



THE ANALYSIS OF PROBLEM BASED LEARNING LESSON PLAN BASED ON SYNTAX AND PROBLEMS IN LINE TO PROBLEM BASED LEARNING LEARNING MODEL

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Abstract

This research aims to describe the result of implementation to Problem Based Learning (PBL) model in several researches to the syntax, teachers' behavior, and problem identification in Teaching and Learning Process (TLP), particularly in teaching Physics reviewed from the Lesson Plan and Students' Worksheet as the main literatures. This research was a qualitative research with descriptive approach in 7 samples of Lesson Plan (LP) and 7 Students' Worksheet (SW). The results showed that the problems raised in learning process did not in line to the TLP, and some samples of teachers' behavior of step I (Organizing Students' Problem) and step III (Guiding Independent and Group Investigation) were not adjusted to the syntax of TLP. It can be concluded that the analysis of PBL model implementation done to the syntaz, teachers' behavior, and content problems in 7 samples of LP and SW did not in line to the syntax of PBL, and the content problems given to students were mostly not actual since some of the test items were memorization which did not need creative thinking, mathematic calculation, and relation between variables through experiment. The suggestion proposed in this research is the use of PBL in LP and SW in TLP should refer to five steps in TLP and problems given to students in PBL learning model with actual problems needs creative thoughts and written clearly and completely in the LP and SW.

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INTRODUCTION

2016 revision of Curriculum 2013 suggests 3 learning models to use. According to Regulation of Ministry of Education and Culture No 103 year 2014, those models are Problem Based Learning, Project Based Learning, and Discovery / Inquiry Learning (Kemdikbud, 2014). These models are hoped to be able to build scientific behavior, social behavior, develop students' curiosity. Problem Based Learning is showed able to improve students' or future physics students' achievements (Celik *et al.*, 2011).

Problem Based Learning (PBL) is a learning approach using real-life problems as the contexts for students to learn for the sake of solving the problems (Arends, 2007; Adiga & Adiga, 2015). The implementation of PBL requires the students to be active, independent, and critical in formulating solution to solve problems using their knowledge (Najah & Widiyatmoko, 2015). The problems proposed by the teachers in PBL are connected to real-life and attract students to solve them creatively (Bilgin *et al.*, 2009; Stegeager *et al.*, 2013)); whereas, the problems have many variations (Mohamed & Abdul, 2005). Creative thinking should be developed to make students able to solve problems in their daily life. Daily phenomena which are related to natural science can be explained with physic concept or natural science concept, something that are important for students to learn (Nowrouzian & Farawell, 2013).

According to Sugiyanto (2009), PBL have five steps to do. Teachers' behavior in the Teaching and Learning Process (TLP) in PBL's syntax can be seen in Table 1 as follows.

Table 1. Problem Based Learning Syntax

Learning Steps	Teachers' Behavior
Step 1 Organizing Problems for Students	Teachers inform the goals of TLP, describe important logistics, and motivate students in solving the problems.
Step 2 Organize students to learn	Teachers help students determining and setting learning materials related to the problems.

Step 3 Guiding Group and Independent Investigation	Teachers guide students to collect information related to the problems, conducting experiment, providing explanation, and giving solution.
Step 4 Develop and Present Products in an exhibition	Teachers help students in planning and preparing products related to the report, video, and model as well as guide them share their product to their friends.
Step 5 Analyze and Evaluate Problem's Solution	Teachers help students to reflect the process of their investigation and experiment.

Problem Based Learning becomes trend among researchers; since, it becomes the most presented model in the proceeding of every national or international seminar from 2011-2015 to teach science, language, or social science. It is proved that this model attracts the intention of people to study. Therefore, related literatures are needed to learn about this model. Besides, there should be a study regarding the syntax, teachers' behavior, and PBL in physics.

The problems raised in this research are how is the implementation of PBL in previous researches to the syntax and teachers' behavior in TLP, especially in physics, reviewed from the LP and SW to the main literature?; How is the influence of PBL implementation in the previous researches to the material problem, particularly in physics, reviewed from the LP and SW?

The purposes of this research are to describe the implementation of PBL in previous researches which targeted to the syntax and teachers' behavior in TLP, especially in physics reviewed from the LP and SW; and describe the implementation of PBL in previous researches to the material problems in physics reviewed from the LP and SW.

METHODS

This research was a qualitative research with descriptive approach. The obtained data in this research were the analysis of Lesson Plan (LP) and Students' Worksheet (SW) made according to PBL.

The samples used in this research were LP of physics from different sources using Problem Based Learning (PBL) in 7 LP and 7 SW. Theoretical Study to LP and SW which have been published were delivered in the form of table and analyzed qualitatively based on the adjustment to the syntax, teachers' behavior, and material problems based on PBL.

The steps used in this research were: (1) collecting LP and SW with PBL for physics, (2)

collecting data regarding syntax, teachers' behavior, and material problems in LP and SW in Table, (3) analyzing data, and (4) arranging the report.

RESULT AND DISCUSSION

This research began with analyzing the Lesson Plan and Students' Worksheet for this research. There were 7 LP and 7 SW used in this research. The analysis was according to teachers' behavior in TLP and material problems in LP and SW for every step of PBL. Theoretical studies for every step were delivered in different tables.

The study to Step I (Organize Problems to Students) in all LP and SW is delivered in Table 2.

Table 2. The Study of LP in PBL: Step I (Organize Problems to Students)

Samples (TLP Materials)	Step I (Organize Problems to Students)		
	TLP by the Sources	Syntax (Compatible/Incompatible)	Material Problems (Compatible/Incompatible)
A (Vibration)	- Teacher motivates the students by asking: "Have you ever watch a pendulum clock? How does it move?" - Teachers say the goals of TLP - Teacher facilitates students to explain materials about vibration and physical quantity of vibration.	Incompatible The problems were not explained in LP in details.	Incompatible The problems were not mentioned in LP
B (Position, Velocity, and Acceleration of Movement)	Teacher explains the goals of TLP	Incompatible Learning motives and problems given to students were not mentioned in LP.	Incompatible The problems were not mentioned in LP.
C (Thermal Expansion)	- Teacher gives the reinforcement and goals of TLP. - The reinforcement is explained as "Have you ever seen a carpenter planning the size of frame and mirror of windows? Why are they installed in tenuous way?"	Compatible Overall syntax done by teacher is based on the PBL.	Incompatible The problem in LP is the problem about how to determine the expansion length, width, and volume of certain things along with the examples of thermal expansion in daily life. The problems were not explained in details in the LP.

Samples (TLP Materials)	Step I (Organize Problems to Students)		
	TLP by the Sources	Syntax (Compatible/Incompatible)	Material Problems (Compatible/Incompatible)
D (Heat)	- Teacher gives students reinforcement on “Why can ice bet melted?” - Teacher explains the goals of TLP, explaining the needed logistics, and reinforce the students to be involved in problem solving activity chosen by them.	Compatible Overall syntax done by teacher is based on the PBL. Teacher has directed the students to the face problems in TLP.	Compatible Teacher explains the problems in LP as: 1. If you heat water, How is the temperature of the water? Why can it be heated? Is the time of heating a litre of water is the same to the double one?”. 2. If you are asked to heat water with milk water or sugar water, which one is faster to be heated? From these problems, do an experiment to solve them. The problems in in the LP has been in line to the problem in PBL.
E (Electromagnetic Wave)	- Teacher explains the goals of TLP and reinforces the students to be involved in solving the problems. - Teachers give the reinforcement. - Teacher explains the problems related to the materials.	Compatible Overall syntax done by teacher is based on the PBL. Teacher has directed the students to the face problems in TLP.	Incompatible The problems were not explained in details in the LP.
F (Work, Kinetic Energy, and Potential Energy)	- Teacher reinforces the students and explains the goals of TLP. - Teacher gives a set of problem cards to different group with materials regarding Work, Kinetic Energy, and Potential Energy. The students formulate the problems by deciding the problems which will be discussed.	Compatible Overall syntax done by teacher is based on the PBL. Teacher has directed the students to the face problems in TLP.	Compatible Problem Cards in LP are explained as follows: Problem Cards 1 (Work): 1. If we push as table with certain forces and the table moves; somehow, if we push a wall, the wall will not move. 2. A boy pushes a table in 3 m distance, somehow, after pushing the wall in 10 m, the boy feels tired. 3. Pulling certain loads horizontally is easier if the pulls is in the same direction to the way of the load move than pulling it from the force direction which forms certain angle with the direction of the things. Problem Cards 2 (Kinetic Energy): 1. Stopping a car with high velocity is more difficult than the slower one. 2. Moving a sedan will be easier than moving a bus or bigger car.

Samples (TLP Materials)	Step I (Organize Problems to Students)		
	TLP by the Sources	Syntax (Compatible/Incompatible)	Material Problems (Compatible/Incompatible)
			3. Work is a form of kinetic energy. Prove it! Problem Cards 3 (Potential Energy): 1. Finding relation between gravity potential energy with height through experiment. 2. Finding relation between gravity potential energy and load mass through experiment. Problems in Cards 1 and 2 are compatible to PBL. Somehow, cards 3 are not compatible to PBL, since they are problems to solve with an experiment.
G (Black Principle)	• Teacher explains the objective of TLP • Teacher builds students' motivation and positive behavior to TLP. • Teacher provides students problem which is in line to their real-life.	Compatible Overall syntax done by teacher is based on the PBL.	Incompatible The problems in LP are: 1. Yanto heats 150ml of water. Then, the water is poured into open glass containing cold water in room temperature with 100ml volume. How much is the mixed temperature of both substances concerning the heat around them? Explain the discovery related to physics from Yanto's experiment? 2. In the second experiment, Yanto mixes 150 ml hot water into 100ml cold water (in room temperature) in calorimeter. From this mixture, how much is the temperature of both substances concerning the heat around them? Explain the discovery related to physics from this experiment! After doing experiment 1 and 2, what kind of problems do you find, and how to solve it? The source has written the problems to students in LP; somehow, the problems are more likely experiments than learning materials.

Based on Table 2, in Step I (Organize Problems for Students), from 7 samples of Lesson Plans, there are 2 LP with incompatible syntax of PBL. In those samples, the problems were not given in details in the Lesson Plan. Meanwhile, from 7 Lesson Plans, 5 of them were not compatible to be used as problems for PBL.

The problems given to the students were not actual; since, they were a memorization test item or experiment.

Review to Step II (Organize Students to Learn) for 7 LP and SW which become the samples in this research can be seen in Table 3.

Table 3. Review of LP in PBL for Step II (Organize Students to Learn)

Samples (TLP Materials)	Step II (Organize Students to Learn)	
	TLP from the Sources	Syntax (Compatible /Incompatible)
A (Vibration)	Teacher divides the students into ten groups. Teacher distributes the SW to each group.	Compatible Teacher has been directly ask students to learn in group by providing problems containing with experiment steps should be done by students in the SW.
B (Position, Velocity, and Acceleration of Movement)	Teacher divides the students into eight groups. Teacher begins PBL by distributing SW with some questions.	Compatible Teacher has organized the students to learn by dividing the class into groups doing the SW.
C (Thermal Expansion)	- Teacher guides the students to form discussion group. - Teacher distributes SW for each group.	Compatible Teacher has organized the students to learn by discussing the answer of questions in SW.
D (Heat)	- Teacher divides the students into some groups. - Teacher distributes SW for each group. - Teacher helps the group to define and organize the tasks related to problems in SW.	Compatible Teacher motivates the students to investigate through SW.
E (Electromagnetic Wave)	- Teacher instructs the students to form group for discussion. - Every group has 5-6 members.	Incompatible After dividing the students in some groups, teacher should help the students to define and organize learning tasks related to the problems.
F (Work, Kinetic Energy, and Potential Energy)	Teacher ask the students to arrange the hypothesis, collecting data by seeing their experiences, and initial knowledge to obtain data.	Compatible Teacher has organized students to learn.
G (Black Principle)	- Teacher divides students into some groups to do investigation/research. - Teacher distributes the SW to students containing problems. - Teacher explains the target of TLP. - Teacher asks the students to analyze problems based on their initial knowledge. - Teacher asks the students to propose hypothesis, designing experiment, and planning the activities to solve problems.	Compatible Teacher has organized students to learn.

According to Table 3, for Step II (Organize Students to Learn), it can be seen that from 7 LP, there was one teacher behavior which was incompatible to the Syntax of PBL. The incompatible behavior was teacher did not divide the students into groups to define and organize the tasks related to problems in the materials.

Teachers' compatible behavior was teacher has been able to divide students in group and distribute SW as their guidance to solve the problems in the materials.

Review to Step III (Guiding Group and Independent Investigation) for 7 LP and SW which become the samples in this research can be seen in Table 4.

Table 4. Review of LP in PBL for Step III (Guiding Group and Independent Investigation)

Samples (TLP Materials)	Step III (Guiding Group and Independent Investigation)		
	TLP done by the sources	Syntax (Compatible/Incompatible)	Materials' Problems (Compatible /Incompatible)
A (Vibration)	- Teacher guides the students to do observation or conduct experiment. - Teacher gives the students freedom to solve problems based on literature or doing experiment in SW.	Compatible Teacher has directed the students to do observation or investigation. Somehow, the students should be guided in every step of investigation to make sure that they get the supposed data to solve the problems. Teachers' guidance can be questions which stimulate the students to do their tasks.	Incompatible The problems in SW are: Counting the period and frequency of vibration and knowing the factors influencing the period and frequency of vibration through experiment. The problems are more likely to find relation between variables through experiment.
B (Position, Velocity, and Acceleration of Movement)	- Teacher invites the students to learn about SW completely - Teacher gives the required information.	Compatible Teacher has organized the students to do investigation, yet teacher has not explained that in details in LP whether teacher is going to guide the investigation or not.	Incompatible The problems in SW are: - It is known that $A = 2i + 2j$ and $B = 3i - 4j$. Count the total of $A+B$ and $A - B$ - The initiate status of particle A was (2,3) after some seconds, it reached in B (7,6) - Determine the displacement of the vector - Determine the total of displacement - A particle moves with the equation of $r = 8ti + (6t - 5t^2)j$, determine the: - Position of the particle when $t = 1 s$ - the displacement from $t = 1 s$ to $t = 2 s$ - the initial velocity of the particle - the velocity when $t = 1 s$ The problems in SW are only a set of calculations.
C (Thermal Expansion)	Teacher asks the students to form some groups to cooperate in finding information of some sources to solve problems in SW. Every group discusses to analyze and find the solution.	Compatible Teacher has directed the students to do the investigation; somehow, it was not explained in LP in details.	Incompatible The problems in SW: - A bar of metal has a length of 40 cm was heated from $25^{\circ}C$ to $225^{\circ}C$. It experienced addition of length to 0.6 cm. Count the coefficient of expansion to the bar! - A glass containing alcohol in $250 cm^3$ in the temperature of $0^{\circ}C$. If it is heated to $50^{\circ}C$, How much is the addition of alcohol volume with alcohol's coefficient of expansion of $0.00120/^{\circ}C$?

Samples (TLP Materials)	Step III (Guiding Group and Independent Investigation)		
	TLP done by the sources	Syntax (Compatible/Incompatible)	Materials' Problems (Compatible /Incompatible)
			Application problems: Have you ever watch people installed an electrical network cable? Why was the installation of telephone cable or electrical network in loose condition from one pole to other pole in the daylight? What will happen to the cable in the evening? The first problem in SW (item 1 & 2) were only a mathematic calculation.
D (Heat)	Teacher asks the students to collect related information, conduct experiment, give explanation, and solve problems.	Incompatible Teacher has motivated the students to learn by distributing SW; somehow, the SW only had the solution of problem 1 with no explanation to problem 2.	Compatible Problems in SW are: - In heating water, how is the condition of the water's temperature? Does it need a same time to heat 1l and 2l of water? Why? - If you are asked to heat water with milk or sugar, which one is faster to be heated? From this problem, do an experiment to know the answer. The problems in SW is compatible to PBL.
E (Electromagnetic Wave)	Teacher asks the students to collect related information, conduct experiment, give explanation, and solve problems through newspaper and discussion sheet.	Compatible Teacher asks the students to learn; somehow, it was not explained in details in LP that the problems will be given in SW or not.	Incompatible The problems in the newspaper are: If a lamp in the house is blinking or in the end of its order, it should be immediately changed or turned off. It is for the sake of your health, since the lamp is potentially spreading X-ray radiation. - Do you know about electromagnetic waves? Draw the direction of electric field in electromagnetic wave of a blinking lamp which can spread X-ray radiation! - How is the speed of the waves that the lamp can spread X-ray radiation? The problems given to the students were only memorization from the distributed newspaper.
F (Work, Kinetic Energy, and Potential Energy)	- Teacher asks the students to test their hypothesis. - Teacher asks the students to determine the solution of the problems collaboratively in group.	Compatible Teacher has directed the students to do investigation; nonetheless, teacher has not explained that in details in LP whether teacher is going to guide the investigation or not.	Incompatible - Problems in SW 1 (Work): What is meant by Work? What are the unit affecting Work? How is the relation between the units to the Work? - Problems in SW 2 (Kinetic Energy): What are the units affecting the total of Kinetic Energy? How is the relation between the units to Kinetic Energy? - Problems in SW 3 (Potential Energy):

Samples (TLP Materials)	Step III (Guiding Group and Independent Investigation)		
	TLP done by the sources	Syntax (Compatible/Incompatible)	Materials' Problems (Compatible /Incompatible)
			What are the units affecting the total of Potential Energy? How is the relation between the units to Potential Energy? The problems in SW were only memorization and mathematic solution.
G (Black Principle)	- Teacher facilitates the students to do experiment needed by the students. - Teacher walks around the class to monitor the experiment.	Compatible Teacher has helped the students in conducting investigation and experiment.	Incompatible Problems in SW are: 1. Yanto heats 150ml of water. Then, the water is poured into open glass containing cold water in room temperature with 100ml volume. How much is the mixed temperature of both substances concerning the heat around them? Explain the discovery related to physics from Yanto's experiment? 2. In the second experiment, Yanto mixes 150 ml hot water into 100ml cold water (in room temperature) in calorimeter. From this mixture, how much is the temperature of both substances concerning the heat around them? Explain the discovery related to physics from this experiment! After doing experiment 1 and 2, what kind of problems do you find, and how to solve it? The source has written the problems to students in LP; somehow, the problems are more likely experiments than learning materials.

Based on Table 4, for Step III (Guiding Group and Independent Investigation), it can be seen that from 7 samples, there was 1 sample which teacher's behavior was incompatible to the syntax of PBL. In this sample, there was an attempt to motivate students to learn; somehow, it was not explained in LP on how to solve problems. In the other hand, there were 6 LP which was incompatible to problems in PBL.

The problems given to the students were not actual; since, they were a memorization test item or experiment. It did not build the students' creativity in finding relation between variables through experiment.

Review to Step IV (Develop and Present Products in Exhibition) for 7 LP and SW which become the samples in this research can be seen in Table 5.

Table 5. Review of LP in PBL for Step IV (Develop and Present Products in Exhibition)

Samples (TLP Materials)	Step IV (Develop and Present Products in Exhibition)	
	TLP done by the sources	Syntax (Compatible /Incompatible)
A (Vibration)	- Teacher asks the students to prepare simple reports. - Teacher asks the students to present the result of the experiment	Compatible Teacher has guided the students to present the solution of problems.
B (Position, Velocity, and Acceleration of Movement)	Teacher asks the representatives of the group to deliver their presentation.	Compatible Teacher has asked the students to deliver their tasks.
C (Thermal Expansion)	Teacher asks the representatives of each group to present the result of their discussion in from of the class along with guiding the groups which have difficulties in analyzing problems.	Compatible Teacher has guided the students to present the result of their discussion.
D (Heat)	- Teacher helps the students to plan and prepare the product related to the tasks, like reports and model, and help them to share their job with their teammate. - Teacher asks the students to present their solution to certain problems.	Compatible Teacher has asked the students to present their products.
E (Electromagnetic Wave)	Teacher asks students' group to present their tasks one by one.	Compatible Teacher has asked the students to present their tasks.
F (Work, Kinetic Energy, and Potential Energy)	Teacher asks the representative group to deliver the solution of problems.	Compatible Teacher has asked the students to present the solution to certain problems.
G (Black Principle)	- Teacher guides the students to show the result of the experiment done by each group. - Teacher takes the score from the experiment done by the students.	Compatible Teacher has asked the students to present their experiment.

According to Table 5, in Step IV (Develop and Present Products in Exhibition) can be seen that teachers' behavior in 7 samples were compatible to syntax of PBL. Teacher has asked the students to prepare reports, make reports, and

ask the students to deliver presentation of solution to certain problems. Review to Step V (Analyze and Evaluate Problem's Solution) for 7 LP and SW which become the samples in this research can be seen in Table 6.

Table 6. Review of LP in PBL for Step V (Analyze and Evaluate Problem's Solution)

Samples (TLP Materials)	Step V (Analyze and Evaluate Problem's Solution)	
	TLP done by the sources	Syntax (Compatible /Incompatible)
A (Vibration)	- Teacher with the students discusses about experiment result. - Teacher gives the students chances to ask the materials.	Compatible Teacher has asked the students to analyze and evaluate the material.
B (Position, Velocity, and Acceleration of Movement)	- Teacher invites the students to conclude the materials. - Teacher evaluates the solution proposed by the students.	Compatible Teacher has invited the students to evaluate and conclude the learning result.
C (Thermal Expansion)	- Teacher discusses the tasks done by the students - Teacher invites the students to conclude the materials.	Compatible Teacher has invited the students to evaluate and conclude the learning result.
D (Heat)	Teacher helps the students to evaluate the investigation done by the students.	Compatible Teacher has analyzed and evaluate the problem solving done by the students.
E (Electromagnetic Wave)	Teacher gives the confirmation to the discoveries from students' group	Compatible Teacher has asked the students to

Samples (TLP Materials)	Step V (Analyze and Evaluate Problem's Solution)	
	TLP done by the sources	Syntax (Compatible /Incompatible)
	discussion. Teacher guides the students to conclude the materials.	analyze and evaluate the material.
F (Work, Kinetic Energy, and Potential Energy)	- The students evaluate the compatible solution to actual problems in group discussion to obtain the best result with teacher's guidance. - Teacher gives evaluation test. - Teacher helps the students to conclude the materials.	Compatible Teacher has asked the students to analyze and evaluate the material in group discussion.
G (Black Principle)	- Teacher helps the students to analyze and evaluate their thinking or investigative and intellectual skills they can use. - Teacher guides the students to make conclusion.	Compatible Teacher has asked the students to analyze and evaluate the material.

Based on Table 6, for Step V (Analyze and Evaluate Problem's Solution), it can be seen that teacher's behavior in all samples were compatible to the syntax of PBL. Teacher has invited the students to discuss the solution of problems and conclude the materials in Teaching and Learning Process (TLP).

CONCLUSION

The result of the research of PBL implementation showed that there were several samples which had incompatible syntax, teacher's behavior, and material problems to the syntax of PBL. Material problems given to student in written or not were mostly not actual; since, most of the items were memorization, mathematic calculation, and relation between variables through experiment which did not involve students' creative thinking. The suggestions proposed for further implementation of Problem Based Learning are:

1. Making Lesson Plan should be based on five steps in PBL.
2. The problems given to the students in PBL should be actual and involve students creative thinking with detail explanation in LP and SW.

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