Enhancing student’s science process skills through problem solving model: an effectiveness study

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Abstract. The present study aimed to determine the effectiveness of the problem solving model for science learning. The model effectiveness was determined by student’s activities, science process skill, and knowledge aspect. The data was obtained through experimental research with a randomized control-group pretest-posttest design. This study was conducted at three different school, namely state junior high school 1 Padang, state junior high school 12 Padang and national junior high school Padang. Two classes of each school were choosen as simple random samling. The instrument were observation sheets to collect student activities and multiple choice questions to collect students SPS and knowledge aspect. Student activity data were analyzed using the Cohen’s Kappa formula and percentage. The data of improving SPS and knowledge aspect were analyzed by U Mann-Whitney test using SPSS 19. The results revealed that the PS models proved effective which was based on the students' activities in which they were categorized as a very active category, as well as to improve students’ SPS and knowledge aspect. Therefore, reflected from the findings of the present study, it is recommended for the teachers to implement the use of PS models in science learning at junior high school.

1. Introduction
Science require the ability to apply scientific methods. Scientist need a set of skills to conduct scientific investigations known as science process skills (SPS). SPS are important in science learning because they are not separate from scientific approaches and lifelong learning skills. Moreover, SPS involve cognitive, manual, and social skills (Rustaman, 2011).

The results of the preliminary study on August 24, 2015, showed that the average SPS of seventh-grade students in Padang were below 50%. Observation skills, designing experiments and measuring were 47%, 39% and 60%. Arranging predictions, asking questions and composing hypotheses 18%, 40%, and 27% respectively. Arrange conclusions, make inferences, apply ideas to new situations and classify are 40%, 34%, 44%, and 34%. The highest score is 84% that is use of simple equipment. The students’ process skills is low likely due to the low understanding of teachers and prospective teachers of SPS (Emereole, 2009; Mbewe, Chabalengula & Mumba, 2010; Balanay, 2013).

SPS are very broad. Rustaman (2011) said that one of the SPS is a problem solving skill. Problem solving is one of the important skills to be a global citizen and to adapt to the community environment. In the 21st century, the problem solving is also one of the important skills (Rich, 1992; Sitti, Sopeerak, & Sompong, 2013). Moreover, Problem solving skills are required for shaping interpersonal skills (Jonassen, 1997; Chi, 2009; Jonassen, 2010; OECD, 2012).
Problem solving skill should be had by students because they are related to the ability to apply science concepts to solve problems encountered in their life. So, it is necessary for students. However, a learning to enhance students’ problem solving skills in science learning still lack in Indonesia (Poedjiadi, 2007; Rustaman, 2011). The learning process with problem solving should be familiarized for student (Sitti, Soeperak, & Sompong, 2013), and teachers need to prepare strategies to teach them in order to students have SPS (Mataka, et.al., 2014).

Based on Alberida’s preliminary study of science teachers in junior high school at Padang city showed that (a) 35% teachers understand problem solving steps; (b) 41% teacher understand the role of the teacher in a problem solving learning; (c) 91% teachers agreed that the problem solving model is suitable for Kurikulum 2013; (d) 91% teachers agree that problem solving skills need to be trained for students; (e) 66% teachers understand that one of the goals of science learning is to train problem solving (Alberida, 2014).

According to Carin and Sund (1964), the goal of science learning is to help students develop problem-solving skills. Therefore it can be understood that the National Curriculum (Kurikulum 2013) has recommended to use a problem-solving (PS) model. The type of PS model recommended by National Curriculum is Creative Problem Solving (Kemendikbud, 2015). Creative Problem Solving is suitable for general problems related to everyday life because students are free to express their opinions according to the background of their knowledge and interests. However, it is difficult to appear problems related to specific science materials or they are not related to everyday life (Jonassen, 2010; Mataka, et. Al., 2014). Creative Problem Solving is good for students in the learning with PS models. This is in accordance with the competencies for seventh and eighth-grade student based national curriculum competencies.

There are many research papers related to problem solving. Cooper, Nammouz, & Case (2008) stated that problem solving is difficult for students, especially in chemistry learning. Sutherland (2002) stated that problem solving for beginners is different from those that are already experts. Caprioara (2015) applied problem solving to improve mathematics learning outcomes.

The approach used in PS is distinguished by scientific and non-scientific problem solving (Gulo, 2008; Mataka, et. Al., 2014; Hung, 2016). Learning activities according to process standards (Permendiknas No 65 of 2013) use a scientific approach. Therefore it is appropriate to use a scientific PS model. Scientific competencies for seventh and eighth grade are at level 4, while ninth grade is at level 4A.

Scientific competencies for level 4 involve asking questions, implementing experiment, recording and presenting the results of the investigation in the form of tables and graphs, concluding and reporting the results of the investigation. Then, scientific competencies for level 4A include asking questions, designing and carrying out experiments, recording and presenting the results of investigations in the form of tables and graphs, concluding and reporting the results of investigations (Ministry of Education and Culture 2015b).

Carin (1997: AP I) proposed PS model steps as follows: (1) planning, (2) collecting data, (3) organizing data, (4) analyzing data, (5) generalization, (6) drawing conclusions. The planning stage includes activities to identify problems, to formulate problems, to plan activities and to solve problems. But the steps of PS about planning activities are not suitable for students of seventh and eighth grade but also for ninth grade and high school level. Based on the competency and scope of the science learning at junior high school, it can be seen that the steps of PS as stated by Carin are too high. So Alberida (2017) developed a PS model for science learning in junior high school. This research was based on these question; 1) What is the PS model that is suitable for science learning in junior school for science subjects? 2) How is the effectiveness of a PS model developed involved student’s activity, SPS, and knowledge aspect?

2. Purpose of study
The purpose of this study is to reveal the influence of the PS model on activities, SPS, and knowledge aspect of junior high school students.
3. Method

The effectiveness of the PS model for science learning is seen in three aspects such as students' activities, SPS, and knowledge aspect. This is an experimental study with a pretest-posttest control group design (Lufri and Ardi, 2015). A first group is an experimental group that using a PS model and another is a control group using learning commonly used by teachers.

The study was conducted in junior high school student in Padang City which had implemented the national curriculum (*Kurikulum 2013*). Schools that had implemented the curriculum were grouped into three groups (categories) based on the 2014 National Examination scores. State junior high school 1 Padang and state junior high school 8 Padang were high-level schools. State junior high school 12 Padang and State junior high school 31 Padang are middle-level schools. And then, *Simak* junior high school and *Nasional* junior high school are low-level schools.

The research subject was the seventh-grade students of Junior High School at Padang City who had attended a learning based *Kurikulum 2013* and they were enrolled students in the July-December 2015. The testing schools were taken from each category (Sanjaya, 2013) with lottery techniques through the following steps: a) determine junior high schools that have implemented the *Kurikulum 2013*, b) Select one school randomly from each group, c) select two classes randomly from each selected school. Then, selected 6 classes will be used as a place of testing. One class from each school will carry out science learning with a PS model and another will carry out learning commonly by the teacher.

Selected schools are three school such as state junior high school 1 Padang, state junior high school 12 Padang and *Nasional* junior high school Padang. Each school was taken for 2 classes the experiment like at state junior high school 1 Padang, it was selected VII F class for the experimental class and class VII E for the control class; at state junior high school 12 Padang, it was chosen VII 2 class as the experimental class and VII 1 class as the control class; at *Nasional* junior high school Padang, it was selected VII A class as the experimental class and class VII B class as the control class. The implementing of the learning model was conducted in 8 meetings.

### Table 1. Technique of collecting data, type of data, Instrument, Validity, and Reliability

| Type of Data                      | Technique of Collecting Data | Description of Research Goal                                                  | Instrument                          | Validity (k) | Reliability (ICC) |
|----------------------------------|------------------------------|-------------------------------------------------------------------------------|-------------------------------------|--------------|-------------------|
| Student’s activity in science learning | observation                 | Observe student’s activity during science learning                           | Observation sheet                   | 0,78         | 0,71              |
|                                  | test                         | Giving questions of science process skill to student in science learning      | Question sheet of science process skill | 0,80         | 0,65              |
|                                  | test                         | Giving questions of knowledge aspect to student in science learning           | Question sheet of knowledge aspect  | 0,84         | 0,83              |

Student activity data was obtained through observation by two observers. The data were analyzed by looking for the average of observer assessment and the percentage of agreements of the two observers. Criteria of student activities showed in Table 2.

### Table 2. Criteria of Students Activity

| Score   | Category |
|---------|----------|
| T > 3,20| Very active |
| 2,40 < T ≤ 3,20 | Active |
| 1,61 < T ≤ 2,40 | Quite active |
| 0,81 < T ≤ 1,60 | Less active |
T < 0.80 Not active
(Adopted from Musdi, 2012)

Data of SPS and knowledge aspect are showed a gain score. Statistical tests were conducted to determine whether there are differences learning outcomes between the experimental and control class. The first step was to carry out normality test using the Kolmogorov-Smirnov test and variance homogeneity test using the Levene test by SPSS version 19. Based on the results of the tests, the hypothesis test used U Mann-Whitney by SPSS version 19.

Normalized gain (g) is used to see an overview of the improvement of SPS and the knowledge aspect. The formula of normalized gain showed below

\[
g = \frac{\text{Posttest Score} - \text{Pretest Score}}{\text{Maximum Score} - \text{Pretest Score}}
\]

The category of normalized gain is in accordance with Hake (1999) as shown in Table 3.

| Normalized Gain Score | Category |
|-----------------------|----------|
| 0.70 ≤ g < 1.00       | High     |
| 0.30 ≤ g < 0.70       | Quite    |
| 0.00 ≤ g < 0.30       | Low      |

(Hake, 1999)

4. Result

The results of the present study include the student’s activities, SPS and knowledge aspect.

4.1 Results of Student Activity Analysis

The students’ activities were observed including science process skill, activities within group, and activities toward scientific attitude. We can see the results of the analysis in Table 4.

| No | Aspect                                                                 | Mean | Criteria     |
|----|------------------------------------------------------------------------|------|--------------|
| 1  | Observe based on worksheet                                              | 3.45 | Very active  |
| 2  | Ask questions based on worksheet                                       | 3.64 | Very active  |
| 3  | Make prediction based on worksheet                                     | 3.64 | Very active  |
| 4  | Construct hypothesis based the problem                                 | 3.66 | Very active  |
| 5  | Collect data through experiment, literature review, etc.               | 3.58 | Very active  |
| 6  | Organize data in the table and diagram                                 | 3.46 | Very active  |
| 7  | Analyze data                                                           | 3.65 | Very active  |
| 8  | Conclude based data gained                                             | 3.55 | Very active  |
| 9  | Communicate knowledge and competency gained                            | 3.47 | Very active  |
| 10 | Sharing task that must be done                                         | 3.54 | Very active  |
| 11 | Participate in the group activity                                      | 3.49 | Very active  |
| 12 | Listen to friends expressing opinion                                   | 3.63 | Very active  |
| 13 | Ask to friends in the group                                           | 3.67 | Very active  |
| 14 | Carefulness                                                            | 3.55 | Very active  |
| 15 | Integrity                                                              | 3.67 | Very active  |
| 16 | Diligence                                                              | 3.62 | Very active  |
| Mean |                                                                      | 3.59 | Very active  |
The students activities in science learning using a PS model are in the very active category including the science process skills, activity within group and activities toward scientific attitude. The percentages of agreements between two observers are 90% in which categorized a very good agreement. In accordance with predetermined criteria, the learning model can be said to be effective if student activities meet the criteria above 1.61 point (quite active-very active). This means that the PS model for science learning is effectively seen from student activities. Figure 1 showed a graph of students’ SPS using the developed worksheet.

![Graph of students' science process skill](image)

**Figure 1.** The average of students’ science process skill

The average of students’ SPS in learning with PS models is categorized in the very high category. The data of students’ answers analysis on their worksheet are shown in Figure 2.

![Graph of student’s answer to worksheet](image)

**Figure 2.** The average of student’s answer to worksheet

The results of the analysis of students’ answers through their worksheet show that the average of student answer is categorized in the very high category.

4.2 The results of data analysis toward SPS

Subsequently, the effectiveness test of the PS model for science learning subsequently consider the result of students’ SPS. SPS are tested after students take learning using a PS model. Therefore, the average of students’ SPS increase which is shown in Table 5.
Table 5. The average of students SPS

| School        | Class          | N  | Pre-test | Post-test | Gain (Δ) | N-Gain | Criteria |
|---------------|----------------|----|----------|-----------|----------|--------|----------|
| SMPN 1        | Experiment     | 32 | 58,5     | 86,5      | 28,1     | 0,7    | High     |
|               | Control        | 31 | 59,1     | 76,2      | 17,2     | 0,5    | Quite    |
| SMPN 12       | Experiment     | 34 | 61,4     | 89,0      | 27,6     | 0,7    | High     |
|               | Control        | 32 | 61,8     | 83,8      | 22,0     | 0,6    | Quite    |
| SMP Nasional  | Experiment     | 14 | 41,8     | 81,5      | 39,8     | 0,7    | High     |
|               | Control        | 20 | 42,2     | 69,9      | 27,7     | 0,5    | Quite    |

Based on Table 5, the increasing of students science process skill as learning outcomes with PS models is higher than the learning model commonly used by teachers.

Next step is a hypothesis test. Hypothesis testing used the Mann-Whitney U test because the parametric test (t-test) criteria are not fulfilled. The results of the normality test and homogeneity test toward increasing of students’ SPS showed in Table 6.

Table 6. Normality and Homogeneity Test Toward Students’ Science Process Skill

| Data                                | Class          | Kolmogorov-Smirnov<sup>a</sup> | Description                  |
|-------------------------------------|----------------|--------------------------------|------------------------------|
| Improvement of students’ science    | Experiment     | .118                          | Not normally distributed     |
| process skill                       | Control        | .117                          | Not normally distributed     |
| Levene Statistic                    | df1            | 80                            | .008                         |
|                                     | df2            | 83                            | .007                         |
|                                     | Sig.           |                                |                              |
|                                     | Conclusion     |                               | Homogenous                   |

a. Lilliefors Significance Correction
b. α=0.05

Data criteria are normally distributed if the significance > α. The results of data processing showed significance in the experimental class 0.008< 0.05; while the control class 0.007 < 0.05. Consequently, both the experimental and control class is not normally distributed.

Criteria for variance are homogeneous if significance > α. The results of data processing showed the significance obtained by 0.806> 0.05. So it means the data variance of students’ SPS is homogeneous. Based on the results of the normality and homogeneity test, the improvement of SPS tested the hypothesis by using the Mann-Whitney test. The Mann-Whitney test used SPSS 19 which is shown in Table 7.

Table 7. The result of the Mann-Whitney Test of SPS.

| Test Statistics<sup>a</sup> | Improvement of SPS |
|-----------------------------|---------------------|
| Mann-Whitney U              | 1890.500            |
| Wilcoxon W                  | 5376.500            |
| Z                            | -4.751              |
| Asymp. C. (2-tailed)        | .000                |

a. Grouping Variable: Kelas   α=0.05

Ho Criteria is rejected if the significance (Asymp. C) < α. The results of the analysis showed Asymp.C,000 < 0.05 that mean Ho is rejected. This means that the improvement of students’ SPS is taught with a PS model for science learning is higher than who are not taught by PS models. Furthermore, an effectiveness test of the PS model is displayed by gain-score in Figure 3.
Figure 3. A gain-score of students’ SPS by each school

Based on the data shown that there was an increase of SPS at the three pilot schools. Furthermore, the results of the effectiveness test of the PS model for science learning are shown from each aspect of SPS in Figure 4.

Figure 4. Effectiveness Test Results of PS Models For Science Learning by Each Aspect of Students' SPS

Based on Figure 4, it can be seen that all aspects of SPS have increased through learning with PS models. Meanwhile skills of classifying, taking measurements, and concluding still low category. Among the schools, Nasional Junior High School Padang achieve the highest improvement.
4.3 Results of data analysis on the knowledge aspect

The effectiveness test of the PS model is about the knowledge aspect. Knowledge aspects are tested after students take learning using a PS model. Improved learning outcomes in the knowledge aspect are shown in Table 8.

| School  | Class  | N  | Pre-test | Post-test | Gain (Δ) | N-Gain | Criteria |
|---------|--------|----|----------|-----------|----------|--------|----------|
| SMPN 1  | Experiment | 32 | 49,2 | 91,7 | 42,5 | 0,8 | High |
| SMPN 1  | Control   | 31 | 48,4 | 80,2 | 31,8 | 0,6 | Quite |
| SMPN 12 | Experiment | 34 | 37,6 | 85,1 | 47,5 | 0,8 | High |
| SMPN 12 | Control   | 32 | 37,8 | 76,3 | 38,4 | 0,6 | Quite |
| SMP Nasional | Experiment | 14 | 37,5 | 75,0 | 37,5 | 0,6 | High |
| SMP Nasional | Control | 20 | 39,3 | 64,6 | 25,3 | 0,4 | Low |

Based on Table 8, it can be seen that the increase of student knowledge with PS model is higher than the learning model commonly used by teachers in which N gain criteria ranging from medium to high, except in the control class of Nasional Junior High School has low criteria.

Furthermore, hypothesis test was done using the Mann-Whitney U test. Table 9 showed the results of the normality test for the improvement of students’ knowledge aspect using SPSS 19.

| Data                  | Class     | Kolmogorov-Smirnov | Conclusion       |
|-----------------------|-----------|--------------------|------------------|
| Improvement of knowledge | Experiment | .133               | df=80 Sig=.001 Not normally distributed |
| Improvement of knowledge | Control   | .145               | df=83 Sig=.000 Not normally distributed |
| Levene Statistic       | df1=1     | df2=161            | Sig=.017 Not homogeneous |

The conclusion of the results of the normality and homogeneity tests showed that the data are not normally distributed and the variance is not homogeneous. So, the hypothesis test uses U Mann-Whitney. The results of the Mann-Whitney U test for knowledge aspect are shown in Table 10.

| Improvement of knowledge | Mann-Whitney U | 1826.000 |
|--------------------------|----------------|----------|
| Wilcoxon W               | 5312.000       |
| Z                        | -4.998         |
| Asymp. Sig. (2-tailed)   | .000           |

Ho Criteria is rejected if the significance (Asymp. Sig) < α. The analysis results were obtained by Asymp. Sig .000 < 0.05, so Ho is rejected. This means that the increase of students' knowledge taught with PS models for science learning is better than who are not taught by PS models. A graph of effectiveness test of the PS model towards increasing students' knowledge by each sample school is showed in Figure 5.
Figure 5. A Gain-Score of Students’ Knowledge by Each School

The PS model is to be effective for science learning if: (1) student activities has range from sufficient category to very active category (2) improvement of students’ knowledge aspect in experiment class is higher than students in the control class, and (3) improvement of students’ SPS in experiment class are higher than students in the control class. Thus, the PS model for science learning is effective when applied in learning.

5. Discussion

The purpose of the PS model for science learning is to improve students’ SPS and their science knowledge. In addition, this model also aims to increase activities of groups by sharing tasks; participating; hearing; asking; answering the question. The model also encourage students’ scientific attitudes such as carefulness, diligence, and honesty. SPS and students’ science knowledge are assessed through written tests. According to Feyzioglu, et al. (2012), SPS can be assessed through written examinations with questions in the form of multiple choice questions and also assessed through performance appraisal during the learning process. In addition to SPS and students’ activities in groups are also assessed through observation techniques. This is in accordance with the opinion of Arends (2007: 32), that collaborative activity can be assessed through observation.

Learning activities in this model use cooperative learning. The results of the observation during the study showed that the activities of students in the group were in the very active category (average 3.58). Cooperative learning has a positive impact on academic values and student attitudes (Michaelsen, Knight, and Fink, 2004). Cooperative learning means doing one thing together in small groups toward one common goal (Johnson, Zhang, and Kahle, 2012). This cooperative learning also emphasizes teamwork and interaction between students (Duch, Groh, and Allen, 2001; Prince, 2004).

Cooperative learning is useful for empowering the role of peers to help with learning with other friends. However, sometimes cooperative learning make students bored. Therefore, the teacher must be creative in giving awards to the most active groups. In addition to group awards, the teacher must also give awards to individuals who show positive activities, such as asking questions, responding to friends’ questions, refuting, giving appropriate arguments and so on.

The teacher must be creative in determining the student group that will present their if not all groups appear. Determination of groups can appear with various games, so the group does not feel forced. The teacher must also give awards to the groups that appear. Awards can be made from cartoons like “star”, “smile”, etc. This picture is collected by a group. The group that gets the most pictures means the most active group. This awards can help to motivate students to learn.

Giving rewards in cooperative learning is in accordance with Arends (2007) statement that it is important for teachers to give rewards to group products or processes. However, Arends (2007) also
argued that there is a possibility of difficulties experienced by the teacher when implementing this reward system. Based on the author’s observations at state junior high school 1 Padang, giving awards actually made the class noisy because all students wanted to display their work. Therefore, the authors argued that giving rewards is not necessary for students whose learning motivation is high. Furthermore, the results of the research by Wieth and Burns (2006) stated that students who are given incentives are more likely to have problem solving skills than those who are not given, rewards also affect students’ performance. Wieth and Burns (2014) further stated that reward only affects simple problem solving. Therefore, the author recommends reward for PS models in science learning, only given to students in the school where students still have low motivation in the learning.

Experts agree that PS is important (Chi, 2009), but how to teach it to students is still a lot of debate. Kirschner, Sweeller, and Clark (2006) teaching PS can making worksheets, then Csibra and Gergely (2009) did PS with clear guidelines and instructions. According to Kirschner, Sweeller, and Clark (2006) stated that explicit instructions can improve cognitive abilities and encourage the acquisition of accurate knowledge. Kapur (2012) proposed combining exploration with explicit instruction. Students who use learning with an exploration approach are combined with explicit instruction better at applying their knowledge (Loehr, Fyfe and Johnson, 2014). Based on this, the PS model in science learning is equipped with worksheet. This worksheet contained instructions in PS steps and contains exploration activities.

The effectiveness of the learning model is seen from student activities and the students' knowledge. The PS model for science learning is developed as one form of active learning so that one parameter of the model's effectiveness is student activity in learning. Student activities were observed in the form of SPS activities, group activities, and scientific attitude. The results of the data analysis show that student activities in the three aspects observed are in the very active category.

Learning activities are activities carried out by students related to learning material. There is no learning if there is no activity. Without activity, the learning process cannot take place properly. An effort to encourage actively students is basically a way to optimize learning activities (Sujana, 1990; Slameto, 2003; Mabroer, 2007). Students’ activities are important to built into learning, the more active students intellectually, manually and socially, the more meaningful the learning experience of students (Rustaman, 2005). So, the students’ activities determine the learning experience that will be obtained. Therefore, current learning is primarily activity-based learning.

Activity-based learning considers students as active learners. If facilitated, students will be able to explore their abilities and learning environment optimally so that learning becomes fun and lasting (Ministry of Education and Culture, 2015a). Active learning directs students to play an active role in the learning process. The characteristic of active learning is that teachers switch roles from lecturers to facilitators providing space, situations or learning environments to make students active in learning activities (Ministry of Education and Culture, 2015b). The PS model for science learning is developed as one form of active learning so that being one of the parameters of the model's effectiveness is student activity in learning.

The effectiveness of the model is further seen from the improvement of students' knowledge aspect. Data analysis showed that the improvement of student learning outcomes with PS model is higher than student learning outcomes with non-problem solving. These results are in accordance with the opinion of Jonassen, (1997), that problem solving involves a variety of cognitive activities such as proportional information, concepts, principles and rules that are within the domain of knowledge. Problem solving also involves structural knowledge including networking, semantic mapping, concept maps, and mental models, and also ampliative skills including construction and applying arguments, analogies, inferences. In addition, according to Jonassen & Tessmer (1996) problem solving also involved motivation and attitude. The opinions above are in accordance with the results of the effectiveness test that the PS model for science learning can improve learning outcomes in aspects of knowledge, SPS and attitudes. Kyu & Ph, (2015) stated that learning with problem solving allows students to gain learning experience at the level higher knowledge structure.
Judging from the implementation, a PS model for science learning applies collaborative learning. According to Davier et al., (2017) collaborative problem solving was characterized by the interaction between two or more students who share ideas, experiences and negotiate when solving a given problem. Collaborative problem solving will enhance students' social attitudes. This is evident from the results of testing the effectiveness that group activities and scientific attitudes of students are in the very active category.

6. Conclusion.
The PS model in science learning for junior high school has very high effectiveness (R= 3.59) that can be seen from student activities. Student’s learning outcomes using the PS model is significantly higher than a model commonly used by teachers in a trial school.

A valid, practical and effective PS model for science learning can improve students' SPS. The average activity of student’s SPS is 3.78 (very high criteria). The average of students SPS is is 87.5 (very high criteria) showed by students' answers on the worksheet.

Implications
The use of PS models for science learning is proven to be able to increase the students’ activities in junior high school, therefore this model is feasible to be considered by teachers in science learning. Science learning with PS models is proven to increase student activity including SPS, activities within the group, and activity toward scientific attitude. The increasing activity of the scientific process includes observing, formulating problems, making predictions, formulating hypotheses, gathering information/data, organizing data, processing data, drawing conclusions and communicating.

PS models can improve group activities in science learning including sharing assignments, participating in group activities, asking friends, and listening to friends' opinions. Viewed from the activity of scientific attitudes, the PS model can increase in honesty and diligence. Moreover, a PS model for science learning can increase students' SPS. The high problem solving activities, group activities and scientific attitudes and there is an increase in SPS so that making this model feasible for teachers to use for science learning in junior high school.

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