# Development of Problem-Based Mathematical Learning Device on Problem Based Learning (PBL) Models by Using GeoGebra Aids to Improve the Problem Solving Skill of the Students in VIII Class of Junior High School (Preliminary Research)

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**ABSTRACT**

Students' low ability in mathematical problem solving can still be found by the researcher in the field. This can be seen in the implementation of learning at school, students are not get used to solved the problem appropriately. Some problem solving indicators are not found during students solved the problem. Students' mathematical learning ability can be improved by using learning device based on PBL by using GeoGebra aids. The purpose of this research is to reveal the process and the result of PBL learning device development by using GeoGebra aids in improving students' mathematical problem solving skill. GeoGebra is software aimed to solve mathematics problem. One of them is to create graphic. This is a development research. The research model is Plomp model which consists of three phases, namely, preliminary research, development or prototyping phase, and assessment phase. In this part, the researchers only discuss about preliminary research. Researchers employ some instruments such as: student questionnaire, teacher interview guideline, field note, and preliminary test question sheet. Data analysis result shows that 1) students' mathematical problem solving is still low, 2) LKPD used by the students has yet be able to facilitate them to improve their problem solving skill, 3) students' are less engaged in the learning process, 4) students like LKPD that is easy to understand, has color, and has clear pictures.

***Keywords*** *- Problem Based Learning (PBL), GeoGebra, Mathematical problem solving skill*

## 1. INTRODUCTION

Mathematics is a science which plays vital importance role in the development of science itself. Mathematics is able to educate human being to think logically, critically, systematically, thoroughly, and is able to develop creativity. In its learning, mathematics has concept that is related from one another, this is due to in order to master a new concept in mathematics, students have to first understand the other concept related with the material being learned. In addition, mathematics is inseparable from other problems in daily life.

Problem solving skill is an ability that must be possessed by student as a standard that has to be developed in mathematics learning. It is due to in problem solving, students are actually obtaining new experience in using their knowledge and skill to be implemented in a non routine problem solving.

In fact, students' mathematical problem solving skill has optimal yet. This is supported by some national research conducted by Fimatesa Windari (2014), Siti Mawaddah (2015), Tina Sri Sumartini (2016), Wahyu Hidayat (2018) and Yerizon (2013) and international level research conducted by Siska Putri Permata, et.al (2018), Thuy (2017), Wadelin (2014), Yuliasari (2017) and Zulfah (2017). The research results revealed that students' mathematical problem solving skill is still low.

Below is the answer given by the student, as can be seen in the following Figure 1.

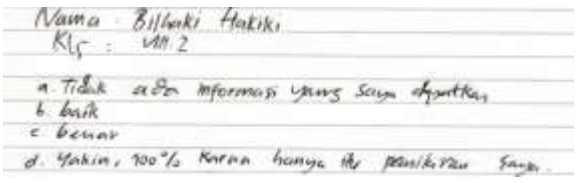


Figure 1. Sample of student's answer

 

Figure 1 shows that student is not able to elaborate the given information and is not able to spell out what is asked on the question given; hence the student write directly that there is no any given information from the question. Meanwhile, in the solving plan, student writes one word only that is true or false. In fact, the instruction on the question is to provide steps in problem solving and how to solve the problem.

The result of Middle Term Test in SMP IT Budi Mulia Padang revealed numerous students whose score is under the KKM. This can be seen on Table 1.

Table 1. Middle Term Test Completeness Percentage of Semester II Class VIII in SMP IT Budi Mulia Padang, Academic Year 2018/2019

| Class | Number of Student | Completeness Percentage (%) |
|---|---|---|
| VIII.2 | 24 | 42 |
| VIII.3 | 27 | 26 |

Source: Mathematics Teacher of Class VIII in SMP IT Budi Mulia Padang

Meanwhile the score percentage of students who answer question of problem solving skill of each indicator can be seen on Table 2.

Table 2. Percentage of Problem Solving Test Result of Class VIII in SMP IT Budi Mulia Padang, Academic Year 2018/2019

| Class | Indicator | Students' Answer Percentage Per Score | | | |
|---|---|---|---|---|---|
| | | 0 | 1 | 2 | 3 |
| VIII.2 | Identifying the given elements and asked elements (understanding problem) | 39% | 10% | 11% | 60% |
| VIII.3 | | 16% | 25% | 13% | 25% |
| VIII.2 | Problem Solving Planning | 11% | 33% | 27% | 3% |
| VIII.3 | | 27% | 46% | 32% | 11% |
| VIII.2 | Solving problem | 18% | 27% | 32% | 10% |
| VIII.3 | | 27% | 3% | 37% | 40% |
| VIII.2 | Draw Conclusion | 21% | 40% | 13% | 13% |
| VIII.3 | | 43% | 43% | 11% | 25% |
| **Score Average** | | 25% | 28% | 22% | 23% |

Table 1 and table 2 show that students problem solving skill need to be improved. In fact, it is not that easy to improve students' mathematical problem solving skill due to numerous problems encountered in learning process. This is supported by interview result with some teachers which shows that students are less interested in the learning process, teacher found it difficult to motivate students to be more active in learning. Most students tend to pay less attention to teacher explanation. In examining the test, teacher also experience difficulties due to students pay less attention to the test given, as the effect their score is very low. Moreover, remedial test revealed that students experience almost no progress; even sometime their score is lower than the previous one.

This can be seen when students are working on the exercise. Students tend to poke their classmates, scribbling on books or tables, banging on tables, in and out of class, move from one to another bench, inviting other friends to chat with; even the far distance friend to chat with. Students tend to do those all rather than to work on the exercise as instructed by teacher.

Researcher also observing teacher during 5 minutes quiz, where students looks very calm in doing the quiz. However, there are only some students who are actually working on that quiz. This is due to the students tending to be quiet rather than to ask on teacher explanation. Teacher provides opportunity for them to ask whenever it is hard to understand. In addition, students find it confusing when teacher asks a little bit different question to them.

The previous research conducted by Barlenti (2017) and Iqbal (2017) revealed that the less optimum of Lesson Plan (RPP) and Student worksheet (LKPD) preparation are the cause to the less effective learning. This problem needs to be solved in order to improve the students' problem solving skill.

One way to improve students' mathematical problem solving skill is by using learning device based on Problem Based Learning (PBL) with GeoGebra aids. PBL is a learning process started with a problem related to daily life situation. Through a given problem to the students, they will be guided then to learn a problem based on new knowledge and experience. Duch in Sumartini, 2016 defined that PBL is a learning approach with real life problem as its characteristics to provide context for students to think critically, to possess the problem solving skill as to obtain knowledge about learning material.

The previous researcher who had employed this PBL model was Sumartini (2016) in which the research result revealed that students' with PBL experiencing a better improvement in mathematical problem solving skill in comparison to those with conventional learning.

Meanwhile, research conducted by Fatimah (2012), Kodrayati and Budi (2016), Yerizon (2013), Yuliasari (2017) and Yustianingsih (2017) concluded that PBL model can improve students' mathematical problem solving skill. This is in line with research conducted by Nida Aisyah (2016) and Dhia Octariani and Isnaini Halimah Rambe (2018) which also concluded that PBL with GeoGebra aids is able to improve students' mathematical problem solving skill.

Amongst the advantage of PBL model are students understand the content of the learning, students discover noble idea, students' mathematical thinking skill can be developed such as problem solving ability, and students are also given opportunity to implement their knowledge in real life. Therefore, this PBL model is appropriate to be developed by teacher.

Times are shifting rapidly, particularly Information and Communication Technology (ICT) also known as TIK development. Being able to use ICT is an advantage for learning by the presence of wide range of information, fast, appropriate, and providing easy access in the learning process. In order to improve education quality, ICT can be used as learning device to help to reduce difficulties in learning mathematics.

One of the software that can be developed as mathematics learning device is GeoGebra. In 2001, this software had developed by Markus Hohenwarter and it is free. GeoGebra can help students to strengthen the correct answer on the exercise in LKPD. In line with previous research conducted by Ibnu (2015), GeoGebra can be used to improve user learning result. This is also in line with Umi (2015) who stated that students' learning result by using GeoGebra interactive program on a straight line of equation graph learning is better than students without this GeoGebra interactive program. In improving students' learning activity, Aija Cunska and Inga Savicka (2012) spelled out the advantage of ICT as the learning that is presenting in the contemporary way in order to motivate students to learn, and to help students to understand the concept, and to finally do the task given.

PBL stages employed in this research are students' orientation on problem, to organize students to learn, to guide students investigation for both group and individual, to develop and to present scientific work, to analyze, and to evaluate problem solving process.

## 2. MATERIALS AND METHODS

Research model in this study is Plomp model. One to one stage, small group and field test are amongst the advantage of this research model in test a product practicality. This research is to develop a product in the form of student worksheet (LKPD) and Lesson Plan (RPP) based on PBL by using GeoGebra aids in order to improve students' mathematical problem solving skill of class VIII SMP. The developed learning device has to be valid, practical, and effective.

Plomp model consists of three phases, namely, preliminary research, development or prototyping phase, and assessment phase. Preliminary research is to conduct three activities; needs analysis, student analysis, curriculum analysis, and concept analysis. After all those three activities implemented, it is then to conduct development or prototyping phase which is to make or to develop learning device that will be tried out and revised in both self evaluation and expert review. The result in this stage then will be continued to the next phase, assessment phase that is to assess the practicality and effectiveness of developed learning device.

## 3. RESULT AND DISCUSSION

There are many analysis activities in the preliminary research stage which is aimed to reveal the problems in the learning process and to reveal the requirements of the learning device that will be developed toward students of Class VIII SMP. This preliminary research stage consists of:

a. Needs Analysis

In this needs analysis, information is obtained through teacher interview guideline, and preliminary test question sheet. The interview with teacher revealed that students seems confuse when given different kind of question comparing to what has explained by teacher previously, take as an example, students was given story type question related with real life situation enriched with problem solving indicator, students end up failing to solve it.

One of the students' failures is at indicator which consists of what information is given in the question in which they are not able to solve it. It can be concluded that their mathematical problem solving skill is still low.

It took longer than the lesson plan time setting since students need more time to relearn the learning material. It can be said that students' mathematical problem solving skill is still low. Printed learning book and LKPD are learning resources used. LKPD used is not designed by teachers themselves, but LKPD from the market. Teachers are expecting that LKPD will consist of steps to guide the students to be able to solve non routine problem and to improve their mathematical problem solving skill.

Based on the observation result, researcher found out that students are less engaged during learning process. If they find it difficult to understand the learning material, they tend to keep silent rather than ask their teacher to explain the learning material again. They tend to ask their peer, even though teacher has provided opportunity for them to ask.

The questionnaire distributed to the students revealed that students still think that mathematics is a difficult and boring lesson. However, they do understand that in fact mathematics has a lot of advantage in their real life. They are not asking actively to their teacher, but rather asking their peer on a difficult learning material. They find it hard to understand the question in LKPD. They think that LKPD has unclear pictures and less interesting. During

learning process, students are not asking actively to their teacher.

b. Student Analysis

Student analysis is to reveal students' characteristics, students' academic capacity, students' environment, students' learning preference, and expected LKPD also its color preference.

Students of a classroom are in great variety in terms of their academic capacity, some are high level ability students, some are middle level ability students, and the rest are low level ability students. They also have different learning styles. Some students like to learn again at home. Some students are in contrast.

Students love to work in group. They prefer LKPD with pictures, interesting color, the same size like usual, and easy to digest. Most students like blue.

c. Curriculum Analysis

Curriculum analysis is implemented on linear equation of two variables. In this phase, there is no change on Basic Competence (KD) and Achievement Indicator as used by the school.

d. Concept Analysis

After implementing concept analysis based on 2013 curriculum on learning material of class VIII in the odd semester which consists of number pattern, coordinate function, straight line equation and a two variable linear equation system. Two variable equations system material was selected as the developed learning device.

Based on the problems encountered in the field, it can be concluded that students need learning device to improve their mathematical problem solving skill. The learning device that will be designed refers to the result of needs analysis, student analysis, curriculum analysis, and concept analysis. The learning device will be designed based on the characteristics of PBL.

## 4. CONCLUSION

Based on the result of discussion and research, it can be concluded that:

1) Students' mathematical problem solving skill is still low
2) LKPD used by the students are not able yet to facilitate students to improve their problem solving skill
3) Students are less engaged in the learning process
4) Students prefer to have LKPD that is easy to understand, has color, and has clear pictures.

It is expected that the developed learning device based on PBL by using GeoGebra aids will result in students take an active part in the learning process as to improve their mathematical problem solving skill.

## REFERENCES

[1] Aija Cunska, Inga Savicka. 2012. Use of ICT teaching-learning methods make school math blossom. Procedia Social and Behavioral Sciences 69 (2012) 1481 – 1488.

[2] Aisyah, Nida. 2016. Pengaruh Model Problem Based Learning Berbantuan Software Geogebra Terhadap Kemampuan Pemecahan Masalah Matematika. JKPM, Vol.01, No.02, 01 Jun 2016, hlm. 159–168.

[3] Arnawa I M, Yerizon, Nita S and Putra R T. 2019. Int J.Sci. Tech Res. 8 287-292.

[4] Barlenti, I. 2017. Pengembangan LKS Berbasis Project Based Learning untuk Meningkatkan Pemahaman Konsep. (Jurnal), (http://www.jurnal.unsyiah.ac.id, 12 Februari 2019).

[5] Farihah, Umi. 2015. Pengaruh Program Interaktif Geogebra pada Materi grafik persamaan garis lurus. Jurnal Pendidikan dan Pembejaran Matematika. Volume 1, no 1.

[6] Fazar, Ibnu. 2015. Pemanfaatan Aplikasi Geogebra Dalam Kegiatan Pembelajaran Matematika Di Sekolah Menengah Atas. Prosiding Seminar Nasional Pendidikan Matematika (SNAPTIKA). Palembang.

[7] Iqbal, M. 2017. Pengembangan lembar kerja peserta didik (LKPD) dengan Pendekatan Kontekstual Ditinjau Dari Pemahaman Konsep dan Disposisi Matematis.(Jurnal),(http://digilib.unila.ac.id, 13 Februari 2019).

[8] Kodrayati, Laila dan Budi Astuti. 2016. Pengaruh Model PBL terhadap Kemampuan Komunikasi dan Kemampuan Pemecahan Masalah Matematika Kelas V SD. Jurnal Prima Edukasia, Print ISSN: 2338-4743, Online ISSN: 2460-9927.

[9] Mawaddah, Siti dan Hana Anisah. 2015. Kemampuan Pemecahan Masalah Matematis Siswa pada Pembelajaran Matematika dengan Menggunakan Model Pembelajaran Generatif (Generative Learning) di SMP. EDU-MAT Jurnal Pendidikan Matematika, Volume 3, Nomor 2.

[10] Octariani, D & Rambe, Isnaini Halimah. 2018. Pengembangan Bahan Ajar Berbasis Project Based Learning Berbantuan Software Geogebra. MES (Journal of Mathematics Education and Science). Vol. 4, No. 1. ISSN: 2579-6550 (online).

[11] Siska Putri Permata, et.al. 2018. Development of Learning Instrument Based on Problem Based Learning (PBL) for Improving the Mathematical Problem Solving Ability of Class VII Junior High

School. Universitas Negeri Padang https://dx.doi.org/10.2991/icm2e-18.2018.69.

[12] Sumartini, T.S. 2016. Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa

melalui Pembelajaran Berbasis Masalah. Jurnal "Mosharafa", Volume 5, Nomor 2 ISSN 2086 4280.

[13] Thuy, Phi Van. 2017. Developing Students' Metacognitive Skills In Mathematics Classroom. Vietnam: Anale. Seria Informatică. Vol. XV fasc. 1 – 2017.

[14] Wadelin, D. 2014. Teaching Mathematical Modelling and Problem Solving- A Cognitive Apprecisenship Approach to Mathematics and Engineering Education. Sweden JEP – Volume 4, Issue 5, Special Issue: "CISPEE".

[15] Windari, Fimatesa. 2014. Meningkatkan Kemampuan Pemecahan Masalah Matematika Siswa Kelas VIII SMPN 8 Padang Tahun Pelajaran 2013/2014 dengan Menggunakan Pembelajaran Inkuiri. Jurnal Pendidikan Matematika Vol. 3 No. 2.

[16] Yerizon. 2013. Student Responses Toward Student Worksheets Based on Discovery Learning for Students with Intrapersonal Intelligence. Universitas Negeri Padang doi:10.1088/1757899X/335/1/01213.

[17] Yustianingsih, Rizza. 2017. Pengembangan Perangkat Pembelajaran Berbasis Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Peserta Didik Kelas VIII. Jurnal Nasional Pendidikan Matematika ISSN 2549-4937.