EXPERIMENTATION OF PROBLEM-BASED LEARNING MODEL ASSISTED BY ISLAMIC-INTEGRATED LKPD ON STUDENTS' MATHEMATICAL LITERACY SKILLS

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Abstract

This study aims to analyze integrated student worksheets on flat-side geometry material (cubes and blocks) in problem-based learning to improve students' mathematical literacy. Teachers' use of contextual learning made some students need more mathematical literacy abilities. This is proved by PISA 2018 data which shows that Indonesia is still ranked at the bottom. The method of this research is quasi-experimental with a non-equivalent control group design. The independent variable of this research is a problem-based learning model assisted by student activity sheets, and the dependent variable is mathematical literacy. The population of this study is the students at MTs Surya Buana Malang City, with a sample of the research is two classes of nine-grade students. The A class of nine-grade students will be the experimental class, and the B class as the control class. The research instrument used descriptive text. The data analysis technique uses an independent sample t-test. The results of the study concluded that the increase in the mathematical literacy of students who received problem-based learning assisted by Integrated Worksheets was significantly better than students who received conventional learning, as indicated by a significant result of 0.000 < 0.005 (H_0 rejected).

Keywords: *Experimentation of Problem-Based, Learning Models*

Abstrak

Penelitian ini bertujuan menganalisis LKS terpadu materi geometri sisi datar (kubus dan balok) dalam pembelajaran berbasis masalah untuk meningkatkan literasi matematika siswa. Penggunaan pembelajaran kontekstual oleh guru membuat sebagian siswa lebih membutuhkan kemampuan literasi matematis. Hal ini dibuktikan dengan data PISA 2018 yang menunjukkan Indonesia masih berada di peringkat terbawah. Metode penelitian ini adalah eksperimen semu dengan desain kelompok kontrol non-ekuivalen. Variabel bebas penelitian ini adalah model pembelajaran berbasis masalah berbantuan lembar kegiatan siswa, dan variabel terikatnya adalah literasi matematika. Populasi penelitian ini adalah siswa MTs Surya Buana Kota Malang, dengan sampel penelitian dua kelas yaitu siswa kelas sembilan. Kelas A siswa kelas sembilan akan menjadi kelas eksperimen, dan kelas B sebagai kelas kontrol. Instrumen penelitian menggunakan teks deskriptif. Teknik analisis data menggunakan independent sample t-test. Hasil penelitian menyimpulkan bahwa peningkatan literasi matematis siswa yang memperoleh pembelajaran berbasis masalah berbantuan LKS lebih baik secara signifikan dibandingkan dengan siswa yang memperoleh pembelajaran konvensional yang ditunjukkan dengan hasil signifikan 0,000 < 0,005 (H0 ditolak).

Kata kunci: Eksperimentasi Model Pembelajaran, Berbasis Masalah

Introduction

Every student in life must have mathematical literacy skills, because in facing various life problems, an individual is required to have problem solving skills and mastering logical reasoning that is not only focused on arithmetic understanding. Based on the results of PISA assessment successively starting in 2000, 2003, 2006 and 2009, Indonesia ranked the bottom seven (Balitbang Kemendikbud, 2011). In 2012, Indonesia was at the 64th rank out of 65 participating countries. In PISA 2015, Indonesia was ranked 69th out of 76 countries (OECD,

2015). Meanwhile, in PISA 2018, with a score of 379, Indonesia was ranked in the lower 7th place.

The result of PISA shows that Indonesia, based on international study, has average score of mathematical literacy yet it is still stagnant at the lower place of the rankings. Indonesian students have not been able to reach the context of real-life problems given by PISA. The students' low mathematical literacy happens because they are not accustomed to working on contextual problems, logical reasoning, argumentation, and creativity in solving these problems (Balitbang Kemendikbud, 2011). This issue becomes a note for educators and prospective educators. The difficulties that the students face in dealing with contextual problems increasingly make them think that mathematics is separated from everyday problems and even create a stigma that mathematics is only about counting and separated from its religious aspects. Most of the Indonesian students are accustomed to only answering theoretical and procedural questions (Habibi and Suparman, 2020).

Studying the results of PISA analysis in three countries, Japan, Brazil and Norway, the main factors that influence PISA results are students, families and schools. Literacy inputs related to mathematics from the three countries include reading practice, belief in mathematical concepts, teacher-student engagement, parent-student communication, and the application of technology in mathematics education. In accordance with the research findings, Sezgin (2017) examined the determinants of mathematical literacy, such as the relationship between teachers and students and students' perceptions of mathematics (Syawahid, 2017). Thus, the interaction between teachers and students is one of the important factors that influence the development of students' mathematical literacy at school. In addition, it is also necessary to learn mathematics that allows and facilitates the development of student-teacher interactions and fosters students' positive perceptions of mathematics. The syntax of problem-based learning is a student-centered approach to problems. Problems are used to facilitate students in building new mathematical knowledge by connecting it with previous mathematical knowledge. Problems in problem-based learning are contextual problems that are most closely related to students' unstructured life (Tan, 2004: 7). If students are in a religious environment, then contextual problems can be approached by providing problems related to the religious context. In this case, for instance, to teach the concept of block volume, the teacher can present contextual problems in the form of ablution problems if the water is less than two *kullah*, and so on. Problem-based learning through collaborative activities positions students as autonomous problem solvers (Herman, 2007: 49). To achieve the goal of autonomous learners, guiding the students doing activities is needed in the form of learner worksheets that help to direct students to achieve the expected learning purposes.

Based on the field observation, the problems include the weak ability of students to relate mathematical concepts to contextual problems or vice versa, especially in geometry. This condition indicates that students' mathematical literacy needs to be improved, one of the ways is by designing the right learning model. Based on this explanation, the researcher did experiment on mathematical literacy of MTs Surya Buana Malang with problem-based learning models with Islamic integrated LKPD. The formulation of the problem proposed in this study is whether the mathematical reading ability of students who obtain problem-based learning with Islamic Integrated Learner Worksheets (LKPD) is significantly better than conventional students. The expected benefits of this research are 1) for students, problem-based learning encourages students to improve their thinking and reasoning skills when solving mathematical problems; and 2) for teachers, problem-based learning model is used as one of the choices of participatory humanistic learning models that can encourage the development of students' mathematical literacy.

Method

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This research uses a quantitative approach with a type of quasi-experiment research with a non-equivalent control group design (Sugiyono, 2009: 116). The research design is:

Table 1. *Experiment Design of Unequal Control Group*

Class	Pretest	Treatment	Posttest
Experiment	O_1	X_1	O_2
Control	O_1		O_2

This study used two types of classes, namely experimental and control classes. Both classes have equal math skills which are known through the equality test. The population of this study was all students of MTs Surya Buana Malang and the sample students are class IX-A and IX-B. The sample students were from the recommendation of mathematic teachers. The experimental class was in Class IX A and the control class was in Class IX B. The instruments of this study include data collection instruments in the form of a description test consisting of two questions related to cube and beam material, observation, and documentation. While learning instruments in the form of problem-based learning lesson plans assisted by Islamic integrated student worksheets. Before being used in research, the instruments were tested for validity and reliability. The validity test was carried out with face and content validity through expert judgment, while the reliability test was carried out using Cronbach's Alpha. The data analysis technique was carried out with inferential statistics, namely the t test (independent sample t-test) using normalized gain data. When the data has been collected, it will be analyzed with SPSS 19.00 and Microsoft excel software using the 5% significance.

Result and Discussion

The purpose of this research is to analyze the mathematical literacy ability between students in problem-based learning assisted by Islamic integrated LKPD compared to conventional learning. Conventional learning is the usual mathematics learning at *madrasah* where the research was conducted. The following is a description of the data from both groups in Table 2.

Tabel 2. *Research Data Description*

Group Statistics

	Kelas	N	Mean	Std. Deviation	Std. Error Mean
Literasi Matematis	Kontrol	24	70.3333	6.80123	2.40959
	Eksperimen	24	81.7143	16.18347	6.11678

Based on Table 2, the number of samples for each class is 24 students, the average of the experimental group is 81.7143 and the control class is 70.3333 with a relatively large standard deviation. After that, the researcher examines the difference in means using independent sample test statistics, as shown in Table 3.

Tabel 3. *Output Independent Sample t Test*

Independent Samples Test

		Levene's Test for Equality of Variances		t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
		F	Sig.						Lower	Upper
Literasi Matematis	Equal variances assumed	2.360	.000	-.306	47	.000	-2.38095	7.78664	-19.51924	14.75734
	Equal variances not-assumed			-.316	10.465	.000	-2.38095	7.54052	-19.08160	14.31970

Based on Table 3, it is obtained that with a 95% confidence interval, the Sig. value is 0.000 <0.005 (H0 is rejected) so that it can be concluded that the problem-based learning model assisted by LKPD improves mathematical literacy significantly compared to conventional learning.

Discussion

Applying problem-based learning to conventional learning has brought some new insights into research. Conventional learning is traditional learning done by junior high school teachers in mathematics classes. In conventional education, teachers are role models for students as all factors related to student academic achievement begin and center around the teacher. The success of traditional education relies heavily on the teacher's competence which includes preparation, knowledge, confidence, enthusiasm, and ability to manage the classroom (Sanjaya, 2008: 191). The subject is delivered by the teacher in the final form, meaning that the teacher explains the subject matter, gives examples of problems and solutions, and directly introduces ideas to students (Ibrahim, 2011). Meanwhile, students will receive the subject material followed by routine practice. Giving routine practice questions can have an impact on the students' knowledge or ideas building.

In the experimental class this research was carried out to develop the students' prior mathematical ideas or knowledge so that students had to be actively involved in solving problems. If mathematics is taught by emphasizing memorization, especially partially, there will be little possibility of students having advanced mathematical skills, because basically learning mathematics as a whole is learning to solve problems that require the involvement of higher-level thinking skills. Significantly, the results concluded that the use of the Islamic-integrated learner worksheet in problem-based learning provides better results in improving students' mathematical literacy when compared to conventional learning methods. The experimental class applied two crucial factors in its learning activities: the utilization of teaching materials and in the process of implementing problem-based learning based on the pedagogical framework outlined in the Lesson Plan (RPP). In line with these learning principles, mathematical problems are presented as teaching materials to encourage and stimulate multi-dimensional interactions among students' mathematical abilities, creating a conducive environment for meaningful learning.

With meaningful learning, students will feel facilitated to develop their mathematical literacy. Mathematical literacy is defined as the ability to use, interpret, and formulate mathematics in various contexts (Asmara, et al, 2017). Based on PISA 2015, there are seven basic mathematical skills needed in mathematical literacy. Meanwhile, according to Turner, basic mathematical abilities are described as follows (Gunardi, 2017) representation, reasoning, communication, mathematization, and argumentation, designing problem-solving strategies, using mathematical tools, using symbols, techniques and operations, and formal language.

The basis of this mathematical literacy is QS AL Alaq verses 1 to 5. As written as follows:

اَقْرَأْ بِٱسْمِ رَبِّكَ ٱلَّذِى خَلَقَ ، خَلَقَ ٱلْإِنسَـٰنَ مِنْ عَلَقٍ ، اَقْرَأْ وَرَبُّكَ ٱلْأَكْرَمُ ، ٱلَّذِى عَلَّمَ

بِٱلْقَلَمِ ، عَلَّمَ ٱلْإِنسَٰنَ مَا لَمْ يَعْلَمْ ۰

Surah Al Alaq was the first revelation revealed to the Prophet Muhammad that commanded him to read, analyze and create. The first verse given to the messenger of Allah was the command to read. So that from this, students can emulate the story of the Prophet Muhammad SAW and get themselves used to using their literacy skills. Teachers can apply it to familiarize students with mathematical literacy. By reading, analyzing, and creating skills, the students can have additional knowledge that previously may not have been learned. Thus, it is hoped that student worksheets can contribute more to the development of children's cognitive domain, especially in mathematical literacy skills.

The experimental class teaching materials consist of unstructured math problems with contextual relevance. The teacher then begins to introduce the sequence of math problems to the students, acting as an early intervention in the learning process. The problems are designed to include mathematical concepts related to flat-sided space building materials, and are intended to arouse students' interest and encourage their engagement in problem-based learning. To achieve the learning goals, the teacher-designed teaching materials include problems that are (1) adapted to students' abilities and prior knowledge, (2) relevant to the material, (3) require detailed explanations for their solutions, thus enhancing students' reflective thinking skills, and (4) challenging enough to stimulate students' interest, attention, and motivation to apply prior knowledge to solve new mathematical problems.

This worksheet is adapted to the students' daily life in the form of Islamic values and Islamic religious texts. Islamic integrated learner worksheets can be prepared by including Islamic elements in it which can be in the form of tawheed, fiqh, akhlaq, interpretation of Qur'an verses and so on. An example of a problem associated with Islam is giving a concrete example of a block shape. Before students understand the volume of flat-sided space, students must know how the nets forming the flat-sided space. The teacher can provide a concrete example by showing a picture of the Kaaba building. After that, students are directed to use their literacy skills in understanding the information about the Kaaba conveyed by the teacher. From this example, the students can better understand how the shape of the block and the nets that make up the building look like. To further familiarize students in using their literacy skills, the teacher can also provide exercises or questions that are still related to the Kaaba but the teacher also includes the size of the Kaaba so that students can find out how to calculate the volume of the building.

In the integration project activities, students are directed to do these activities in the hope that when there are problems related to thaharah, students will not only look for mathematical concepts but also religious concepts. Problems related to Islamic integration on the student worksheet are calculating the volume of water in a bathtub which is then associated with the minimum limit of water that can be used for purification, namely students are given a problem regarding "does the volume of water in the tub meet the volume limit of water used for purification?" in accordance with the hadith which says:

وَعَنْ عَبْدِ اللَّهِ بْنِ عُمَرَ رَضِيَ اللَّهُ عَنْهُمَا قَالَ: قَالَ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ: ـ إِذَا كَانَ الْمَاءُ قُلَّتَيْنِ

لَمْ يَحْمِلِ الْخَبَثَ ـ وَفِي لَفْظٍ ـ لَمْ يَنْجُسْ ـ أَخْرَجَهُ الْأَرْبَعَةُ, وَصَحَّحَهُ ابْنُ خُزَيْمَةَ وَابْنُ حِبَّان

Meaning: "'Abdullah ibn 'Umar RA reported that Rasulullah SAW said: 'If water reaches two *kulahs*, it does not become impure'" (HR Abu Dawud, At-Tirmidzi)

From this problem students can calculate the volume of water in a bathtub with a certain size which will then be compared with the limit of water used for purification which is 2 kulah or equivalent to approximately 216 liters of water. If the volume of water in the bathtub

exceeds 216 liters, then the water in the bathtub can be used for purifying while if the volume of water is less than 216 liters then the water in the bathtub cannot be used for purifying. In addition, the teacher can also provide other questions that are still related to washing and the limit of water that can be used for washing. For example, by giving the question "what if the volume of water is increased or decreased?". From the existence of Islamic integrated student worksheets, the teacher can familiarize the students to learn one field can be combined with other fields.

During the learning process, the teachers need to plan, compile and prepare the material as well as possible to facilitate students with diverse learning strategies so that there will be interaction between students and their learning surroundings. Problem-based learning in the form of small discussions consists of students with different cognitive abilities. Meanwhile, students with the ability to respond to ideas, opinions or help from teachers or friends and problem solving strategies have a very close relationship with the cognitive abilities that exist in students. This requires more careful and thorough teacher assistance, so that each student gets help or encouragement in accordance with the planned pedagogical framework by taking into account the development of each student. This is emphasized by the findings of research conducted by Suryadi (2009) that the characteristics of students' early mathematical abilities greatly influence the proportion of teacher intervention provided during the learning process. This can lead to variations in the development of students' adaptive thinking skills.

Students are expected to learn meaningfully through active involvement in learning and understand the teaching materials presented through problem-based learning. The use of teaching materials in the form of problems or tasks given to students at the beginning of learning, teacher involvement by recording and observing the development of each student, and student-student interaction are some of the causes of the success of problem-based learning. their learning environment. Thus, the results of this study strengthen and enrich previous research. Various literacy studies that have been developed are Minrohmatillah (2019), Azrai, et al. (2019), Widianti and Hidayati (2021) which specifically examine mathematical literacy and student learning styles in mathematics learning.

Based on research from Sugiarto, et al (2021), it also states that students' literacy skills are at the third level, namely being able to present source information but when viewed from the overall average, students' mathematical literacy skills are still in the low category. From this, the teacher should not overly impose students' procedural understanding but also provide variations in giving exercises. Research conducted by Maslihah (2021) shows that through problem-based learning, worksheets allow students to provide encouragement for students in improving basic math skills. Therefore, by providing this learning model to improve mathematical literacy, students can be directed in using critical thinking, problem solving, communication, and collaborative skills (Ghani, 2021; Hendriana, 2018).

Conclusion

Based on the results above, it can be concluded that the mathematical literacy skills of students who get problem-based learning assisted by Islamic integrated LKPD are significantly better compared to conventional learning at MTs Surya Buana Malang. By using Islamic integrated student worksheets, students do not only solve a mathematical problem, but they can also use their literacy skills to understand the Islamic context of the problem.

The suggestions related to the mathematical literacy of ninth grade junior high school students are: 1) teachers can develop students' mathematical literacy by giving problems whose substance is daily life problems and universal values of Islamic teachings; 2) researchers can conduct research that is still relevant to this study and then associate it with different contexts. The importance of mathematical literacy can be taken into account at every

level of the research subject so that future researchers can also examine mathematical literacy at other levels of education.

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