ABDIMPACT
ABDIMPACT: Journal of Community Service and Impact

# The Effectiveness of Using Problem-Based Learning-Based LKPD to Improve Students' Mathematical Problem- Solving Skills

**Lalu Ajimuliardi Akbar [1*)] Lalu Indar Anggara Putra[2)]**
**Universitas Qamarul Huda Badaruddin Bagu [1,2)]**

**Abstract**

*This study aims to determine the effectiveness of using Problem Based Learning (PBL) worksheets (LKPD) to enhance problem-solving skills in solid geometry. This research is categorized as Research and Development (R&D) utilizing the ADDIE development model, which includes the steps: Analyze, Design, Development, Implementation, and Evaluation. The subjects of this study were 26 eighth-grade students from one class at SMP Muhammadiyah Pakem, serving as the experimental group. Data collection techniques used in this study included validation sheets, mathematics problem-solving tests, and student response questionnaires. The effectiveness of the PBL-based LKPD was assessed by examining the correlation value from the paired sample t-test results. The correlation value was found to be 0.837, indicating a high category. These findings suggest a significant impact of the PBL-based LKPD on the experimental class, demonstrating its effectiveness in improving students' problem-solving skills.*

**Keywords**
Problem-Based Learning, worksheets (LKPD), problem-solving skills, geometry.

## INTRODUCTION

Geometry is a branch of mathematics that has been used in science and art since ancient times (Walle in Fitriasari, 2019). Geometry is widely applied in real life, such as in engineering, geography, and other fields (Solihah & Afriansyah, 2017). The abstract concepts in geometry often pose difficulties for students in problem solving (Fitriani, Suryadi, & Dahrim, 2018). The difficulty in solving geometry problems was also mentioned in the research by Lee & Chen (in Hidayati & Riszal, 2019). In fact, the introduction of basic geometric concepts is indirect knowledge that students acquire through their informal educational environment, especially in relation to play objects during the concrete development stage of students (Andriyani, 2020). However, in reality, many students still believe that geometry is a complicated subject because it is an abstraction of the real world (Bhagat & Chang, 2014).

This difficulty in problem solving by students is ironic given that the basic objective of geometry learning is to train students to become good problem solvers (Abdussakir, 2010). Problem solving is a process or effort by students to respond to or overcome obstacles when an answer or method of answering is not yet clear (Siswono, 2018). Some of the difficulties students experience in solving geometry problems are those related to two-dimensional objects in three-dimensional objects (Ryu et al., 2007). Other difficulties in geometry problems are those related to plane diagonals, space diagonals, diagonal planes, and nets that form three-dimensional shapes (Mutia, 2017). One of the causes of these difficulties is that many students are still unable to understand basic geometric problems related to intersecting and crossing lines (Abdussakir & Basuki in Indrayany & Lestari, 2019).

Difficulties in solving three-dimensional problems are related to other geometric concepts that are components in the construction of three-dimensional objects. The interrelationship between these geometric concepts is an important point in problem solving. This also occurs in solving flat-sided spatial problems taught in the eighth grade of junior high school. Based on observations and interviews with

mathematics teachers on Tuesday, April 2, 2019, at Muhammadiyah Pakem Junior High School, it was found that students still had difficulties in solving flat-sided spatial problems, especially in identifying problems related to the elements of a spatial figure. As a result, most students are also unable to understand the problem, unable to make a plan to solve the problem, unable to implement the plan to solve the problem, and most of them do not recheck the results of their problem solving. Using Polya's problem-solving steps as an indicator, the results of the test of problem-solving skills for flat-sided shapes, especially cubes and blocks, were grouped based on the students' ability levels, namely high, medium, and low ability students. The low problem-solving ability related to the students' inability to relate their previous conceptual knowledge to routine and non-routine problem-solving methods and real-world problems shows that students are not well-trained to deal with real- world problems that are ly related to several concepts. Therefore, students need an innovative student-centered learning model that uses problem-solving as the starting point of the learning process to develop students' problem-solving skills, namely *Problem-Based Learning* (PBL) (Zulfah et al., 2018; Nugraha et al., 2017).

*Problem-Based Learning* is also one of the learning models recommended in the 2013 curriculum, as referred to in Permendikbud Number 103 of 2014 and Permendikbud Number 22 of 2016. Through *Problem-Based Learning*, students learn from real problems, are challenged to solve problems, are required to understand problems and find answers to existing problems, while teachers only act as facilitators (Wardani, 2015). Therefore, the *Problem-Based Learning* approach is suitable for helping students solve various types of problems and has a positive impact on students' problem-solving abilities (Jonassen, 2011). This is in line with Wilder's (2015) opinion that PBL not only fosters the development of content knowledge but also shares skills, such as communication and collaboration skills, decision making, problem solving, critical thinking, and independent learning. Other results from preliminary research also found that in learning about flat-sided shapes, teachers still use Student Worksheets (LKPD) that do not contain authentic (real) problems for students to solve and do not stimulate student participation in group work. So far, the LKPD used are monotonous printed books from the government, or directly present material in language that is difficult for students to understand, with many story questions, which makes students bored, experience difficulties that result in obstacles, and lack of student activity in learning. The existing LKPD also does not contain important knowledge to guide students to become proficient in problem solving and have their own problem-solving strategies.

Based on the above problems, the researcher developed LKPDs based on *Problem Based Learning*. The problems presented in the LKPDs contain real-life issues. These problems can be used as a starting point in the learning process. The LKPDs based on *Problem Based Learning* developed by the researcher present problems in the form of story questions so that students are trained to solve problems in the form of story questions. Furthermore, the worksheets developed by the researcher will present steps in problem solving, so that they can guide students to be proficient in solving every problem given and have strategies for solving problems. By presenting problem-solving steps in the LKPD, students are able to understand problems, make plans to solve problems, and implement plans to solve problems, as well as get used to checking the results of problem solving.

## RESEARCH METHOD

This study uses the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model developed by Dick and Carey. The product developed is a PBL-based student worksheet to improve problem-solving skills , which was tested on eighth-grade students at Muhammadiyah Pakem Junior High School. The development process included validation, practicality, and effectiveness of the product. Data collection instruments included: The validation sheet instrument was assessed based on the feasibility aspects according to the Ministry of Education and Culture (2008), namely content feasibility, language feasibility, presentation feasibility, and suitability with the characteristics of the Problem-Based Learning approach

according to Santyasa (2007). The student response questionnaire instrument was assessed based on three aspects, namely content feasibility, presentation, and graphics (Firanti & Paidi, 2016). This instrument was used to determine the practicality of student responses to LKPD with the PBL approach. The problem-solving ability test instrument was used to measure the effectiveness of LKPD in improving students' problem-solving abilities in flat-sided spatial figures using problem-solving ability indicators. From the analysis of the flat-sided spatial figures material, a grid was obtained for the problem-solving ability test questions. Data were obtained from instrument and product validators, as well as 26 students in class VIIIA at Muhammadiyah Pakem Junior High School. Data collection techniques included non-tests and tests. Non-tests included validity assessment of the LKPD by subject matter and media experts, as well as practicality assessment by students through questionnaires. A written test was used to measure the effectiveness of the LKPD in improving problem-solving skills in flat-sided spatial geometry material. The research instruments, which included questionnaires and test questions, were validated by experts before use. Qualitative data analysis was conducted to ensure that the LKPD was valid, practical, and effective, by organizing the data according to categories and summarizing it systematically (Sugiyono, 2016).

## RESULTS AND DISCUSSION

At the evaluation stage, researchers conducted a summative evaluation to determine the effectiveness of the product. The effectiveness of the product was tested using pretest and posttest questions on problem-solving skills in flat-sided shapes. In this study, the effectiveness of the LKPD was assessed by comparing the students' problem-solving test scores on the *pretest* questions before being given the PBLbased LKPD with their problem-solving test scores on the posttest questions after being given the PBLbased LKPD. The researcher gave *pretest* questions to the experimental class and *posttest* questions. After obtaining the pretest and *posttest* results, the researcher then conducted *a paired sample t-test* to compare the results of the problem-solving ability test in the form of pretest questions with the results of the problem-solving ability test in the form of posttest questions using SPSS 22 for Windows software. The results obtained can be seen in Table 1 below.

**Table 1. Results of *Paired Samples t-Test* and *Paired Samples Correlations***

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | Pretest | 37.31 | 26 | 15.826 | 3.104 |
| | Postest | 67.50 | 26 | 10.794 | 2.117 |

| | | N | Corre lation | Sig. |
|---|---|---|---|---|
| Pair1 | Pretest & Postest | 26 | .837 | .000 |

**Table 2. *Paired Samples t-Test***

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Pretest - Postest | -30.192 | 8.998 | 1.765 | -33.827 | -26.558 | -17.110 | 25 | .000 |

If the significance value (2-tailed) < 0.05, then there is a significant difference between the learning outcomes in the *pretest* and *posttest* data. However, if the significance value (2-tailed) > 0.05, then there is

no significant difference between the learning outcomes in the *pretest* and *posttest* data. Based on Table 1, it shows that the Sig. value (2-tailed) is 0.000 <0.05, so there is a significant difference between the mathematics learning outcomes in the pretest and *posttest* data. Meanwhile, to see the effectiveness of the developed LKPD, we can look at the correlation value in Table 2. From the results of the *paired sample t-test* above, it is known that the correlation value obtained is 0.837, which is in the high category. In this study, to see the extent of the effectiveness of the developed product, we refer to the analysis of product effectiveness categories according to Sugiyono (2010) presented in Table 3 below.

**Table 3. Categories of Effectiveness of the Developed Product**

| Correlation Value | Category |
|---|---|
| 0.800 – 1.000 | High |
| 0.600 – 0.800 | Moderate |
| 0.400 – 0.600 | Slightly Low |
| 0.200 – 0.400 | Low |
| 0.000 – 0.200 | Very Low |

Based on Table 3, a developed LKPD is considered effective if the correlation value in the paired sample ttest results meets the minimum sufficient category. In other words, there is an increase between the results of the problem-solving ability test in the form of a pretest before being given learning materials in the form of Problem-Based Learning-based LKPD and the results of the problem-solving ability test in the form of a posttest after being given learning materials in the form of Problem-Based Learning- based LKPD. This means that there is an increase in problem-solving skills in the experimental class before and after being given teaching materials in the form of *Problem-Based Learning*-based worksheets. With these results, it can also be concluded that the developed worksheets can be used because they meet the product feasibility requirements, namely validity, practicality, and effectiveness.

These results indicate that *Problem-Based Learning*-based worksheets can improve students' problemsolving skills. These results are in line with research conducted by Zulfah, Fauzan, and Armiati (2018) and research by Siagian, Saragih, and Sinaga (2019), which states that the use of *Problem-Based Learning*based worksheets has been proven to improve students' problem-solving skills. Research conducted by Lahirna Dwi Agitsna, Reny Wahyuni, and Drajat Friansah (2019) also shows that students' mathematical problem-solving skills improve when using PBL-based worksheets when learning about flatsided shapes. In a study conducted by Siswantoro (2018), it was found that *Problem-Based Learning* can improve students' problem-solving skills because the learning process uses authentic problems, thereby encouraging students to be more active in constructing knowledge and concepts in their minds.

Another study conducted by Diasty Ponjen and Suparman (2019) stated that mathematics teaching materials in the form of Student Worksheets (LKPD) based on *Problem-Based Learning* (PBL) can improve students' problem-solving skills. This is in line with research conducted by Nafida Hetty Marhaeni (2020) on 11th grade science students who experienced an increase in problem-solving skills after implementing learning using *PBL-based* LKPD on matrix material. Supported by research by Winarti, E.R., Waluyo, S.B., Rochmad & Kartono (2019), *Problem-Based Learning* is a learning approach that builds knowledge by activating students' knowledge, and problem-solving strategies from structured problems are developed and obtained through group discussions.

Research conducted by Helda Monica et al. (2019) shows that by applying the *problem-based learning* model, *students can become more active in learning activities because they can find* their own solutions to

problems related to the material being studied. Students can also solve real problems and relate the material being studied to their daily lives, thereby creating a conducive learning atmosphere. This occurs because in the application of the Problem-Based Learning model, students better understand problems, plan to solve problems, solve problems according to plan, and recheck or interpret solutions. Students are also guided to think scientifically in a systematic and empirical manner.

These results are supported by research conducted by Diding and Ilham (2016), which found that students who received the PBL learning model experienced an increase in their mathematical problem-solving heuristic strategy skills compared to students who received conventional learning. Then, research conducted by Yuli Warti and Hurriyah (2019) from the practicality test results obtained that the Problem Based Learning-based LKPD had a practicality value of 86.37 by students in the very practical category and by teachers obtained a result of 88.23 in the very practical category.

## CONCLUSION

*Problem-based learning-based* worksheets to improve the problem-solving skills of eighth-grade students in flat-sided spatial figures meet the criteria for effectiveness. This is based on the results of *the paired sample t-test* above, which shows that the correlation value obtained is 0.837, which is in the high category. The worksheets developed are considered effective if the correlation value in the paired *sample t-test* results meets at least the sufficient category. The overall conclusion is that *the Problem- Based Learning*-based LKPD to improve problem-solving skills can be used because it meets the criteria of validity, practicality, and effectiveness.

## REFERENCES

Abdussakir, A. 2012. Pembelajaran Geometri Sesuai Teori Van Hiele. Madrasah: Jurnal Pendidikan dan Pembelajaran Dasar, 2(1).

Agitsna, L. D., Wahyuni, R., & Friansah, D. 2019. Pengembangan Lembar Kerja Siswa Berbasis Problem Based Learning Pada Materi Bangun Ruang Sisi Datar. Aksioma: Jurnal Program Studi Pendidikan Matematika, 8(3), 429- 437.

Andriyani, Juniati, D. 2020. Belajar hubungan antara segi empat menggunakan puzzle geometri untuk siswa tunanetra.J. Phys .: Conf. Ser. 1470 012029.

Akker, J., Bannan, B., Kelly, A. E., Nieveen, N., & Plomp, T. 2013. An Educational Desaign Research. Netherland: Netherland Institute.

Aqsan, M., Nurhayati, B., & Karim, H. 2018. Pengembangan Lembar Kerja Peserta Didik Biologi Berbasis Keterampilan Proses Sains Pada Kelas XI SMA Negeri 1 Pangkep. In Seminar Nasional Biologi.

Arends, R.I. 2008. Learning to Teach. Yogyakarta: Pustaka Pelajar.

Barrows, H. S. 1996. Problem Based Learning in Medicine and Beyond: A brief overview. New directions for teaching and learning, 1996(68), 3-12.

Basuki, R.N. 2012. Analisis Kesulitan Siswa SMK pada Materi Pokok Geometri dan Alternatif Pemecahannya. Seminar Nasional Pendidikan Matematika Surakarta, 09 Mei 2012.

Bhagat K K and Chang C Y. 2014. Incorporating GeoGebra into Geometry learning-A lesson from India.Eurasia Journal of Mathematics, Science & Technology Education 11 77-86.

Depdiknas. 2008. Panduan Pengembangan Bahan Ajar. Jakarta: Depdiknas. Depdiknas. 2013. Kurikulum 2013. Depdiknas: Jakarta.

Fatmasuci, F. W. 2017. Pengembangan perangkat pembelajaran berbasis masalah berorientasi pada kemampuan komunikasi dan prestasi belajar matematika siswa SMP. Jurnal Riset Pendidikan Matematika, 4(1), 32-42.

Fatmawati, A. 2016. Pengembangan Perangkat Pembelajaran Konsep Pencemaran Lingkungan Menggunakan Model Pembelajaran Berdasarkan Masalah untuk SMA Kelas X. EduSains. 4 (2) : 94 – 103.

Fitriani, N., Suryadi, D., & Darhim. 2018. The Students' Mathematical Abstraction Ability Through Realistic Mathematics Education With VBA- Microsoft Excel. Infinity, 7(2), 123–132.

Firanti, A., & Paidi. 2016. Pengembangan LKPD Pembelajaran Biologi Berbasis Masalah dan Keefektifannya Terhadap Kemampuan Berpikir Kreatif dan Reflektif. Integrated Lab Journal, 4(2), 259-268.

Fitriasari, P. 2020. Kemampuan Pemahaman Konsep Matematis Mahasiswa PGSD Pada Materi Geometri Dasar. Jurnal Indiktika, 2(1), 86-95.

Hidayati, D. W., & Riszal, A. 2019. Bahan Ajar Geometri Analitik Berbasis Geogebra dan Kreativitas Belajar: Dapatkah Meningkatkan Kemampuan Pemecahan Masalah?. JNPM (Jurnal Nasional Pendidikan Matematika), 3(2), 191-206.

Indrayany, E. S., & Lestari, F. 2019. Analisis kesulitan siswa SMP dalam memecahkan masalah geometri dan faktor penyebab kesulitan siswa ditinjau dari teori van hiele. Jurnal Math Educator Nusantara: Wahana Publikasi Karya Tulis Ilmiah Di Bidang Pendidikan Matematika, 5(2), 109-123.

Islamiah, N., Purwaningsih, W. E., Akbar, P., & Bernard, M. 2018. Analisis Hubungan Kemampuan Pemecahan Masalah Matematis dan Self Confidence Siswa SMP. Journal on Education, 1(1), 47-57.

Ismawati, E., & Ghofur, M. A. 2020. Pengembangan LKPD Berbasis Problem Based Learning Untuk Meningkatkan Berpikir Kritis Peserta Didik Pada KD Perdagangan Internasional. Jurnal Pendidikan Ekonomi (JUPE), 8(2), 38-43.

Jonassen, D. 2011. Supporting problem solving in PBL. Interdisciplinary Journal of Problem-Based Learning, 5(2), 95-119.

Lee, C. Y., & Chen, M. J. 2015. Effects of Polya Questioning Instruction for Geometry Reasoning in Junior High School. Eurasia Journal of Mathematics, Science & Technology Education, 11(6).

Lestari dan Yudhanegara. (2015). Penelitian Pendidikan Matematika. Bandung: PT. Refika Aditama.

Miles, M.B., & Huberman A.M. 2014. Analisis Data Kualitatif: Buku Sumber Tentang Metode-Metode Baru. Jakarta: Universitas Indonesia Press.

Muntaha, A. 2013. Pengembangan Perangkat Pembelajaran Model Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kreatif. Journal of Primary Education, 2(2), 115-119.

Murdiana, I. N. 2015. Pembelajaran Pemecahan Masalah Dalam Pembelajaran Matematika. Aksioma, 4(1).

Mutia, M. 2017. Analisis kesulitan siswa SMP dalam memahami konsep kubus balok dan alternatif pemecahannya. Beta: Jurnal Tadris Matematika, 10(1), 83-102.

Nadiah. 2015. Pengembangan LKS Berbasis Pendekatan Pemodelan Matematika pada Materi Sistem Persamaan Linear Di SMAN 18 Palembang. Skripsi. Inderalaya: FKIP Unsri.

Nahrowi, A., & Maulana. 2006. Pemecahan masalah Matematika, Bandung: UPI Press

Nugraha, A. J., Suyitno, H., & Susilaningsih, E. 2017. Analisis kemampuan berpikir kritis ditinjau dari keterampilan proses sains dan motivasi belajar melalui model pbl. Journal of Primary Education, 6(1), 35-43.

Nurdin, 2007. Model Pembelajaran Matematika yang Menumbuhkan Kemampuan Metakognitif untuk Menguasai Bahan Ajar. Disertasi. Surabaya: PPS UNESA.

Nurdiyanto, T., Rafida, I., Nuhadila, A., & Winarni, S. 2020. Pengembangan Lkpd Berbasis Problem Based Learning Untuk Melatih Kemampuan Koneksi Matematis Peserta Didik Kelas XI. Jurnal Edukasi dan Sains Matematika (JES-MAT), 6(1), 37-54.

Nurmita, F. 2017. Pengembangan Buku Ajar Siswa Dan Buku Guru Berbasis Matematika Realistik Untuk Meningkatkan Pengetahuan, Sikap dan Keterampilan Matematika Siswa Kelas VIISMPAL Karim Kota Bengkulu. Edu-Mat: Jurnal Pendidikan Matematika, 5(1).

Peranginangin, S. A., Saragih, S., & Siagian, P. (2019). Development of learning materials through PBL with Karo culture context to improve students' problem solving ability and self-efficacy. International Electronic Journal of Mathematics Education, 14(2), 265-274.

Polya, G. 1973. How Solve It: A new Aspect of Mathematical Method. New Jersey: Princeton University Press.

Ponjen, D., & Suparman, S. (2019). Analisis Kebutuhan Lkpd Berbasis Problem Based Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah. Prosiding SENDIKA, 5(1).

Prastowo, Andi. 2011. Panduan Kreatif Membuat Bahan Ajar Inovatif. DIVA Press. Yogjakarta

, S. Z., & Afriansyah, E. A. 2017. Analisis kesulitan siswa dalam proses pemecahan masalah geometri berdasarkan tahapan berpikir Van Hiele.Mosharafa: Jurnal Pendidikan Matematika, 6(2), 287298.

Siswono, T.Y.E. 2018. Pembelajaran Matematika Berbasis Pengajuan dan Pemecahan Masalah. Bandung: PT. Remaja Rosdakarya.

Sihotang, B., & Rahmayani, V. 2020. Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Problem Based Learning Untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa SMP.

Sugiyono. 2009. Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R & D). Bandung: IKAPI.

Sugiyono. 2016. Metode Penelitian Kuantitatif, Kualitatif dan R & D. Bandung: Alfabeta.

Sukardi. 2012. Evaluasi Pendidikan Prinsip dan Operasionalnya. Jakarta: PT Bumi Aksara.

Van de Walle, J. A. 1998. Elementary and middle school mathematics: Teaching developmentally. AddisonWesley Longman, Inc., 1 Jacob Way, Reading, MA 01867; toll-free.

Waluya, B., Rochmad, R., & Kartono, K. 2019, February). Pemecahan Masalah dan Pembelajarannya dalam Matematika. In PRISMA, Prosiding Seminar Nasional Matematika (Vol. 2, pp. 389-394).

Wardani, S,D. 2015. Penerapan Bahan Ajar Berbasis PBL (Problem Based Learning) Terhadap Kemampuan Berpikir Kritis Peserta didik SMA. Semarang: FKIP Universitas Negeri Semarang.

Warsono, H., & Hariyanto, M. S. 2012. Pembelajaran aktif teori dan asesmen. Bandung: PT Remaja Rosdakarya.

Widodo, C. S., & Jasmadi, S. T. P. 2008. Panduan menyusun bahan ajar berbasis kompetensi.Jakarta: Elex Media Komputindo.

Widoyoko, E. P. 2012. Evaluasi program pembelajaran. Yogyakarta: pustaka pelajar, 238.

Wilder, S. 2015. Impact of problem-based learning on academic achievement in high school: a systematic review. Educational Review, 67(4), 414-435.

Zulfah, Fauzan, A., Armiati. 2018. Pengembangan Lembar Kerja Peserta Didik Berbasis Problem Based Learning Untuk Materi Matematika Kelas VIII. Journal Pendidikan Matematika, 12(2), 33-4