

The Effect of Problem Based Learning (PBL) Model and Self Regulated Learning (SRL) toward Physics Problem Solving Ability (PSA) of Students at Senior High School

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Abstract This study aimed to analyze whether student's Problem Solving Ability that learned using Problem Based Learning Model better than conventional learning, to analyze whether student's Problem Solving Ability who have above average of Self Regulated Learning better than students who have below the average Self Regulated Learning, and to analyze interaction between Problem Based Learning and conventional learning using Self Regulated Learning in improving students' Problem Solving Ability. This research is a quasi-experimental design with two group pretest posttest design. The study population were all students of class XI SMAN 13 Medan academic year 2015/2016 and the sample was grade XI IPA 3 and 5 selected by simple random sampling. The data were analyzed by two ways ANOVA. The results showed that: (1) student's Problem Solving Ability that learned using Problem Based Learning Model was better than the conventional learning, (2) Problem Solving Ability groups of students who have above average Self Regulated Learning is better than the students who have below average Self Regulated Learning, and (3) there was an interaction between Problem Based Learning Model and conventional learning using Self Regulated Learning in influencing students' Problem Solving Ability.

Keywords: *Problem Based Learning (PBL), Self Regulated Learning (SRL), Problem Solving Ability (PSA)*

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1. Introduction

Problem Solving Ability (PSA) of students in Indonesia, especially in North Sumatra is still relatively low. It is based on the results of PISA (Program for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) which showed that the PSA of students in Indonesia is still low in position 69th from 76 countries. In theory, low ability students in problem solving authentic is because the learning process is still teacher centered. The learning is more centered on teachers, lack of student involvement in the learning process so that students get the material passively and less ability in solving problems. To solve this problem we needed one learning model that able made student become active in learning. One of learning model is Problem Based Learning (PBL). Further PBL has applied in many of research. Constructively PBL model can make learner has high level thinking ability like critical thinking, PSA, and creative thinking. PSA is the ability to solve problem with finding accurate method or procedure. PBL is an active learning that enables students to become caring and decisive PSA and learning needs of students, learning to learn, able to make knowledge become operative and displays the task group in the face of real life problems as

in [1,3,7]. Creating active learning physics should start from the students who have the independence to learn to prepare and everything needed in the learning process.

Self Regulated Learning (SRL) is an active process and establish where learners specify learning objectives and to monitor, regulate, control their cognition, motivation, and their attitude, guided and limited by their purpose, and features contextual environment, [1,18,19]. PBL using SRL have a positive impact, students can organize their lesson, and improve their computing abilities as in [21] and [24]. PBL and SRL also lead students to have the freedom and responsibility in learning, they are free and responsible to increase their knowledge seek other learning resources such as libraries and internet as in [1] and [9].

PBL model phase according to Arends [4] consists of provide an orient for students to the problem to the learners, organize students to study, assist independent and group investigation, develop and present artifacts and exhibits, analyze and evaluate the Problem Solving process. Indicator of SRL according Pintrich [18], that measured in this research were planning, controlling their effort in academic class assignment, cognitive strategy to understand of matter. Indicator of PSA [11] consists of understand the problem, interpreting the problem, plan the solution, implementing the plan, and evaluating the solution.

The different of this research between the earlier researches is to find the interaction of PBL Model and conventional learning using SRL in increasing the student's physics PSA. This matter as background researcher to research about effect of PBL and SRL toward physics student's PSA.

The formulation of the research problem is (1) Is the student's physics PSA using PBL model better than the student's physics PSA using conventional learning, (2) Is the student's physics PSA that have above average SRL better than student's physics PSA that have below average SRL, (3) Is there an interaction between the PBL model and conventional learning using SRL to improve student's physics PSA.

2. Method

This research is a quasi-experiment aimed to see the effect of PBL model on PSA that distinguished the above average SRL and the below average SRL. The population in this research was State Senior High School 13 class XI in Medan North Sumatera 2015-2016 school year that consist of ten classes. Sample in this research were two classes using simple random sampling, first class as control class taught by conventional teaching and second class as experimental class taught by PBL model. Both of sample classes consist of 40 students. The design of the study was two group pretest-posttest design. The design of analyze was 2x2 factorial designs using technical analyze of variance (ANOVA) two ways.

The independent variables there are two kinds of models PBL (experimental group) and conventional learning (control group). The dependent variable is the PSA/ PSA. The moderator variable is SRL. Indicator student's physics PSA consist of five aspects namely : problem understanding, problem interpreting, plan a solution, implement the solution and evaluate the solution. Indicator SRL consist of three aspects namely : Planning, Controlling his efforts at classroom academic work and Cognitive strategies to understand the material.

Data collection techniques in this study will be obtained through a PSA tests and questionnaires SRL. The instruments had been validated and fulfilled the requirements of validity and reliability of test. Data collection will be conducted in two stages, collect data about student SRL and collect data about student's physics PSA.

The design of research were given on [Table 1](#).

Table 1. Design of Research

Class	Pre test	Treatment	Posttest
Experimental	T ₁	X ₁	T ₂
Control	T ₁	X ₂	T ₂

Explanation:

X1: Treatment using Problem base learning model (5 meetings @100 minutes)

X2: Treatment using conventional learning (5 meetings @100 minutes)

T1: Pre test

T2: Post test

The design data analyze using Anova 2 x 2 two ways were given on [Table 2](#).

Table 2. Design data Analyze Anova 2 x 2 two ways

	Conventional Class (A ₁)	PBL Class (A ₂)	Average PSA
SRL below average (B ₁)	A ₁ B ₁	A ₂ B ₁	μB ₁
SRL above average (B ₂)	A ₁ B ₂	A ₂ B ₂	μB ₂
Average PSA	μA ₁	μA ₂	

Explanation:

A1 B1 = Student's PSA using conventional learning who have SRL below average

A1 B2 = Student's PSA using conventional learning who have SRL above average

A2 B1 = Student's PSA using PBL who have SRL below average

A2 B2 = Student's PSA using PBL who have SRL above average

μA1 = Student's PSA using conventional learning.

μA2 = Student's PSA using PBL;

μB1 = Student's PSA who have SRL below average

μB2 = Student's PSA who have SRL above average

3. Result

Student's PSA on the Conventional class and PBL class show on following table.

Table 3. Pre test and Post test Problem solving ability

	Problem solving ability	
	Conventional class	PBL class
Pre test	31,30	39,18
Post test	57,90	73,33

Base on [Table 3](#), description of the average value of pretest and posttest PSA on the PBL and conventional class as follows: For each class pretest conventional and PBL are 31,3 and 39,18 in the low category. : For each class post test conventional and PBL are 57,90 and 73,33 in medium and high category.

The Results of post test student's physics PSA on the Conventional and PBL class using SRL below average and above average show on following [Table 4](#).

Table 4. Post test Student's PSA

Self regulated learning	Problem solving ability (A)		Mean
	Conventional class	PBL class	
	(A ₁)	(A ₂)	
Below average (B1)	55,95	61,75	58,85
Above average (B2)	71,52	73,83	72,68
Mean	63,74	67,79	

[Table 4](#) shows maximum average student's PSA 73,83 on group PBL class with self regulated above average. Minimum average student's PSA 55,95 on group conventional learning class with self regulated below average.

Hypothesis testing

Before testing the hypothesis first tested the prerequisite that normality test, homogeneity, and test results normal distribution and homogeneous data. After the prerequisite test is done, and then followed with two ways ANOVA with SPSS 21.0.

Table 5. ANOVA's two ways result

Result	Square Sum	Degree of Freedom	Square Average	F	Sig.
Learning Model	3816,78	1	3816,78	64,98	.000
Self Regulated Learning	1269,16	1	1269,16	21,60	.000
Learning Model* Self Regulated Learning	386,46	1	386,46	6,58	.012

Table 6. Post Hoc Test by Scheffe test

Interaction (I)	Interaction (J)	Mean Difference (I-J)	Std. Error	Sig.
CC-SRL below average	CC-SRL above average	-3,62	2,436	,535
	PBL-SRL below average	-9,54*	2,518	,004
	PBL-SRL above average	-22,06*	2,262	,000
CC-SRL above average	CC-SRL below average	3,62	2,436	,535
	PBL-SRL below average	-5,92	2,633	,177
	PBL-SRL above average	-18,44*	2,390	,000
PBL-SRL below average	CC-SRL below average	9,54*	2,518	,004
	CC-SRL above average	5,92	2,633	,117
	PBL-SRL above average	-12,52*	2,474	,000
PBL-SRL above average	CC-SRL below average	22,06*	2,262	,000
	CC-SRL above average	11,44*	2,390	,000
	PBL-SRL below average	12,52*	2,474	,000

Explanation:

CC-SRL : Self Regulated Learning in Conventional Class

PBL-SRL : Self Regulated Learning in PBL Class.

Based on Table 5, the results of the data analyze are as follows: (1) PSA of students that learned using PBL model is better than the conventional learning (sig 0,000 < 0,05), (2) PSA groups of students who have above average SRL better than the students who have below average SRL (sig 0,000 < 0,05), and (3) there is interaction between PBL model and conventional learning using SRL in influencing students' PSA (sig 0,012 < 0,05).

In analyzing the difference between the groups then used the analyze of Post Hoc Test with Scheffe test. The results presented in Table.

Base on Table 6 test results Post Hoc by Scheffe test then obtained some comparisons interaction between groups as follows: 1) The PSA on CC for groups of students SRL below average is as same as the PSA of students on CC for groups SRL above average with significant $p > 0.05$, 2) PSA on PBL for groups of students SRL above average is higher than the PSA of students in PBL for groups SRL below average with significant $p < 0.05$; 3) PSA on CC for groups of students SRL above average is less than the PSA of students on PBL for groups SRL above average with significant $p < 0.05$, 4) PSA on CC for groups of students SRL below average is less than the PSA of students on PBL for groups SRL below average with significant $p < 0.05$; 5) PSA on CC for groups of students SRL above average is less than the PSA of students on PBL for groups SRL below average with significant $p < 0.05$; 6) PSA on CC for groups of students SRL below average is less than the PSA of students on PBL for groups SRL above average with significant $p < 0.05$.

For more clearly in view as the interaction will be shown in Figure 1.

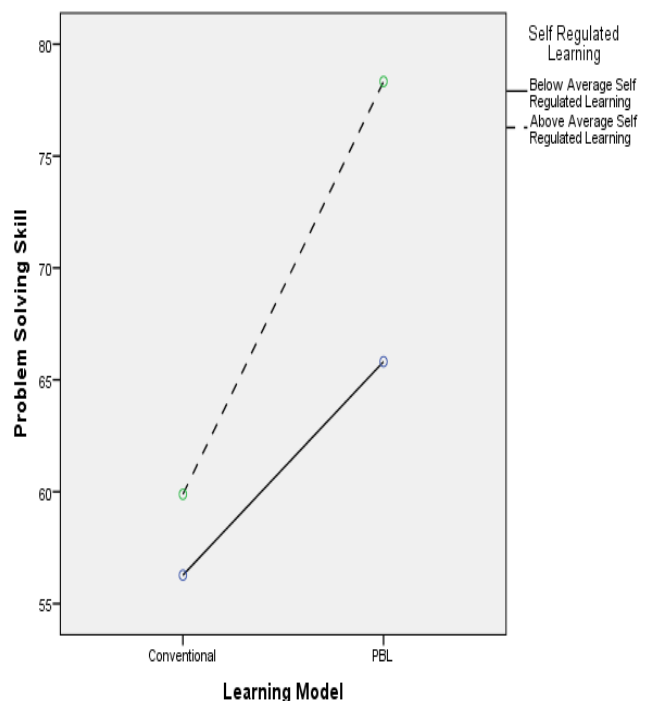


Figure 1. Interaction Model of Learning and Self Regulated Learning Toward PSA

The graph shows that the PBL class with student's PSA that have above-average better than student's PSA that have below-average SRL. On Conventional class, student's PSA that have above-average same as student's PSA that have below-average SRL. The graph shows that the PBL model with above average SRL over a positive influence in increasing the student's PSA.

4. Discussion

4.1. Student's PSA Using PBL Models Is Better than Using Conventional Learning

Based on average value and hypothesis test shown that student's PSA using PBL was better than using Conventional. The result of this research resemblance also found in previous studies. Dwi [7], get the value post test PSA for experimental class was better than control class. And also research Goddess (2014) get the average value of PSA using PBL was better than the average value of PSA using Conventional.

PSA increased in PBL model because students play an active role in the learning process that requires students to think critically, be able to solve the problem, and is directed at the abilities to participate [13,14]. PBL have a problem authentic to train students in developing higher level thinking abilities of students as in [2,6,8,16,17,22]. PBL motivated students to do research freely in private and collaborate in groups [5]. In the conventional learning, students tend to be passive in class, received only learning one direction and less confronted with the problem that the student's independence in developing his own understanding as in [15,23].

4.2. Student's PSA in Group of Students Who Have SRL above Average Better than Group of Students Who Have SRL below Average

Base on hypothesis testing that student's PSA in group of students who have SRL above average better than group of students who have SRL below average. This is due to students who have above average SRL able to manage themselves in preparing himself in learning, maintain motivation, set goals, monitor progress, and engage in self-reflection as in [1,9,10,20]. Students whose SRL is below the average value PSA is low due to lack of diligent and persistent in solving a problem, when they find difficulty in resolving a problem, despair and quickly gave up and had a learning activity is low as in [10].

4.3. There Was an Interaction between PBL Model and Conventional Learning Using SRL

Based on hypothesis testing there was interaction between PBL and conventional learning using SRL for increasing the student's physics PSA. Influence SRL to student's physics problem solving on PBL class higher than on conventional learning class. Interaction between PBL model using SRL result in increased interest and enthusiasm for learning so that student's Problem Solving abilities increase as in [7,21,24]. Interaction between PBL and SRL provides an alternative potential to develop higher-level thinking [12]. On PBL class, students who have above-average SRL their PSA are better than students who have below average SRL. On conventional class, students who have above-average SRL their PSA are same as students who have below average SRL. This

is due to students who have above average SRL able to manage themselves in preparing themselves in learning, maintain motivation, set goals, monitor progress, and engage in self-reflection as in [1,9,10,20]. Students whose SRL is below the average value PSA is low due to lack of diligent and persistent in solving a problem, when they find difficulty in resolving a problem, despair and quickly gave up and had a learning activity is low as in [10].

5. Conclusion

Student's physics PSA using PBL model is better than using conventional learning. These results showed that there is effect of PBL model and conventional model to student's Physics PSA. Student's Physics problem solving ability in student's group who have above average SRL are better than student's group who have below average SRL. These results showed there is effect SRL toward student's physics PSA. There is an interaction between PBL model and conventional learning using SRL in enhancing students' physics PSA. In this research that on PBL class, SRL gave high effect on student's physics PSA. On conventional class SRL did not give effect to student's physics PSA.

6. Suggestion

PBL will be more effective in improving the student's physics PSA if supported by providing training that contain physical problem related to everyday life, giving appropriate practicum to solve physics problems, as well as presenting problems of physics that requires students to solve the problem. Model of PBL give optimum result in increasing the PSA if it applied on condition that the student has SRL is above average (high). Self regulated will have a good interaction with the PBL model if students already have good intrinsic motivation in physics PSA, and has high spirit of learning so that students will prepare everything that is required in the learning process.

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