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"Improving Professionalism and Reflective Thinking through Design Research"

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"Improving Professionalism
and Reflective Thinking through Design Research"

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Preface

It is an honor and privilege to welcome you to the 7th South East Asia Design Research International Conference. The conference's theme, "Improving Professionalism and Reflective Thinking through Design Research," invites us to reflect on the current educational challenges, e.g. globalization and industrial revolution 4.0, and transform them into opportunities through design research. It acknowledges the need to develop our professionalism so that we can proactively contribute to the advancement of educational science and praxis. It challenges us to re-thinking the design research as a method to make learning and teaching innovation possible, but also as a paradigm in building our capacity for innovation.

Yogyakarta is an artsy and historical city which serves as a fitting cultural, social, political, and economic milieu for the conference. The tagline, "Jogja Istimewa," itself shows how the city has special values to be explored and experienced, and we encourage you to absorb the city's abundance: The Kraton, the cultural and political heart of the city; Fort Vredeburg museum; Malioboro road; Dipowisata urban tourism, to name a few.

The perfect ambience of Yogyakarta will provide us with a convenient space to interact and exchange ideas with colleagues as a means of professional learning. Our goal is for you to get new ideas, tools, and materials from the conference which will contribute to your professional development. The variety of sessions, workshops, and social events will give you opportunities to connect with friends and colleagues to expand your networks. We are excited about the keynote and invited speakers. We believe they will share challenging and innovative ideas about education.

This conference is the result of the hard work, support, and dedication of a number of parties. We wish to thank all the committee members who together make the conference possible. The committee has been working throughout the year to propose sessions, review a record number of submissions, answer queries, arrange the schedule, and response to last-minute requests. We also want to thank Sanata Dharma University; Ministry of Research, Technology, and Higher Education of Indonesia; Sogang University and SEAMEO QITEP in Mathematics for their contribution to funding the conference. Thank you for being here with us. We value your presence at the 7th South East Asia Design Research International Conference. Enjoy the conference!

Yosep Dwi Kristanto, Conference Chair
Albertus Hariwangsa Panuluh, Conference Vice Chair

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Learning Design on Set Materials Using the Model Problem Based Learning

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Abstract: This study aims to: produce learning trajectories to teach set material using PBL models in class VII junior high school of Kanisius Kalasan. This research was conducted in Kanisius Kalasan Middle School Yogyakarta. This type of research is design research. The subjects in this study were VIIC class students (trial class) and VIIA class students (research class). Data collection methods used are documentation of research, written tests, interviews and field notes. The data analysis technique used is data reduction, data presentation and conclusions or verification. Researchers designed learning using PBL models on set operating material (intersection and union) and final test analysis of mathematical problem-solving abilities. The results showed that: the feasibility of learning trajectory that has been designed using the PBL model on set material according to the revised HLT results.

Keywords: PBL, learning trajectories, HLT results

Introduction

Based on interviews with mathematics teachers in 2018, in the learning process the teacher still uses conventional methods in teaching and learning activities where the teacher explains and provides material and students sit quietly, listen to material, accept formulas, work on practice questions. The teacher also said that, students had difficulty in solving non-routine questions. Most students have difficulty in modeling real situations mathematical problems and do not understand the meaning of the symbols used in solving problems related to set operations (intersection and union). Students tend to pass questions that require problem analysis. During learning, students often wait for the teacher to explain or wait for friends to work in front of the class. Students are less independent and tend to need a long time to learn. Activities like this that cause passive students, are less motivated in understanding and applying mathematical concepts. As a result, students seem passive and have difficulty understanding and learning the material.

On the standard content of mathematics subjects in 2006 stated that one of the important aspects learned by students is problem solving ability (Wardhani, 2010). Therefore, teaching is needed which can spur students' ability to solve mathematical problems. Through problem solving skills, students are enabled to gain experience using the knowledge and skills they already have to apply to solving a problem.

Based on the background above, the formulation of the problem in this study is how is the learning trajectory to teach set operating material (intersection and union) using a problem-based learning model for VII grade students of Kanisius Kalasan Middle School Yogyakarta? So, the purpose of this study is to produce a learning trajectory to teach set material using a problem-based learning model.

Problem Based Learning

Problem based learning is a learning model that is designed so students exercise the ability to solve problems (Setyorini, Sukiswo, & Subali, 2011). With the problem-based learning model, learning will result in students being more able to solve the problems they face. Thus, the ability to solve problems will increase automatically. The stage in problem-based learning is as follows (Trianto, 2007).

Table 1. Stages of Problem Based Learning

Phase	Indicator	Teacher Activity
1	Student orientation to problems	The teacher explains the learning objectives, explains the logistics needed, motivates students to be involved in the problem-solving activities they choose.
2	Organizing students to study	The teacher helps students define and organize learning tasks related to the problem.
3	Guiding individual and group investigations	The teacher encourages students to gather appropriate information, carry out experiments to get explanations and problem solving.
4	Developing presents	The teacher assists students in planning and preparing suitable works such as reports, videos, and models that help them to share tasks with their friends.
5	Analyze and evaluate the problem-solving process	The teacher helps students to reflect or evaluate their investigations and the processes they use.

Then it can be concluded by the researcher, that Problem Based Learning is a learning model that makes the problem the basis of a learning process. Problems taken in Problem Based Learning are problems in real life.

Design Research

Design research is a systematic study of designing, developing and evaluating educational interventions (such as programs, strategies and learning materials, products and systems) as solutions to solving complex problems in educational practice, which also aim to advance our knowledge of characteristics and interventions. the intervention and the design and development process (Plomp, 2007).

Design Research Function

The function of design research is to design / develop an educational intervention (such as programs, strategies and learning materials, products and systems) with the aim to solve complex educational problems and to develop knowledge (theory) about the characteristics of interventions and the design process of interventions and processes design and development (Plomp, 2007).

Results from Design Research

There are three results obtained from design research (Plomp, 2007), namely:

1. Principles of design theory and intervention theory

Design research aims to generate knowledge about whether and why an intervention works in a particular context. In design research, research results cannot be generalized from sample to population.

2. Intervention model

Design research will produce program designs, learning strategies, teaching materials, products and systems that can be used to solve problems in empirical learning or education.

3. Professional Development

Design research is carried out collaboratively and collaboratively by researchers and educational practitioners in the field. Practical collaboration can be useful to overcome various problems of learning and education quickly and precisely.

Research Method

The learning model used is developing student learning materials (HLT) is PBL. The type of research used in this study (Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006) is design research. Data analysis in this study uses the model of Miles and Huberman, including 3 data analysis activities, namely: data reduction, data presentation and conclusion drawing.

Findings and Discussion

The First Meeting

1. Phase 1: Student Orientation to Problems

The teacher begins learning by checking student readiness, class readiness, and conveying learning objectives.

a. If there are students, they cannot mention the last material they have learned, and no student can mention the meaning of the set.
b. If the teacher asks students about their answers, that does not mean the answer is incorrect, but the teacher wants to know the thinking process of the students.
c. The teacher distributes students in several groups.
d. The teacher illustrates the problem to students. Problems that can be made can be presented in the following table form:

Name	Preferred Subjects
Andi	
Bunga	

2. Phase 2: Organizing Students for Learning

a. The teacher appoints two students to mention the 5 subjects they like. The following are the results of the two students who mentioned the subjects they liked

Nama	Preferred Subjects
Andi	Mathematics, Religion, Bahasa Indonesia, IPS, Sports
Bunga	Bro. Indonesia, Mathematics, English, Sports, Science

b. The teacher asks students what category is right for Andi, and interest? Then what categories are right for Mathematics, Religion, Bahasa Indonesia, Social Sciences, Sports, Science, English.

Possible 1:

Students cannot state the set of names and set of subjects.

Possible 2:

Students can declare a set of names that is

• Andi and the set of subjects namely {Mathematics, Religion, Bahasa Indonesia, IPS, Sports}.

• Interest and set of subjects, namely {Indonesian, Mathematics, English, English, Sports, Science}

Possible 3:

Students cannot express Andi's relationship with Mathematics, Religion, Bahasa Indonesia, IPS, Sports.

Possible 4:

Students can express Andi's relationship with Mathematics, Religion, Bahasa Indonesia, Social Sciences, Sports are "preferred subjects"

Possible 5:

Students can declare a set of names that is

• Andi and the set of subjects namely {Mathematics, Religion, Indonesian, Social Sciences, Sports}.

• Interest and set of subjects namely {Bahasa Indonesia, Mathematics, English, Sports}

• Andi and Bunga have a set of preferred subjects, namely {Bahasa Indonesia, Mathematics, Sports}

Possible 6:

A = {Mathematics, Religion, Indonesian, Social Sciences, Sports}

B = {In Indonesian, Mathematics, English, Sports}

C = {Indonesian. Sports Mathematics}

3. Phase 3: Guiding individual and group investigations

a. The teacher goes around to monitor the process of solving the problems carried out by each group by going around in the classroom and having dialogue with students.

b. The teacher asks questions that can stimulate students to solve student answers, for example:

1) The teacher asks students what category is right for Andi, and interest? Then what categories are right for Mathematics, Religion, Bahasa Indonesia, Social Sciences, Sports, Science, English. If students have answered "name" and "preferred subject", then further guide the students to write the names and subjects with a comma (,) separator. After that, guide students to add curly brackets at the beginning and end of the category. When students finish writing, the teacher asks students how to read it. The answers expected by the teacher (according to possibility 2) are: "the set of names is Andi and the interest while the set of subjects that are preferred are Indonesian, Mathematics, English, Sports, Science"

2) The teacher asks students what is Andi's relationship with Mathematics, Religion, Indonesian, Social Sciences, Sports? What is the relationship between Flowers and Bahasa Indonesia, Mathematics, English, English, Sports, Science? The teacher's expected answer is "preferred subject" according to the Possibility 4.

3) The teacher gives a question like this: can you write a new set of members whose members are Andi and Bunga's favorite subjects? The answer expected by the teacher is according to the possibility 5. The teacher continues the question again so that students can write with the symbols of the set by specifying the name of the set? The answer that the teacher expects is in accordance with Possibility 6. In addition, the teacher can also direct students to mention the symbol or symbol of "slices". Because the symbol or symbol of the slice has not been studied before ... Then the teacher gives stimuli to students to be able to define slices according to students' language that is easy to understand.

4. Phase 4: Developing and Presenting Works

a. The teacher checks students' understanding by asking.

b. The teacher gives appreciation to students because they have understood the problem correctly, that is, can mention what is known and asked about the problem given.

c. The teacher gives appreciation to students for writing down the problem-solving plan according to what they understand from the purpose of the problem. Then the teacher gives motivation to students to continue the next step according to the plan that has been made by the students

5. Phase 5: Analyzing and Evaluating the Problem-Solving Process

a. The teacher helps students to reflect or evaluate their investigations and the processes they are working on.
b. The teacher directs students to conclude the material they have learned.
c. Students can conclude the material that has been studied along with teacher interaction, namely Slices A and B are a set whose members are members of set A and are also members of set B and are denoted by $A \cap B$.

Second Meeting

1. Phase 1: Student Orientation to Problems

The teacher begins learning by checking student readiness, class readiness, and conveying learning objectives.

a. If there are students, they cannot mention the last material they have learned, and no student can mention the meaning of the set.
b. If the teacher asks students about their answers, that does not mean the answer is incorrect, but the teacher wants to know the thinking process of the students.
c. The teacher illustrates the problem to students. Problems that can be made can be presented in the following table form:

Name	Preferred Subjects
Andi	
Bunga	

2. Phase 2: Organizing Students for Learning

a. The teacher appoints two students to mention the 5 subjects they like. The following are the results of the two students who mentioned the subjects they liked
b. The teacher appoints two students to mention the 5 subjects they like. The following are the results of the two students who mentioned the subjects they liked

Name	Preferred Subjects
Andi	Mathematics, Religion, Bahasa Indonesia, IPS, Sports
Bunga	Bro. Indonesia, Mathematics, English, Sports, Science

c. The teacher asks students what category is right for Andi, and interest? Then what categories are right for Mathematics, Religion, Bahasa Indonesia, Social Sciences, Sports, Science, English?

Possible 1:

Students cannot state the set of names and set of subjects.

Possible 2:

Students can declare a set of names that is

• Andi and the set of subjects namely {Mathematics, Religion, Bahasa Indonesia, IPS, Sports}.

• Interest and set of subjects, namely {Indonesian, Mathematics, English, English, Sports, Science}

Possible 3:

Students cannot express Andi's relationship with Mathematics, Religion, Bahasa Indonesia, IPS, Sports.

Possible 4:

Students can express Andi's relationship with Mathematics, Religion, Bahasa Indonesia, Social Sciences, Sports are subjects that are liked.

Possible 5:

Students can declare a set of names that is

• Andi and the subject set are {Mathematics, Religion, Indonesian, Social Sciences, Sports}.

• Interest and set of subjects namely Indonesian, Mathematics, English, English, Sports}

• Andi and Bunga have a set of preferred subjects namely {mathematics, religion, Indo, social studies, sports, Bhs English}

Possible 6:

A = {Mathematics, Religion, Indonesian, Social Sciences, Sports}

B = {Indonesian, Mathematics, English, Sports}

Possible 7:

A = {Mathematics, Religion, Indonesian, Social Sciences, Sports}

B = {Indonesian, Mathematics, English, Sports}

C = {Mathematics, Religion, Bahasa Indonesia, Social Studies, Sports, English}

3. Phase 3: Guiding individual and group investigations

a. The teacher goes around to monitor the process of solving the problems carried out by each group by going around in the classroom and having dialogue with students.

b. The teacher asks questions that can stimulate students to solve student answers, for example:

1) The teacher asks students what category is right for Andi, and interest? Then what categories are right for Mathematics, Religion, Bahasa Indonesia, Social Sciences, Sports, Science, English. If students have answered "name" and "preferred subject", then further guide the students to write the names and subjects with a comma (,) separator. After that, guide students to add curly brackets at the beginning and end of the category. When students finish writing, the teacher asks students how to read it? The answers expected by the teacher (according to possibility 2) are: "the set of names is Andi and Flowers while the set of subjects that are preferred are Indonesian, Mathematics, English, Sports, Science"

2) The teacher asks students what is Andi's relationship with Mathematics, Religion, Indonesian, Social Sciences, Sports? What is the relationship between Flowers and Bahasa Indonesia, Mathematics, English, English, Sports, Science? The teacher's expected answer is "preferred subject" according to the Possibility 4.

3) The teacher gives questions like the following: can you write a new set of members whose members are Andi and Bunga's favorite subjects? The answer given by the teacher is according to possibility 5.

4) The teacher continues the question again so that students can write with the symbols of the set by specifying the name of the set? The answer that the teacher expects is according to Possibility 6.

5) The teacher gives support to students like the following: try to check the members of set A and set B, take the first element of A then match the members of set B. If there is the same, delete the element from set A. If there is no equal go to the next element. Repeat the process for the second element, third until all elements C have been matched. All elements of set A are added with the remainder of set elements B is a combination of set A with set C. The

answer given by the teacher is according to possibility 7. In addition, the teacher can also show students what is a symbol of “combination”. Then the teacher gives stimuli to students so that they can define the combination according to students' language which is easy to understand.

4. Phase 4: Developing and Presenting Works

a. The teacher checks students’ understanding by asking.
b. The teacher gives appreciation to students because they have understood the problem correctly, that is, can mention what is known and asked about the problem given.
c. The teacher gives appreciation to students for writing down the problem-solving plan according to what they understand from the purpose of the problem. Then the teacher gives motivation to students to continue the next step according to the plan that has been made by the students.

5. Phase 5: Analyzing and Evaluating the Problem-Solving Process

a. The teacher helps students to reflect or evaluate their investigations and the processes they are working on.
b. The teacher directs students to conclude the material they have learned.
c. Students can conclude the material that has been studied along with teacher interaction, namely: Combined set A and B is a set whose members consist of members of set A or members of set B. It is denoted by A ∪ B

Description of Students' Problem Solving Abilities

The researcher gives a problem to find out students’ problem solving abilities related to slices and combinations that have been studied before. The results of solving student problems are as follows:

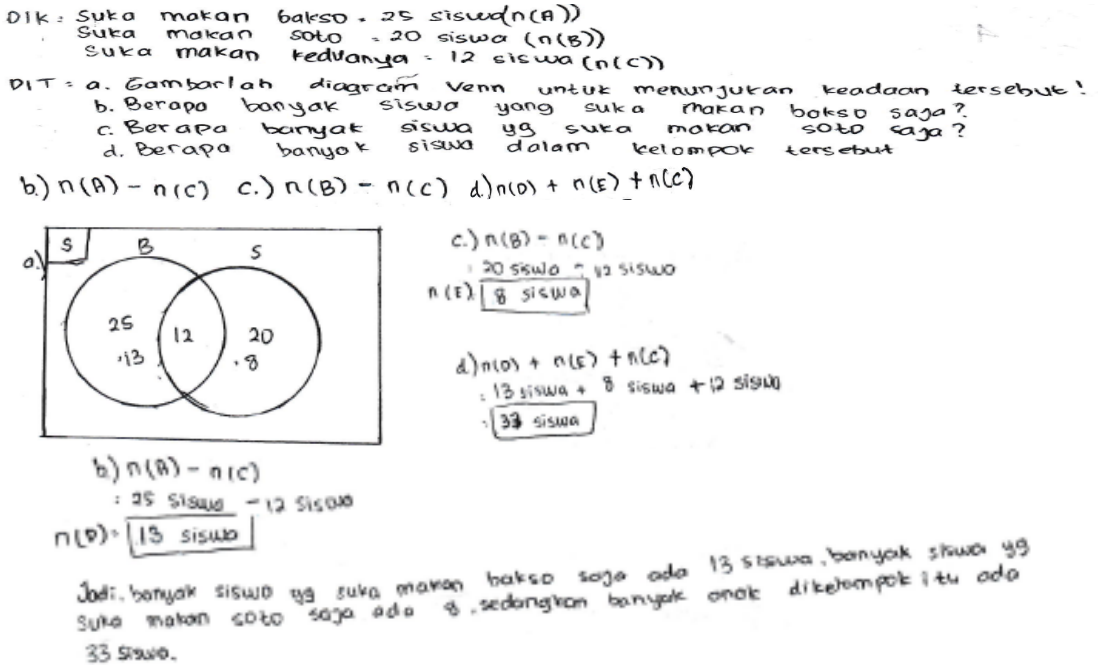

Figure 1. Picture of Student Work Results 1 (S1)

It appears that S1 has understood the problem, writing down what is known and asked about the Puestion. In writing what is known, S1 symbolizes many students who like to eat meatballs, namely n(A), many students who like to eat soup are n(B) and many students like to eat both namely n(C). S1

also writes down what was asked of the problem. The following is an excerpt from an interview with S1:

P: From question number 1, what is known?

S1: There are those who like to eat meatballs, namely 25 students who are given n (A), those who like to eat soto are 20 which are represented by n (B) and like both 12 are raised with n (C).

P: What are the questions about number 1?

S1: Students read what has been written on the answer sheet.

P: Try to retell the meaning of question number 1!

S1: Find out how many students like to eat meatballs only, students who like to eat soup and how many students are in the class.

In planning problems, S1 uses mathematical symbols to solve the problem. S1 can plan completion by using the concept of operating slices of two sets. The following is an excerpt from an interview with S1:

P: What concept is used to solve the problem?

S1: Use the concept of slice operation.

Based on the results of the S1 answer, for point (a) it can be seen that S1 describes the Venn diagram correctly. S1 describes the Venn diagram with two sets which are given information from meatballs (B) and soto (S). In diagram (B), S1 writes in Venn diagrams (B) 25 and 13, in the S diagram, S1 writes 20 and 8 and in the middle circle, S1 writes 12.

After describing the Venn diagram, S1 determines how many students only like meatballs which are assumed to be n (D) in point (b) according to the plan that has been done before, namely reducing the number of students who like meatball n(A) with the number of students who like both n(C) as follows 25-12 = 13 students. Next to answer point (c), namely the number of students who only like soto n(E) is the number of students who like soto n(B) is reduced by the number of students who like both n(C) as follows 20-12 = 8 students. Then to calculate how many students in the group, S1 sums up the number of students who only like meatball n(D), the number of students only likes soto n(E) and the number of students who like both n(C) that is 13 + 8 + 12 = 33 students.

S1 can also conclude the results of his work, by writing the number of students who like meatballs alone are 13 students, who like Soto only are 8 students and many students in the group are 33 students. This is reinforced by interviews with S1 as follows:

P: Try to explain how you solve problem number 1?

S1: For a, draw a Venn diagram, so there are two sets of fruit circles, namely 25 students like Soto, 20 students who like meatballs and 12 students in the middle.

P: In circle B there are 25 and 13 what does it show?

S1: So 25 are students who like to eat meatballs, 13 are students who only like to eat meatballs.

P: What is 12, what is 8?

S1: 12 is a student who likes to eat both. 8 it is students who only like to eat soup.

P: What is 12 from B and S?

S1: Is a slice.

P: For point b?

S1: n (A) likes to eat meatballs, which n (C) likes both. So n (A) -n (C) = 25 students-12 students = 13 students that I compared n (D) as students who only like meatballs.

P: For point c?

S1: n (B) likes to eat meatballs, which n (C) likes both. So n (B) -n (C) = 20 students-12 students = 8 students that I compared n (E) as students who only like meatballs.

P: Which one?

S1: That is right, asking how many students in the group. many students in the group mean n (D) as many students who only like soto are summed with n (E) as many students only like soto and n (C) as many students like both. So 13 students + 8 students + 12 students = 33 students.
P: From number 1, are you sure the answer is correct?
S1: Yes sir.
P: Where are you sure the answer is correct?
S1: I tested it by summing students who only like to eat meatballs with 13 with 12 being 25 students who like meatballs. Students who only like to eat soto are 8 and add up to 13 so there are 20 students who like to eat soup. When counting all students in the group, the number of students who only like meatballs is summed, students who only like soto and students who like both are seen from the venn diagram that has been described.
P: What are the conclusions
S1: So there are 13 students who only like to eat meatballs, there are 8 students who only like to eat soto, there are 8 students, while there are 33 students in that group.

Based on the results of student answers and S1 interviews, it is concluded that, S1 already has problem solving skills in solving problems in daily life related to set operations (intersection and union) of two sets, **namely understanding the problem**, things This is indicated by the ability of the S1 to identify the adequacy of the data to solve the problem by mentioning the information provided from the questions asked, namely the elements known from the questions and what was asked from the questions. **Devising a plan**, this is indicated by the ability of the subject to make a mathematical model of the problem given. S1 has a plan for solving the method by showing that to solve the problem one method of resolution will be chosen. **Carrying out the plan**, S1 is able to plan problem solving by showing the steps to solve the problem using the chosen strategy that is the operation of two sets of pieces so that the resolution of the problem is 13 students, who just like Soto is 8 students and many students in the group are 33 students. **Looking back**, S1 is able to re-examine the truth of the conclusions obtained by showing how to check the correctness of the answer, namely reexamining the value obtained at the conclusion.

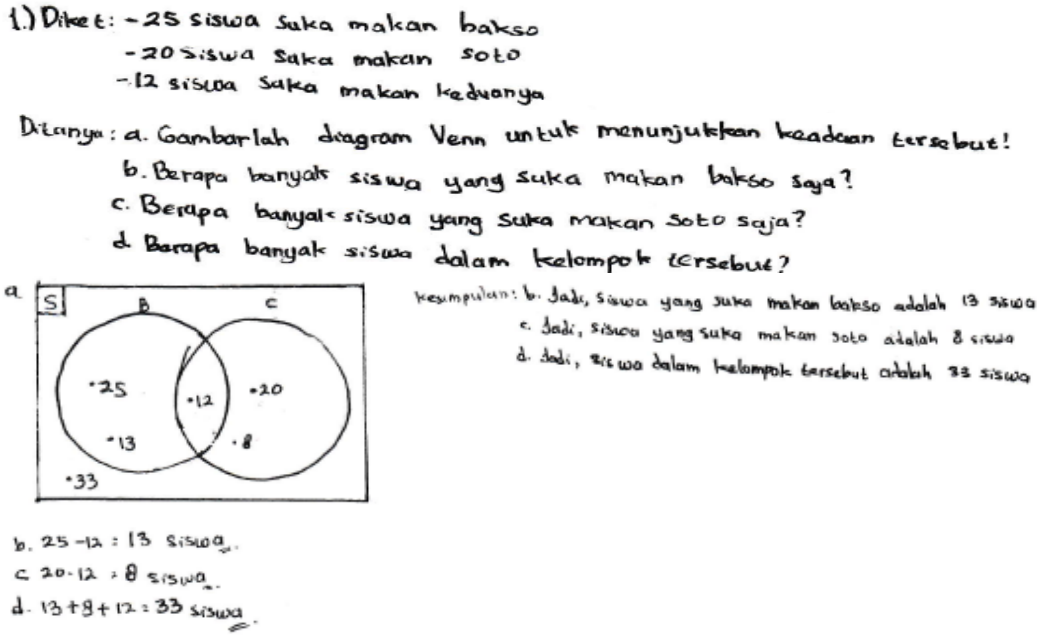

Figure 2. Pictures of Student Work Results 2 (S2)

It appears that S2 has understood the problem, writing down what is known and asked about the Puestion. But in writing what is asked, S2 does not write sentences into the formal form of mathematics, which is a symbol of the number of sets of problems. The following is an excerpt from the interview with S2:

P: From question number 1, what is known?
S2: While reading the questions, students 25 students like to eat meatballs, 20 students like to eat soup and 12 students like to eat meatballs and soup.
P: What are the questions about number 1?
S2: Students read questions
P: Try to retell the meaning of question number 1!
S2: How to draw a Venn diagram, determine the sets of students who like to eat meatballs only, like to eat soup and how many students in the group.
P: What concept is used to solve the problem?
S2: Using the slice concept.

Based on the results of the S2 answer, for point (a) it appears that S2 describes the Venn diagram correctly. S2 describes the Venn diagram with two sets which are given information from meatballs (B) and soto (C) and write 25 and 13. In the set diagram B and in the set diagram C, S2 writes 20 and 8, while 12 is the slice of the two sets that is the number of students who like both.

After describing the Venn diagram, S2 determines how many students only like meatballs in point (b), which is to reduce the number of students who like meatballs with the number of students who like both as follows: 25-12 = 13 students. Next to answer point (c), namely the number of students who only like Soto is that the number of students who like Soto is reduced by the number of students who like both as follows: 20-12 = 8 students. Then to calculate how many students in the group, S2 sums up the number of students who only like meatballs, the number of students who only like Soto and the number of students who like both are 13 + 8 + 12 = 33 students.
S2 can also conclude the results of his work, by writing the number of students who only like meatballs are 13 students, who only like Soto are 8 students and many students in the group are 33 students. This was confirmed by interviews with S2 as follows:

P: Can you explain how you solve problem number 1?
S2: For a, draw the Venn diagram first, there are two sets, 25 students like meatballs, 20 students like meatballs and 12 students in the middle.
P: There you have written 25 and 13, what do you mean?
S2: 25 students who like to eat meatballs and 13 I reduce by those who like both. It's the same with 20 and 8, sir (while showing Venn diagram).
P: What does 13 show?
S2: 13 shows that there are many students who only like meatballs and there are many students who only like soup.
P: How do you complete point b?
S2: Students who only like meatballs are reduced by students who like both 25-12 = 13 students (while pointing to the answer).
P: For point c? How to?
S2: It's the same as the one, sir.
P: How do you do it?

S2: Students who like soto are reduced by students who like both, namely 20-12 = 8 students. And for c, students in that group, I add from students who only like meatballs, students who only like soto and students who like both are 13 + 8 + 12 = 33 students.
P: From answer number 1, is that correct?
S2: Yes sir.
P: Where are you sure the answer is correct?
S2: I have seen what was known and what was asked, the process of counting and then I wrote the conclusion, sir (while pointing to the results of the work).
P: Is there another way to prove this number 1 answer?
S2: So students who only like to eat meatballs are summed with 12 to 25 students who like meatballs. Students who only like to eat soto are 8 and add up to 13 so there are 20 students who like to eat soup. It was summed up, which only likes to eat meatballs, soto and like both the results, 33 students were all in the group.

Based on the results of student answers and S2 interviews, it was concluded that, S2 already has problem solving skills in solving problems in daily life related to set operations (intersection and union) of two sets, namely understanding the problem, things This is indicated by the ability of the S2 to identify the adequacy of the data to solve the problem by mentioning the information provided from the questions asked, namely the elements known from the questions and what was asked from the questions. Planning deviing a plan, this is indicated by the ability of S2 to use the concept of operating slices of two sets to solve the problem. Carrying out the plan, S2 was able to do a problem solving plan by showing the steps to solve the problem using the chosen strategy, namely the operation of two sets so that the completion of the problem was 13 students, who just like Soto is 8 students and many students in the group are 33 students. Looking back, the S2 is able to re-examine the truth of the conclusions obtained by showing how to check the truth of the answer, namely reexamining the value obtained at the conclusion.

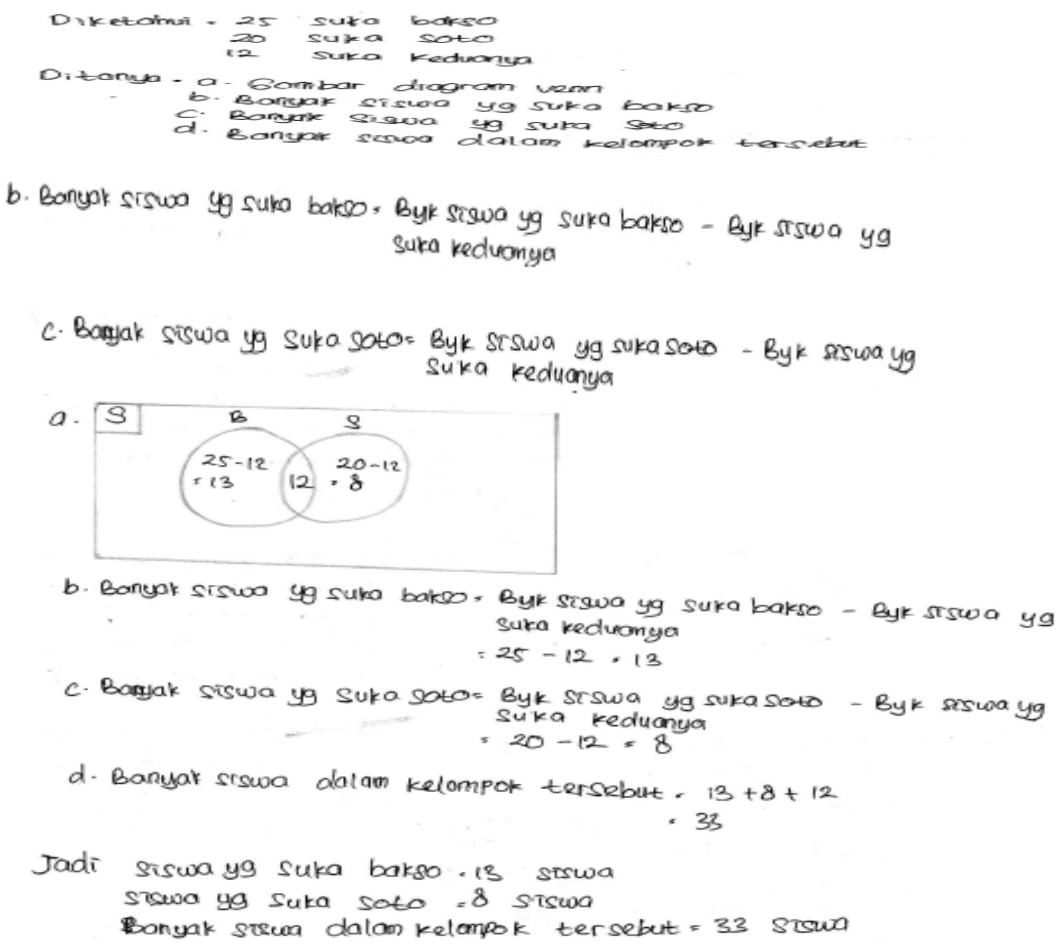

Figure 3. Pictures of Job Results for Students 3 (S3)

It appears that S3 has understood the problem, by writing down what is known and asked about the question. But in writing what is asked, the S3 does not write sentences into the formal form of mathematics, which is a symbol of the number of sets of problems. The following is an excerpt from an interview with S3:

P: From question number 1, what is known?

S3: While reading the questions, students 25 students like to eat meatballs, 20 students like to eat soup and 12 students like to eat meatballs and soup.

P: What are the questions about number 1?

S3: students read questions

P: Try to retell the meaning of question number 1!

S3: How to draw a Venn diagram, determine the sets of students who like to eat meatballs only, like to eat soup and how many students in the group.

In planning problems, S3 does not use mathematical symbols but uses words to solve problems. But based on interviews with S3, S3 can use the solution to use the concept of operating slices of two sets.

P: What concept is used to solve the problem?

S3: Using the slice concept.

Based on the results of the S3 answer, for point (a) it appears that S3 describes the Venn diagram correctly. S3 describes the Venn diagram with two sets which are given information from meatballs (B) and soto (S). In the set diagram B, S3 writes 25-12 = 13 which is the number of students who only like meatballs, in the S diagram, S3 writes 20-13 = 8 which is the number of students who only like soto, while 12 is the slice of the two sets which is the number of students who like both.

After describing the Venn diagram, S3 determines how many students only like meatballs in point (b), which is to reduce the number of students who like meatballs with the number of students who like both as follows: 25-12 = 13 students. Next to answer point (c), namely the number of students who only like Soto is that the number of students who like Soto is reduced by the number of students who like both as follows: 20-12 = 8 students. Then to calculate how many students in the group, S3 sums up the number of students who only like meatballs, the number of students who only like Soto and the number of students who like both are 13 + 8 + 12 = 33 students.
S3 can also conclude the results of his work, by writing down the number of students who only like meatballs are 13 students, who only like Soto are 8 students and many students in the group are 33 students. This is reinforced by interviews with S3 as follows:

P: Can you explain how you solve problem number 1?
S3: For a, draw the Venn diagram first, there are two sets, 25 students like meatballs, 20 students like meatballs and 12 students in the middle.
P: There you have written 25 and 13, what do you mean?
S3: 25 students who like to eat meatballs and 13 that I reduce by those who like both. It's the same with 20 and 8, sir (while showing Venn diagram).
P: What does 13 show?
S3: 13 shows that there are many students who only like meatballs and there are many students who only like soup.
P: How do you complete point b?
S3: Students who only like meatballs are reduced by students who like both 25-12 = 13 students (while pointing to the answer).
P: For point c? How to?
S3: It's the same as the one, sir.
P: How do you do it?
S3: Students who like soto are reduced by students who like both, namely 20-12 = 8 students. And for c, students in that group, I add from students who only like meatballs, students who only like soto and students who like both are 13 + 8 + 12 = 33 students.
P: From answer number 1, is that correct?
S3: Yes sir.
P: Where are you sure the answer is correct?
S3: I tested it by summing students who only like to eat meatballs with 13 with 12 being 25 students who like meatballs. Students who only like to eat soto are 8 and add up to 13 so there are 20 students who like to eat soup. When counting all students in the group, the number of students who only like meatballs is summed, students who only like soto and students who like both are seen from the venn diagram that has been described.

Based on the results of student answers and S3 interviews, it is concluded that, S3 already has the ability to solve problems in solving problems in daily life related to the set operation (intersection and union) of two sets, namely understanding the problem, things This is indicated by the ability of the S3 to identify the adequacy of the data to solve the problem by mentioning the information provided from

the questions asked, namely the elements known from the questions and what was asked from the questions. Planning devising a plan, this is indicated by the ability of S3 to use the concept of operating slices of two sets to solve problems. Carrying out the plan), S3 was able to do problem solving plan by showing the steps to solve the problem using the chosen strategy, namely the operation of two sets of pieces so that the resolution of the problem was 13 students, who just like Soto is 8 students and many students in the group are 33 students. Looking back, S3 is able to re-examine the truth of the conclusions obtained by showing how to check the truth of the answer that is reexamining the value obtained at the conclusion.

Conclusion

The results showed that: 1) learning trajectory with the PBL model as follows: (a) The researcher conveys the learning objectives so that students can set strategies to solve problems according to the learning objectives and the researcher gives real problems verbally with context in the class about set operations joint); (b) Researchers form students in groups and provide problems related to set operating material (intersection and union); (c) Next the researcher accompanies students; (d) After students have finished solving the problem, then presented (e) Then the researcher and students evaluate the problem solving process by students. (f) Next the researcher gives a problem related to the real problem related to the material of the set operation (intersection and union) based on the results of the description and interview with students, students are able to construct their knowledge in solving problems.

REFERENCES

Plomp, T. (2007). Educational design research: An introduction. In T. Plomp & N. Nieveen (Eds.), *Educational Design Research*. Enschede, Netherlands: National Institute for Curriculum Development.

Setyorini, U., Sukiswo, S. E., & Subali, B. (2011). Penerapan model problem based learning untuk meningkatkan kemampuan berpikir kritis siswa SMP. *Jurnal Pendidikan Fisika Indonesia, 7*(1), 52-56.

Shadiq, F. (2009). *Kemahiran matematika*. Paper presented at diklat instruktur pengembangan matematika SMA jenjang lanjut. PPPG Yogyakarta.

Sugiyono. (2008). *Metode penelitian kuantitatif, kualitatif, dan R & D*. Bandung: Alfabeta.

Trianto. (2007). *Pengembangan perangkat dalam teori dan praktek*. Surabaya: Prestasi Pustaka.

Van den Akker, J., Gravemeijer, K., & McKenney, S. (2006). Introducing educational design research. In J. Van den Akker, K. Gravemeijer, S. McKenney, & N. Nieveen (Eds.), *Educational design research* (pp. 15-19). New York: Routledge.

Wardhani, S. (2010). *Implikasi karakteristik matematika dalam pencapaian tujuan mata pelajaran Matematika di SMP/MTs*. Yogyakarta: Departemen Pendidikan Nasional PPPPTK.