THE COMPARISON OF PUPILS’ MATHEMATICAL PROBLEM SOLVING ABILITY IN THE CLASSROOM TAUGHT USING PROBLEM-BASED LEARNING AND PROJECT BASED LEARNING MODEL IN GRADE SEVEN SMP NEGERI 2 PANAI TENGAH A.Y. 2015/2016

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Abstract
The aim of this research is to study if pupils’ mathematical problem solving ability in the classroom that taught using Problem Based Learning (PBL) higher than in the classroom that taught using Project Based Learning (PjBL). The population of this research is all pupils in class VII SMP Negeri 2 Panai Tengah. The sample of this research consists of two classes, namely, VII – 1 as the experiment class taught using PBL (30 pupils), VII – 2 as the comparison class taught using PjBL (31 pupils). The design of this research is posttest only comparison group. The result of the research shows that the mean score are 54.07 in experiment class and 41.32 in the comparison class; and t_{calculation} ≤ t_{table}, that is, 1.327 ≤ 1.671 with significance level of 0.05 one tailed. It means that the pupils’ mathematical problem solving ability in the classroom taught using PBL model is not higher than in the class taught using PjBL model.

Keywords: Mathematical Problem Solving Ability, Problem Based Learning, Project Based Learning

INTRODUCTION
The need of mathematical problem solving is truly becoming a trend of Mathematics lesson. According to Schoenfeld, a mathematics education expert, there is one particular mathematical point of view regarding the role that problems have in the lives of those who do Mathematics. This unifying theme is that the work of mathematicians is solving problems. Mathematical problem solving is at the heart of any mathematicians work and to become a mathematician, one who discovers, conjectures, tests and proves one must become a problem solver. For this to happen, students must therefore engage in solving real problems (O’ Shea, 2010).

Mathematics teaching at all levels should include opportunities for: exposition by the teacher; discussion between teacher and pupils and between pupils themselves; appropriate practical work; consolidation and practice of fundamental skills and routines; problem solving, including the application of mathematics to everyday situations; investigational work.

This vision has not been implemented yet, however, in practical lesson in school Mathematics. Many teachers still use only exposition, but discussion between teacher and pupils and between pupils not yet to be well organized. Cockroft reported this in his statement: “Yet we are aware that although there are some classrooms in which the teaching includes, as a matter of course, all the elements which we have listed, there are still many in which the mathematics teaching does not include even a majority of these elements.” (Ibid, paragraph 243)

Other problems in learning problem solving are the difficulties and obstacles faced by pupils. Orton (2004: 94) found that “Very few people, including university students of mathematics, are able to solve Problem 1 within a limited time period. It is necessary to draw lines which go outside the shape implicitly defined by the nine dots”.

Actually, as a reference to the real facts above, Mink (2010: 188) proposes that there are seven difficulty factors in learning problem solving: (1)
wrong order; (2) key words; (3) extraneous numbers; (4) hidden word numbers; (5) implied numbers; (6) multiple steps; and (7) exact mathematical vocabulary.

It is clear now that learning problem solving is not without challenges and difficulties. Solving problems improves critical and creative thinking. Pupils are intended to create their own thinking during the process of problem solving. This point is still important to highlight that pupils are in Regular thinking is not enough to solve the problem and pupil must develop their ideas and connect them into other ideas. Pupils must be also identifying to which factors they tend to be very low. This is crucial because teacher should know in which case pupils are learning, so that teacher can help pupils effectively and efficiently.

Sierpinska (1994: 160) stated that "In a mathematics class, when teaching [problem solving], the teacher will point to information that is relevant from the mathematical point of view, and discard that which is irrelevant". This is important in learning problem solving for pupils, in pupil will learn meaningfully because teacher has discard unnecessary information. The role of teacher must in duty of helping pupils. It is not realized yet in SMP Negeri 2 Panai Tengah.

The lack of problem solving ability becomes a topic that teacher must focus on. Teacher, with all of his or her professionalism, must engage pupils to learn problem solving. Teacher, for example, prepares pupils with many exercises. In doing the problem solving, the openness is truly important. Here is the point in which teacher and pupils interact all together in constructing knowledge. The more exercise, the more experience pupils. The exercises will help students to enrich their experiences in problems explorations. This point is represented by Bell (Gutierrez and Boero, 2006: 34) as follows:

… I understand problem solving to refer to the solving of problems by the forming and solving of equations; this is the narrow sense of the term. But the essential mathematical activity is that of exploring problems in an open way, extending and developing them in the search for more results and more general ones. Hence [all algebra learning] … is based on problem explorations. This is the broad sense of the term.

In order to teach problem solving Mathematics, there are two models of teaching proposed to. These models are two models offered by New Syllabus of Indonesian Mathematics 2013; i.e. Problem Based Learning (PBL) and Project Based Learning (PjBL).

Both PBL and PjBL rise higher order thinking skill (HOTS). Dehkordi and Heydarnejad, Kasai et al., Albanese and Mitchell (Shaer and Gaber, 2014: 81) reported that students in Problem Based Learning scored higher when compared to the traditional method students. Norman and Schmidt, Vernon and Blake found that PBL is effective in promoting higher order thinking (Ibid).

PBL provides an experiential learning in which students participate to exploration and discovery. Students can also find their own difficulties and
discuss them within groups and share their result of explorations.

Project – Based Learning (PjBL) is other instructional model that promoting to enhance students’ learning outcomes. Project – Based Learning, as reported by New York Department of Education (2009) also increases student engagements for several reasons. The reasons can be written briefly that in Project – Based Learning students are enabled to be active learners, more social, and identify and investigate real problems.

Based on the general description above, then the researcher is interested to do research entitled “The Comparison of Pupils’ Mathematical Ability in the Classroom that Taught Using Problem – Based Learning and Project – Based Learning Model in Grade Seven SMP Negeri 2 Panai Tengah A.Y 2015/2016”.

Specifically, objectives of the researchis to determine if pupils’ mathematical problem solving ability in the classroom that taught using Problem Based Learning (PBL) higher than pupils’ mathematical problem solving ability in the classroom that taught using Project Based Learning (PjBL). The hypothesis of this research is pupils’ mathematical problem solving ability taught by Problem Based Learning is higher than pupils’ mathematical communication ability taught by Project Based Learning.

Problem solving itself means engaging in a task for which the solution method is not known in advance. In order to find a solution, students must draw on their knowledge. National Council of Teacher Mathematics (NCTM) creates Problem Solving Standards in which the instructional programs from prekindergarten through grade 12 should enable students to:

1. build new mathematical knowledge through problem solving;
2. solve problems that arise in Mathematics and in other contexts;
3. apply and adapt a variety of appropriate strategies to solve the problems;
4. monitor and reflect on the process of mathematical problem solving.

(NCTM, 2000: 52)

The problem solving ability consists of understanding the problems, devising a plan, carrying out the plan, and looking back stages as Polya proposed (Isoda ed., 2007: 92). PBL and PjBL have advantage in promoting problem solving skills (Akinoglu and Tandogan, 2006; Chang et al., 2011).

RESEARCH METHOD
This research is a post-test-only comparison group design conducted to compare pupils’ mathematical problem solving ability taught by Problem Based Learning and Project Based Learning in SMP Negeri 2 Panai Tengah Academic Year 2015/2016 grade 7. The design is given as follows:

Table 1. Posttest Only Comparison Group Design

<table>
<thead>
<tr>
<th>Class</th>
<th>Treatment</th>
<th>After Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>X₁</td>
<td>T₁</td>
</tr>
<tr>
<td>Comparison</td>
<td>X₂</td>
<td>T₁</td>
</tr>
</tbody>
</table>
The population of this research is all pupils of grade 7 SMP Negeri 2 Panai Tengah in academic year 2015/2016. The sample is 30 pupils in VII-1 as the experimental class taught by Problem Based Learning and VII-2 as the comparison class II taught by Project Based Learning consists of 31 pupils. In addition, the instrument was mathematical problem solving ability test.

**Table 2. Descriptive Statistics Summary of PBL and PjBL Class**

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Sum</th>
<th>Mean</th>
<th>Std Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PBL Score</td>
<td>30</td>
<td>0</td>
<td>100</td>
<td>1022</td>
<td>54.07</td>
<td>40.014</td>
</tr>
<tr>
<td>PjBL Score</td>
<td>31</td>
<td>0</td>
<td>100</td>
<td>1281</td>
<td>41.32</td>
<td>34.919</td>
</tr>
</tbody>
</table>

Before analysing the data by using Independent Sample t-test, the normality, independence, and homogeneity tests should be conducted. The normality test used is Kolmogorov-Smirnov test with significance level (α) of 5% using SPSS Version 22. Based on the result of normality test conducted using SPSS, the significance value of mathematical problem solving ability test in the experimental class is 0.111 and the comparison class is 0.071 which are higher than significance level of 0.05. On the result of Kolmogorov-Smirnov test, the population is normally distributed.

Since PBL and PjBL are two independent classes, a *Levene’s test* of homogeneity with significance value (α) of 5% using SPSS 22 is selected. A Levene’s test gives the statistics 1.435 and p value of 0.236. Since p -value is larger than 0.05 then the null hypothesis is accepted and the conclusion is that the variances of both groups (PBL and PjBL) are assumed equal.

An *Independent Sample t-test* should be conducted to compare two means of different groups. In this test, there are two hypotheses; they are:

\[ H_0: \mu_1 \leq \mu_2 \]
\[ H_a: \mu_1 > \mu_2 \]

The data are analysed using Normality test, Homogeneity test, and Independent Sample t-test.
Note:

μ₁ : Mean score of pupils’ mathematical problem solving ability taught by PBL

μ₂ : Mean score of pupils’ mathematical problem solving ability taught by PjBL

Based on the Independent Sample t-test is obtained \( t_{\text{calculation}} = 1.327 \) whereas \( t_{\text{table}} = 1.67 \). The value of \( t_{\text{calculation}} \) is less than or equal to \( t_{\text{table}} \) then \( H_0 \) is accepted and \( H_a \) does no longer exist. So, we can conclude that the pupils’ mathematical problem solving ability taught by PBL is not higher than pupils’ mathematical problem solving ability taught by PjBL.

The result is empirically rejecting the paper of Hung (2011) for SMP Negeri 2 Panai Tengah case, although Hung viewed that pupil seems that “(PBL) is likely to result in better development of self directed learning and ability to deal with uncertainty than the (PjBL)”. This study is relevant with Harahap’s research (2014) stated that pupils’ mathematical problem solving ability in class taught using PBL is not better than in PjBL in class X SMA Negeri 11 Medan and automatically rejecting Hung’s paper (2011) as well as to the expected hypothesis. The result can be understood although pupils in PBL and PjBL classrooms learn mathematical problem solving in the same context and place, the absence of pupils while the test was conducted, was unable to prevented, besides the other factors that cannot be avoid or predicted, such as learning styles and habits, different environments, intelligence, etc. possessed by pupils.

Pupils in PBL classroom have real experiences in this research by working worksheets to hand pupils on modified problems. Every pupil works in their group and tries to solve problems using Polya’s steps, from identifying what problem want they to solve, devising a plan to solve the problem and carrying it out. However, they are seemed to be confused while the problem forces them to look back at their solution although teacher has given scaffolding. Pupils tend to leave the part of ‘looking back’ empty in the first and second meetings. It is evident from pupils’ solution in the test.

In the similar manner, pupils in PjBL classroom also have real experiences by working worksheets in order to link pupils on real life problems based on their circumstance. Pupils are doing a mini research through their worksheets. Worksheet of PjBL classroom does not provide an explicit Polya’s steps like in PBL classroom, however, but it covers the steps implicitly. In the test, clearly, pupils tend not to write the Polya’s steps explicitly in the test paper, but they work on it clear enough.

From both classes, there is a tendency in which pupils do not write the verification of their solution (looking part). No clear reason for leaving this part, but alternatively, there should be a thought that this part is not too important. This case is important to be highlighted in this research.

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Both of instructional models have made pupils to be stronger in understanding the problem solving process. Through challenging activities, PBL and PjBL models have been giving the consciousness to pupils to learn more about the problems around them to solve. Although this research does not explain more about pupils’ attitude in the classroom in the implementation of PBL and PjBL models, pupils are seemed to be interested in learning mathematics further. This is consistent to the findings of Akinoglu and Tandogan (2007), Yalcin et al. (2009), Bagheri et al. (2013), Shaer and Gaber (2014).

CONCLUSION

Based on the result of research obtained can be concluded that pupils’ mathematical problem solving ability taught by PBL in the experimental class is not higher than pupils’ mathematical problem solving ability taught by PjBL in the comparison class on subtopic Social Arithmetic in grade 7 SMP Negeri 2 Panai Tengah.
REFERENCES


