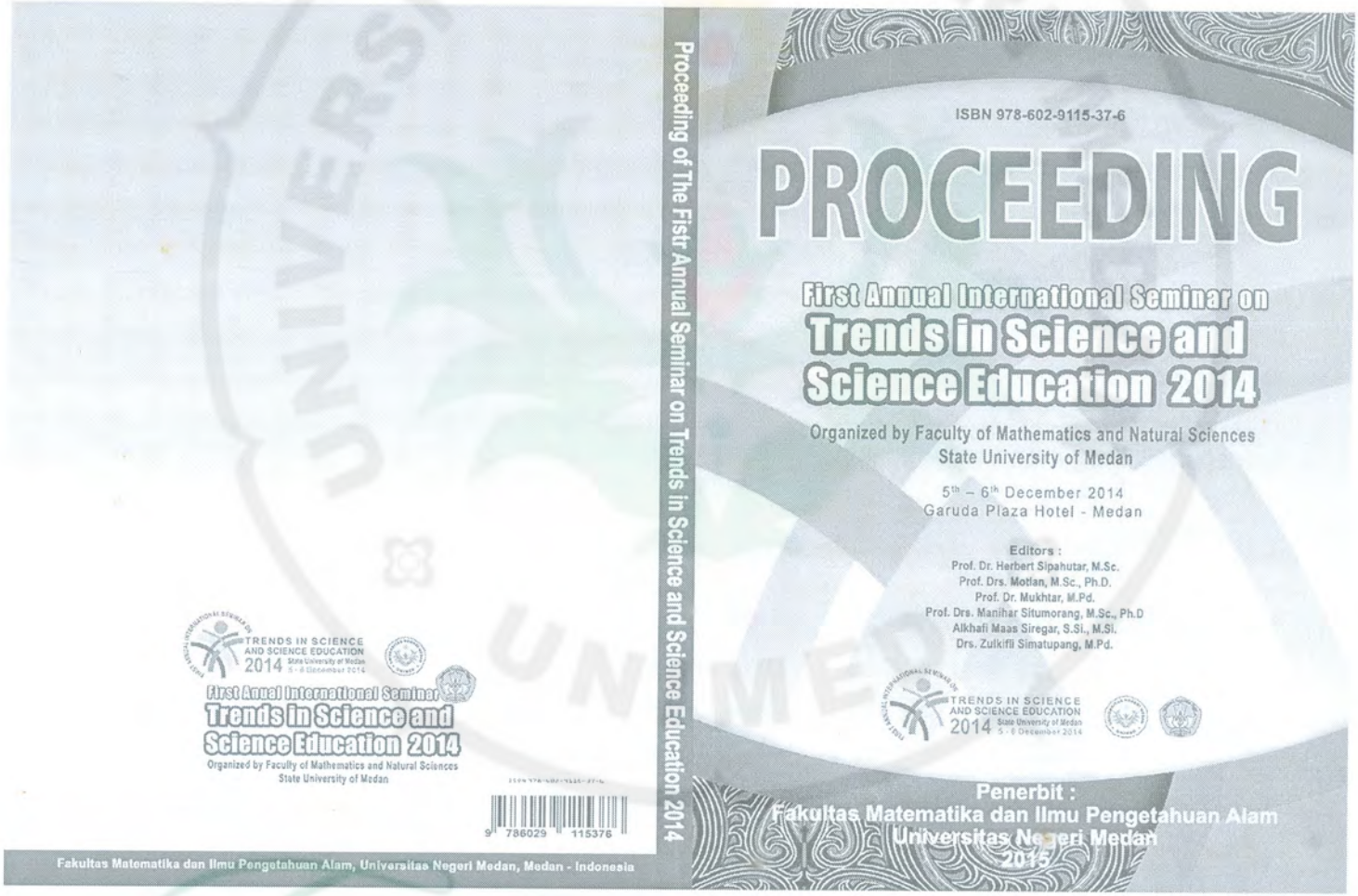

PROCEEDING

First Annual International Seminar on Trends in Science and Science Education 2014

5th – 6th December 2014
Garuda Plaza Hotel - Medan

Editors:

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Fakultas Matematika dan Ilmu Pengetahuan Alam
Universitas Negeri Medan
2015

Proceeding: The First International Seminar on Trends in Science and Science Education 2014 – ISBN 978-602-9115-37-6

FROM THE EDITORS

The First International Seminar on Sciences and Science Education, ISOSE, organized by Faculty of Mathematics and Natural Science of State University of Medan, was held on 4 – 5 December 2014 in Medan, North Sumatera, Indonesia. The seminar particularly encouraged the interaction of research students and developing academics with the more established academic community in an informal setting to present and to discuss new and current work. The high quality of the papers and the discussion represent the thinking and experience of experts and practitioners, researchres, lecturers and students in their particular fields and interests. The papers contributed the most recent scientific knowledge known in science and science education.

This proceeding contains all the paper presentated in the seminar, consisted of 11 papers of Biological Sciences, 11 papers of Chemical Sciences, 3 papers of Mathematical Sciences, 14 papers of Physical Sciences and 39 papers of Science Education.

In addition to the contributed papers, an outstanding keynote presentation on National Curriculum 2013 was made by Prof. Dr. Syawal Gultom (formerly Rector of State University of Medan, Unimed), now as Head of Badan Pengembangan Sumberdaya Manusia Pendidikan of Department of Education and Culture of Republic of Indonesia. This presentation gives all pratisipants a new and comprehensive perspective on the orientation of national education in the next era.

Two invited keynote presentations were given by Prof. Dr. Yaya Rukayadi from Department of Food Science, Faculty of Food Science and Technology and Laboratory of Natural Products, Institute of Bioscience, Universiti Putra Malaysia, Serdang, Selangor DarulEhsan, Malaysia who spoke on how to appreciate the nation through research javanese turmeric or temulawak (*Curcuma xanthorrhiza* ROXB.), and by Dr. Phattrawan Tongkumchum, Department of Mathematics and Computer Science, Faculty of Science and Technology, Prince of Songkla University, Pattani, Thailand who spoke about the applications of the weighted sum contrasts methods on graphing confidence interval for adjusted mean, their used for comparing two and several groups, and adjustment for covariates.

We would like to express our deep appreciation to Prof. Dr. Ibnu Hajar, Rector of State University of Medan for financial support by means of Dana DIPA Unimed FY 2014.We would like to express our deep appreciation to Prof. Dr. Motlan (Dean of FMIPA Unimed), all sponsors, all member of seminar committe, that make the seminar happen in a great succes.

We thank all authors and participants for their contributions.

Medan, February 2015

Editors

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THE DIFFERENCE OF MATHEMATICAL PROBLEM SOLVING ACHIEVEMENT OF PUBLIC JUNIOR HIGH SCHOOL BASED ON LEARNING APPROACH

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ABSTRACT

This paper is the result of a study to investigate the difference of the students's achievement in mathematical problem solving (MPS) based on learning approach. The research is static and quasi-experimental group posttest only. The population was all of students of upper and middle level public Junior High School in Bandung, West Java, Indonesia. One school of each level and two classes of each school were involved as samples. The research also investigate students' mathematical prior knowledge (MPK) either in upper or in the middle level school. One way Anova and two way Anova are used to analyze the data. The research results are: (1) The students in PBL classroon get better achievement in MPS test than the students in conventional one; (2) There is no interaction between PBL and MPK towards MPS; (3) There is no interaction between learning approach and school level.

Keywords: *Mathematical problem solving, problem-based learning.*

INTRODUCTION

Since the eighteens, mathematical problem solving (MPS) has become the focus of many experts, researchers, and practitioners of mathematics education in many countries. In Indonesia, it is involved as one of goals of learning and teaching mathematics at all levels of school (MoE of Indonesia, 2006). It is due to the view that MPS is considered as the heart of mathematics. In fact, everything learned in mathematics was dedicated to solving a variety of problems. In short, the main goal of doing mathematics is problem solving and through solving problems students construct their new knowledge and grasp mathematical concepts.

According to TIMSS's evaluation (Mullis, et al. 2008), Indonesian eight grade students achievement in problems solving is categorized very low. Deeply speaking, in Geometry they only get 19%, meanwhile the international achievement is 32%. In algebra, they get 8% while the international achievement is 18%. The data indicates that the students are lack of problem solving ability. Inherently to the above findings, prior investigation on eigth grade at one public school in Bandung shows that they are incompetent in mathematical problem solving. Precisely, they only get 39%.

Researchers hypothesized that students' low achievement in mathematical problem solving due to the teaching approach the teachers applied (Schoenfeld, 1994). Mathematical

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classrooms are still dominated by direct instruction (conventional teaching learning) with less emphasis on applying mathematics to daily life. Students do not have enough experiences seeing how problems be solved and in turn doing it themselves. In short, students are rarely engaged in solving problems. Instead, they only be able imitating their teachers solving routine exercises. This is what Arends (2008) claims as passive processes of learning.

Other research finds that mathematical prior knowledge (MPK) gives contribution to students' mathematical problem solving ability (Krulik & Reys, 1980). The finding is in line with Arslan and Altun (2007) whose stated that the lack of ability of students in solving mathematical problem is due to the poor of mathematical prior knowledge and the incompetency of choosing and applying the knowledge they have to handle the tasks.

It is then relevant to realize and implement the ways of teaching which give students opportunities and time to be engaged in constructing new skills and knowledge and involved in solving mathematics problems as some researchers and institution recommend (MoE of Indonesia, 2006; Kilpatrick, et.al., 2001; NCTM, 2000; Schoenfeld, 1994).

Arends (1994), Ronis (2008) believe that an innovative and potential approach of teaching which endorse and enable students constructing and reinventing their new knowledge is problem-based learning (PBL). Through PBL, students in the small group are encouraged and facilitated to be actively engaging in solving problems. Using previous knowledge and experience, they try to sharpen their mathematical skills by solving real, challenging, open-ended, and contextual problems.

This research implement PBL with the purpose to enable students reach mathematical problem solving abiiity. So, the research questions are:

1. Is there the difference of the students' MPS achievement between students in PBL classroom and the students in conventional classroom?

2. Is there in interaction between learning approach (PBL and conventional one) and MPK towards the students MPS?

3. Is there interaction between learning approach (PBL and conventional one) and school level towards the students MPS?

Aspect of mathematical problem solving that will be measured is based on NCTM (2000), they are modelling a situation or daily life problem mathematically, hoose or apply appropriate strategy, and explain until interpret solution to initial problem.

METHODOLOGY

The study is a quasi-experimental design with non-equivalent control group posttest only. The population is all of upper and middle level public junior high school students in Bandung,

Indonesia. As samples, two classrooms are taken from each school level: one is for experimental group with PBL instruction, another one is for control group with direct (conventional instruction). Totally, there are 145 students took part in this study, i.e. 71 students are included in PBL classroom, and 74 students belong to conventional classroom.

At each classroom, the students are divided into 8 groups. There are 5 students in each group which consisted of students from mixed ability (high, middle and low MPK) to examine the interaction between learning approach and MPK.

Five experts validated teaching material and mathematics problem solving instrument before being tried-out to students of other equivalent school. All item of the test was valid with Cronbach Alpha reliability 0.76.

Data are collected using a set of instrument. The instrument is a problem solving post-test designed by the investigator for the purpose of this study. The test is given to experiment classroom as well as to conventional one for comparison purposes. An item of the test is presented below.

Problem 1: The trip of the boat
There is a boat which is sailed from Port A in the North straight to Port B in the South along 20 km. The boat turn to the East as far as 24 km to reach Port C. From Port C, the travel of a boat continue straight to Port D in the South along 12 km. Find the distance from Port A to Port D.

RESULTS

Data is analysed by using Statictics Package for Social Science (SPSS) version 19 based on instruction, previous knowledge, and school level. Test of normality and homogeneity of variance gave significant result either for MPS score based on learning approach, MPS score based on learning approach an MPK, or MPS score based on learning approach and school level. Kolmogorov-Smirnov is used tc test the normality of the data, and analyses of variance is used to test homogeneity of data at 5% level of significance.

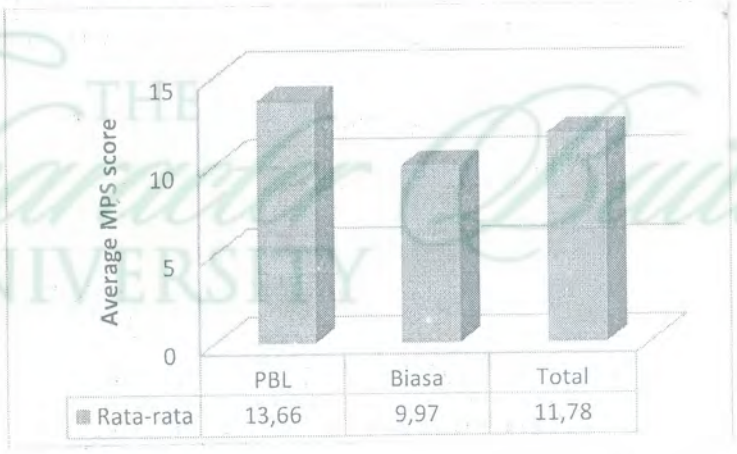

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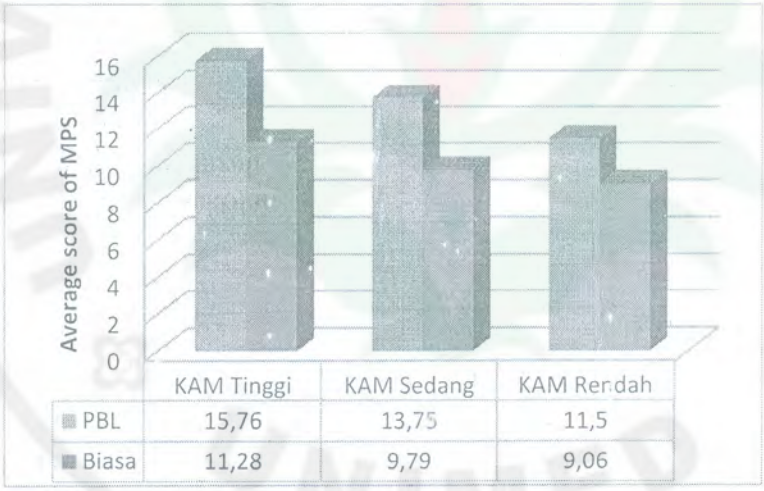
Figure 1. The Difference of Students' Mathematical Problem Solving Achievement.

The Difference of Students' Mathematical Problem Solving Achievement Based on Learning Approach. Figure 1 describes mathematical problem solving average score based on learning approach. The students in PBL classroom receieved average of MPS score 13,66 (approximately 54%), while students in conventional classes earned an average score 9,97 (about 24%). The test of the hipothesis is signifiacant at 0,05. It means there'is significant difference MPS students' achievement between the students in PBL classroom and their counterpart in conventional one.

Interaction between Learning Approach and MPK towards MPS Achievement. Two-way Anova is used to test the existence of interaction between learning approach and MPK towards MPS ability. The result is there is no common effect between learning factor with MPK towards students MPS achievement in both groups. The students MPS average score based on learning approach and MPK is presnted in Figure 2.



	KAM Tinggi	KAM Sedang	KAM Rendah
PBL	15,76	13,75	11,5
Biasa	11,28	9,79	9,06

Figure 2. Students MPS Average score based on learning approach and MPK

Interaction between Learning Approach and School towards MPS. Statistical test of hypothesis about interaction between learning factor (PBL, Conventional) and level of school (upper, middle, lower) is not significant. So, we concluded that there is no interaction between learning factor and school level towards students MPS achievement.

Analyss and Discussions on Students Performance. Many students get high score in solving problems test that measure their representation ability as a part of understanding the problem, i.e., sketch the picture/graph assocciated with the words problem such as for problem 1 such that they easily represent that sketch into mathematical models. Example of the student representation ability is presented in Ficture 3. This student belongs to experiment classroom.

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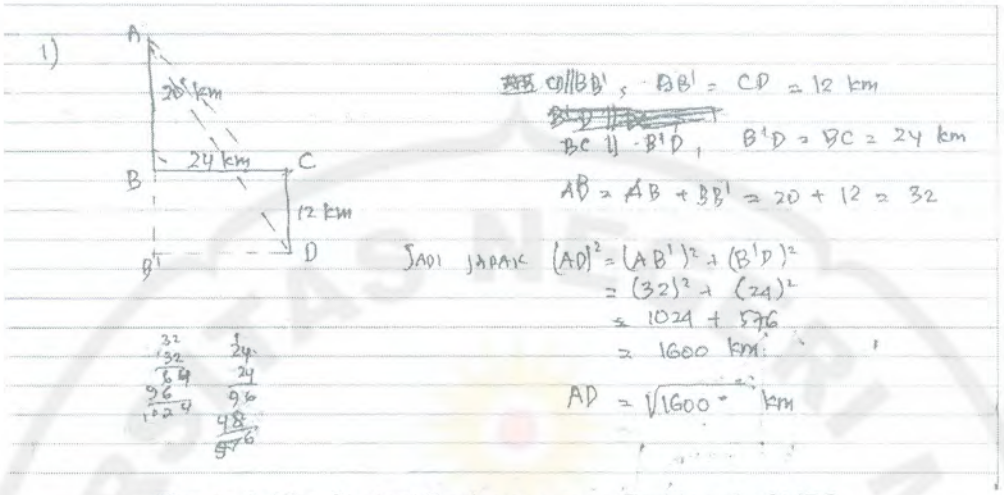

Figure 3. The Student Performance on Problem 1 of MPS.

Although a large amount of the students get high score for problem 1, but some of the them get low score for this problem. Actually, many students do not make the sketch (the graph) or other representation so it is harder for them to arrive at the right solution.

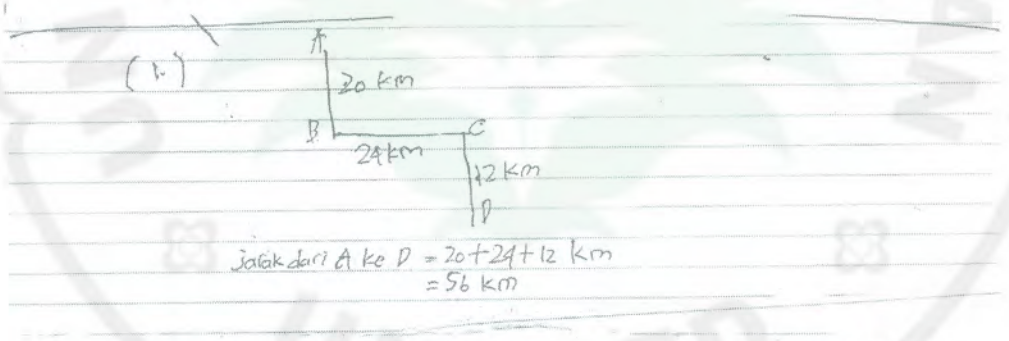

Figure 4. Another Student Performance on Problem 1 of MPS

It can be seen from Figure 4, the student gives the graph but the solution for the problem is not comprehensive enough so they do not know what must to do next. It indicate that some of the students have grasped the concept of Pythagorean completely, but they forget about how to find square root number such that it hard for them to finish the problem. The fallacy is not due to the instrument since it has validated by five education experts. Moreover, the teacher has implement instruction properly. Probably the student counts for the fallacy. So, the researcher asked this student why his work was so bad and the answer is he do not like mathematics. So, the next research maybe should include attitude aspect. Like or dislike towards mathematics is influenced by the fact that the students are rarely enggage in problem solving activity (Wilson 1997), such that the knowledge is not store in longterm memory and hard to retrieve whenever needed (Hiebert & Carpenter, 1992; Carpenter Lehrer 1999).

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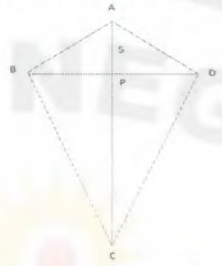
Problem 6

Look at the picture of a kite below. Every edge of the kite are made of bamboo, so do their diagonal. The lenght of vertical diagonal of the kite is 40 cm, and the horizontal one is 24 cm. A button is put at every 5 cm at each side of a kite. Compute how many button at least you need for these porpose. You must write every step you need to get the solution.



A kite

The student get difficulty in solving problem 6 (the last problem). It is interesting, for this problem the achievement of the students in experiment classroom is not higher than the achievement of the students in conventional one., i.e., average score of MPS for the students in experiment classroom is 1,97 of 4. Meanwhile, average score of MPS for for the students in conventional classroom is 2,01 of 4 (See Table 2). Example of student performance in problem 6 is presented in Figure 5 and Figure 6.

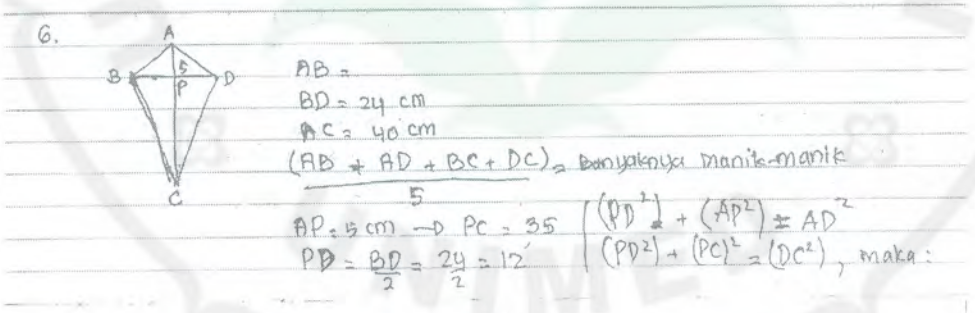


Figure 5. The Student Performance on Problem 6 of MPS

Figure 1 indicates that this student actually can finish the problem but he has no time anymore to do it. His time has out to solve five other problems.

The performance of the student in Figure 6 is almost perfect, only slightly fallacy he made, that is, he doesn't chek wether his proposed solution is right. This student is lack of aspect number 4 of problem solving steps, i.e., reflection or looking back Polya (1981). In this experiment, this aspect include in aspect 3.

Overall, the performance of MPS of students who get PBL approach belongs to middle category. In the other side, the performance of MPS of the students who get conventional learning belongs to low category (the score is under ideal average score, ideal average score is 4).

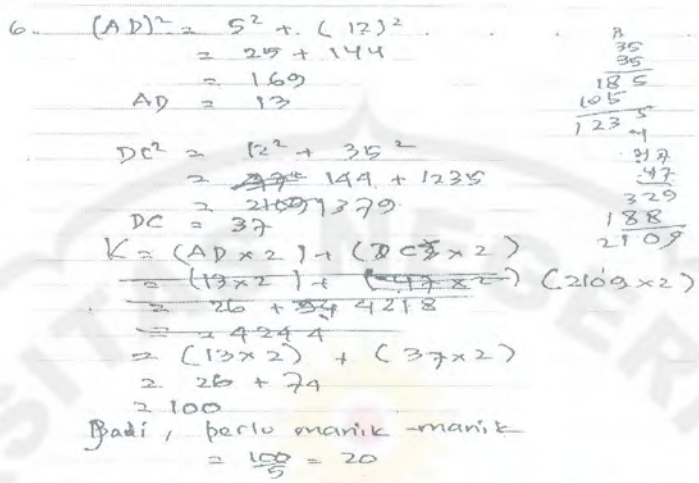


Figure 6. Another Student Performance on Problem 6 of MPS

Average of Sudents' MPS Achievement Based on Learning Aproach for each problem is presented in Table 2.

Tabel 2. The Average of Sudents' MPS Achievement Based on Learning Aproach

Item	MPS*)	
	PBL	Conventional
1	3,00	2,36
2	2,19	1,77
3	3,17	1,49
4	1,34	1,34
5	1,97	1,12
6	1,97	2,01
Average	2,733	1,682

*)Ideal score = 4

At the end of the program, the study found weaknesses in students' mathematical problem solving ability involve lack of prior knowledge, poor mathematical understanding ability and strategy to overcome the problems. This is in line with Arslan & Altun (2007) and Napitupulu (2011).

CONCLUSIONS AND RECOMENDATION

Based on the findings we conclude that: a.The student in PBL classroom get better MPS achievement than their counterpart in conventional classroom, b.There is no interaction between learning factor and MPK towards students' MPS achievement, and c) There is no interaction between learning factor and MPK towards students' MPS achievement.

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It can be recommended that: (a)PBL should be applied as an alternative mathematics teaching approach to develop junior high school students' mathematical problem solving ability, (b) In applying PBL, teacher should have adequate mastery on its characteristics of PBL such as creating real contextual problem, guiding discussion, give scaffolding appropriately, ensuring avaibility of resources, and keep time available such that learning process run well, and evaluate students performance holistically, and (c) Future researcher need to investigate further whether PBL approach gives also siginicant effect on other mathematical competencies such as mathematical connection, representation, communication, and reasoning.

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