions when completing project assignments with their groups (Kusumawati, 2012).

Optimal design of teaching materials and development of learning objectives, has not been able to optimize SC. The low utilization of school facilities and environment in the three JHS makes the average of this aspect also low (63.3%). The low level of this aspect indicates that the school has not paid attention to this aspect. Whereas the provision and use of appropriate learning facilities can facilitate the process and improve student learning outcomes (Maradona, 2016).

CONCLUSION

Based on the results and discussion above, it can be concluded that SC, which includes participation in activities, communicating, and linking concepts, is categorized as good but not optimal, and the element with the lowest optimality is the activity of linking concepts. This affects the achievement of learning objectives, PjBL which is also not optimal. To improve the optimality of the SC, there are three aspects that must be done, namely developing a learning design that meets the characteristics of teaching materials, the objectives of learning mathematics, and the use of school facilities and environment. Of these three aspects, the lowest optimality is the utilization of school facilities and environment in learning.

REFERENCES

- Agustina, N. (2016). Assessment of Project-Based Learning in Science Class. *Jurnal Siliwangi*, 2(2).
- Almulla, M. A. (2020). The Effectiveness of the Project-Based Learning (PBL) Approach as a Way to Engage Students in Learning. *SAGE Open*, 10(3). <https://doi.org/10.1177/2158244020938702>
- Choridah, D. T. (2013). PERAN PEMBELAJARAN BERBASIS MASALAH UNTUK MENINGKATKAN KEMAMPUAN KOMUNIKASI DAN BERPIKIR KREATIF SERTA DISPOSISI MATEMATIS SISWA SMA. *Infinity Journal*, 2(2). <https://doi.org/10.22460/infinity.v2i2.35>
- Darmadi. (2017). Pengembangan Model dan Metode Pembelajaran dalam Dinamika Belajar Siswa - Darmadi - Google Buku. *Deepublish*.
- Dwi Ariani, S. R., Addiin, I., & Redjeki, T. (2014). Penerapan Model Pembelajaran Project Based Learning (Pjbl) Pada Materi Pokok Larutan Asam Dan Basa Di Kelas Xi Ipa 1 Sma Negeri 2 Karanganyar Tahun Ajaran 2013/2014. *Jurnal Pendidikan Kimia Universitas Sebelas Maret*, 3(4), 7–16.
- Fitrina, T., Ikhsan, M., & Munzir, S. (2016). Peningkatan Kemampuan Berpikir Kreatif dan Komunikasi Matematis Siswa SMA melalui Model Pembelajaran Project Based Learning Berbasis Debat. *Jurnal Didaktik Matematika*, 3(1), 87–95. <https://doi.org/10.24815/jdm.v3i1.4753>
- Gay, L., Mills, G., & Airasian, P. (2006). Educational Research- Competencies for Analysis and Applications (8th Edition). *Upper Saddle River, New Jersey: Pearson Education Inc.*
- Hodiyanto, H. (2017). KEMAMPUAN KOMUNIKASI MATEMATIS DALAM PEMBELAJARAN MATEMATIKA. *AdMathEdu : Jurnal Ilmiah Pendidikan Matematika, Ilmu Matematika Dan Matematika Terapan*, 7(1). <https://doi.org/10.12928/admathedu.v7i1.7397>
- Koparan, T. (2014). The Effect on the 8th Grade Students' Attitude towards Statistics of Project Based Learning. *European Journal of Educational Research*, 3(2). <https://doi.org/10.12973/eu-jer.3.2.73>
- Kristanti, Y., Subiki, S., & Handayani, R. (2016). Model Pembelajaran Berbasis Proyek (Project Based Learning Model) Pada Pembelajaran Fisika Di SMA. *Jurnal Pembelajaran Fisika Universitas Jember*, 5(2).
- Kusumawati, N. (2012). PENGEMBANGAN PERANGKAT PEMBELAJARAN MATEMATIKA MODEL PROJECT BASED LEARNING (PBL) UNTUK MENINGKATKAN KEMAMPUAN KOMUNIKASI MATEMATIK. *Pena Jurnal Ilmu Pengetahuan Dan Teknologi*, 23(1).
- Lindawati, Fatmariyanti, S. D., & Maftukhin, A. (2013). Penerapan Model Pembelajaran Project Based Learning Untuk Meningkatkan Kreativitas Siswa Man I Kebumen. *Radiasi*, 3(1).
- Maradona. (2016). Faktor-faktor yang mempengaruhi keaktifan belajar siswa kelas

IV B SD. *Jurnal Pendidikan Guru Sekolah Dasar*, 17(5).

- McMillan, J. H. (2004). Educational Research: Fundamental for Consumer. *HarperCollins CollegePublishers*.
- Movahedzadeh, F., Patwell, R., Rieker, J. E., & Gonzalez, T. (2012). Project-Based Learning to Promote Effective Learning in Biotechnology Courses. *Education Research International*, 2012. <https://doi.org/10.1155/2012/536024>
- Mukra, R., & Nasution, Y. M. (2016). PERBEDAAN HASIL BELAJAR SISWA MENGGUNAKAN MODEL PROJECT BASED LEARNING DENGAN PROBLEM BASED LEARNING PADA MATERI PENCEMARAN DAN PELESTARIAN LINGKUNGAN HIDUP. *Jurnal Pelita Pendidikan*, 4(2).
- R, A., Dwijanto, & P, H. (2015). Keefektifan Model Project-Based Learning Berbasis Gqm Terhadap Kemampuan Komunikasi Matematis Dan Percaya Diri Siswa Kelas Vii. *Unnes Journal of Mathematics Education*, 4(2). <https://doi.org/10.15294/ujme.v4i2.7601>
- Ramellan, P., Musdi, E., & Armiati. (2012). KEMAMPUAN KOMUNIKASI MATEMATIS DAN PEMBELAJARAN INTERAKTIF. *Jurnal Pendidikan Matematika*, 1(1), 77–82.
- Remijan, K. W. (2016). *Project-Based Learning and Design-Focused Projects to Motivate Secondary Mathematics Students The Interdisciplinary Journal of Problem-based Learning VOICES FROM THE FIELD Project-Based Learning and Design-Focused Projects to Motivate Secondary Mathematic*. 11(1).
- Sari, N. (2018). THE IMPLEMENTATION OF PROJECT BASED LEARNING TO IMPROVE STUDENTS RESPONSIBILITY IN SOCIAL STUDIES LEARNING. *International Journal Pedagogy of Social Studies*, 3(2), 19–32. <https://doi.org/10.17509/ijposs.v3i2.14468>
- Sawawa, D., Solehudin, A., & Sabri, S. (2018). PENGARUH FAKTOR INTERNAL DAN EKSTERNAL SISWA TERHADAP HASIL BELAJAR PADA MATA PELAJARAN MEKANIKA TEKNIK DAN ELEMEN MESIN. *Journal of Mechanical Engineering Education*, 5(1). <https://doi.org/10.17509/jmee.v5i1.12615>
- Sugiyono. (2019). METODE PENELITIAN PENDIDIKAN. In *Bandung:Alfabeta*.
- Sugrah, N. U. (2020). Implementasi teori belajar konstruktivisme dalam pembelajaran sains. *Humanika*, 19(2), 121–138. <https://doi.org/10.21831/hum.v19i2.29274>
- Supriadi, A. (2011). Analisis Prakondisi Implementasi Kebijakan Peningkatan Kompetensi Guru. *Jurnal Pendidikan Dan Pembelajaran (JPP)*, 18(1).
- Susilawati, A., Hernani, H., & Sinaga, P. (2017). the Application of Project-Based Learning Using Mind Maps To Improve Students' Environmental Attitudes Towards Waste Management in Junior High Schools. *International Journal of Education*, 9(2), 120. <https://doi.org/10.17509/ije.v9i2.5466>

Yulianto Aris, Fatchan A, K. A. (2017). Penerapan Model Pembelajaran Project Based Learning Berbasis Lesson Study Untuk Meningkatkan Keaktifan Belajar Siswa. *Jurnal Pendidikan*, 2(3).