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EXAMINING THE MODELLING SKILLS OF GRADE 8 STUDENTS ON THE SYSTEM OF LINEAR EQUATION IN TWO VARIABLES THROUGH PROBLEM-BASED LEARNING MODEL

Ikhlasul Amal[1]; Dwi Fadhiliani[2]; M. Hasbi[3]
[1,2,3]Universitas Syiah Kuala, Jl. Syeikh Abdur Rauf, Banda Aceh 23111, Indonesia
Email: *dwifadhiliani@usk.ac.id*

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Abstrak

Pemodelan matematika ialah proses menyelesaikan sebuah permasalahan di dunia nyata dengan menyederhanakannya ke bentuk matematika. Kemampuan pemodelan matematika sangat bermanfaat bagi siswa dalam mengembangkan pengetahuan dan memperdalam konsep yang dimiliki. Dalam pembelajaran, kemampuan ini dibutuhkan dalam menyelesaikan soal-soal kontekstual. Namun, banyak siswa kesulitan dalam melakukan penyederhanaan masalah ke dalam model matematika khususnya pada materi Sistem Persamaan Linier Dua Variabel (SPLDV). Menerapkan model *Problem Based Learning* adalah salah satu upaya untuk meningkatkan kemampuan pemodelan matematika siswa. Penelitian ini menggunakan pendekatan kuantitatif dan menggunakan *Pre-Eksperimental Design* jenis *One-Group Pretest-Posttest Design*. Penelitian ini melibatkan seluruh siswa kelas VIII di salah satu sekolah di Aceh Besar. 31 siswa dipilih sebagai sampel, dan teknik *random sampling* digunakan. . Instrumen pada penelitian ini adalah soal tes kemampuan pemodelan matematika. Selanjutnya, uji-t satu pihak digunakan untuk menganalisis data yang diperoleh. Hasil penelitian menunjukkan bahwa model *Problem Based Learning* meningkatkan kemampuan pemodelan matematika siswa pada materi SPLDV. Penting bagi guru untuk terus mengasah kemampuan pemodelan siswa dengan membiasakan siswa menyelesaikan masalah sehari-hari menggunakan model matematika sehingga dapat meningkatkan kemampuan pemodelan matematika siswa. Meningkatkan kemampuan pemodelan siswa merupakan salah satu strategi untuk mengembangkan kemampuan pemecahan masalah matematis siswa yang menjadi landasan pembelajaran bermakna.

Kata kunci: Model *Problem Based Learning,* Kemampuan Pemodelan Matematika

Abstract

Mathematical modelling is the process of solving a problem in the real world by simplifying it into mathematical form. Mathematical modelling skills are very useful for students in developing knowledge and deepening their concepts. In learning, these skills are required in solving contextual problems. However, many students have difficulty in simplifying problems into mathematical models, particularly on the System of Linear Equation in Two Variables (SLETV). Applying the Problem-Based Learning model is one of the efforts to improve students' mathematical modelling skills. This research uses a quantitative approach and uses a pre-experimental design type of one-group pre-test-post-test design. This study involved all VIII grade students in one of the schools in Aceh Besar. 31 students were selected as samples, and a random sampling technique was used. The instrument in this study was a test question on mathematical modelling skills. Furthermore, one-party t-test was used to analyse the data obtained. The results showed that the Problem-Based Learning model improved students' mathematical modelling skills on SLETV material. It is important for teachers to continue to hone students' modelling skills by getting students used to solving everyday problems using mathematical models so as to improve students' mathematical modelling skills. Improving students' modelling skills is one of the strategies to develop students' mathematical problem-solving skills which are the foundation of meaningful learning.

Keywords: Problem-Based Learning Model, Mathematical Modelling Skills

Introduction

Mathematics is a field of study that is always used in life. Various human activities can be completed effectively and efficiently using mathematics, such as measurement and calculation; hence the need to strengthen mastery of mathematics from an early age is important. Math is a compulsory subject at primary to secondary school levels, even starting from kindergarten. However, the mastery of mathematics by students in Indonesia is very low, which can be seen from the educational achievements of Indonesian students in international rankings, which are far behind other countries in the field of mathematical literacy (numeracy). Based on the Programme for International Student Assessment (PISA) results released (OECD, 2019), Indonesia ranks 70th out of 81 countries, and its average numeracy score decreased from 2018 to 2022. In 2022, Indonesia obtained a score of 366, whereas in 2018, it obtained a score of 379. The low numeracy ability of Indonesian students is one of the reasons for linking real-world problems with mathematics. Many students think that mathematics is difficult to understand and boring; as a result, they have difficulty in understanding the problem (Jayanti, Arifin, & Nur, 2020).

Referring to the PISA results, Indonesia introduced the National Assessment (NA) to replace the National Examination (UN) in 2021. One of the NA instruments is the Numeracy Minimum Competency Analysis (MCA). The assessment on MCA consists of three aspects, namely content, cognitive process, and context (Pusat Asesmen dan Pembelajaran, 2021). In the cognitive process aspect, students are required to solve non-routine problems that require translation from the real world into mathematical models. AKM Numeracy consists of five contents, namely numbers, algebra, geometry, measurement, and data and uncertainty (Pusat Asesmen dan Pembelajaran, 2021).

Based on the results of observations carried out in November 2023 in one of the schools in Aceh Besar district, through the Class AKM test activities, it was found that around 80% of students were not proficient in analysing the problems in the problem. The cause of the problem is that students have not been able to solve contextual problems, one of which is the System of Linear Equation in two variables (SLETV) problem. Based on the test results, information was also obtained that students were still at the basic numeracy competency level, which means that students can only solve simple routine mathematical problems (Pusat Asesmen dan Pembelajaran, 2020). Therefore, this research focuses on SLETV material to support algebraic content in MCA Numeracy.

Mathematical modelling skills are needed by students in solving SLETV problems. This mathematical modelling ability is needed in one of the stages of solving SLETV, namely making mathematical models (Nugroho & Meisaroh, 2009). Agustini and Pujiastuti (2020) suggested that students still have difficulties when solving story-shaped SPLDV problems, such as being unable to understand the problem in the problem, being unable to convert contextual problems into mathematical models, and being unable to apply the concept of algorithm solutions with the correct method. These findings are reinforced by Khusna and

Ulfah (2021), who asserted that students' mathematical modelling skills were still very diverse; there were students who could not make mathematical models because they did not understand the problems given in the problem.

The method of expressing real-world problems in mathematical terms to find solutions to those problems is called mathematical modelling (Hartono & Karnasih, 2017). According to Brinus, Makur and Nendi (2019), mathematical modelling can also support solving concrete problems by transforming them into mathematical models. Mathematical modelling is fundamental because it provides more opportunities for students to develop their strengths and depths of understanding (Nursyarifah, Suryana, Abdul, & Lidinillah, 2017). Therefore, mathematical modelling plays an important role in mathematics learning and needs to be improved.

The application of an appropriate learning model is one way to improve students' abilities. As expressed by Djonomiarjo (2020), it is known that the learning model is one of the impacts that affect student learning outcomes. The appropriate model to improve students' mathematical modelling skills on SLETV for solving story problems is the problem-based learning model. One of the characteristics of this model is learning that begins with giving a problem. Problems that can be used during the learning process with the problem-based learning model are those found in the real world that are not simple (Johar & Hanum, 2021).

The connection between the problem-based learning model and mathematical modelling skills can also be seen in the advantages of the model. One of the advantages of the problem-based learning model is that it supports students to transfer their knowledge to master real-life problems, then improve their skills in solving the problems at hand so as to provide flexibility for them to use known knowledge in the real world (Haerullah & Hasan, 2017). The problem-based learning model is able to allow students to learn and practice solving real-world problems; as a result, they will apply the knowledge they learn and try to find new knowledge needed to turn a real-world problem into a mathematical model. Meanwhile, the use of the problem-based learning model on SLETV can facilitate students in forming their own knowledge about this material. This is in accordance with what Santoso, Yahya, and Isa (2023) found that the problem-based learning model can help students solve problems related to *SLETV* problems based on real-life problems. Therefore, the application of the problem-based learning model is a way used by researchers to overcome the problem of students' low mathematical modelling ability and low student learning outcomes on *SLETV*.

Based on the introduction that has been presented, the problem-based learning model is suitable for improving students' modelling skills on SLETV material. However, similar research has not been found. Therefore, it is important to carry out this research to obtain information about the application of problem-based learning model in improving the modelling skills of students, which will have an impact on the completeness of their learning outcomes on SPLDV material. Therefore, it is important to conduct this research.

Research Method

This research is experimental quantitative research, with the type of pre-experimental design being one-group pre-test-post-test. The population of this research is all students of class VIII of SMPN 1 Lhoknga in the 2023/2024 school year, which is spread over three classes, with the sample students of class VIII-1 selected through a simple random sampling technique. The research instrument was a test question in the form of a description consisting of three items with a difficulty level of the fifth cognitive (C5) The test questions in the form of descriptions aim to see the stages in solving student problems, especially in making mathematical models. The test questions are sourced from the 2013 curriculum mathematics book, grade VIII, which is in accordance with the learning and research objectives. Before being used in the study, the test questions were content validated by experts consisting of one lecturer in the mathematics education study program and a mathematics teacher.

The assessment of mathematical modelling skills on a scale of 0-3 refers to five indicators created by Maaß (2006). The score will be transformed into a scale of 1-100. The scoring guidelines for mathematical modelling skills are adapted from Nuryadi, Santoso, and Indaryanti (2018).

The data collection technique used two tests: before (pre-test) and after (post-test) treatment. The difference in the scores of the two tests will then be analysed with a right-sided t-test to determine whether there is an increase in students' mathematical modelling ability with the basic assumption that the data comes from a normally distributed population. The normality test uses the Lilliefors test with the test steps found below (Nuryadi, Astuti, Utami, & Budiantara, 2017).

Results and Discussion

The sample in this study was 31 students, but when the research was carried out, there were two students absent, so the data in this study became 29 students. This research data was obtained through tests twice, namely before and after treatment. Table 1 below presents the test results before (pre-test) and after (post-test) treatment.

Table 1. Students' test results before and after treatment

Before Treatment (*Pre-Test*)		**After Treatment (*Post-Test*)**	
Score	**Number of Students**	**Score**	**Number of Students**
0 - 20	28	0 - 20	0
21 - 40	1	21 - 40	10
41 - 60	0	41 - 60	13
61 - 80	0	61 - 80	3
81 - 100	0	81 - 100	3

Lilliefors is a normality test used in this study. Data normality testing was carried out with the help of MS. Excel. The results obtained were L-count = 0.117. Then, with $\alpha = 0.05$ and n = 29, L-table = 0.165. Because L-count < L-table, namely 0.117 < 0.165, it can be decided that H_0 is rejected and H_1 is accepted. Based on this statement, it can be concluded that the data comes from a normally distributed population. The next step is hypothesis testing.

Hypothesis testing was conducted to obtain a conclusion about students' mathematical modelling ability. The data came from a normally distributed population, so the hypothesis test was carried out using the right-side t-test with a significant level of 0.05. Hypothesis testing was carried out on the results of the difference between post-test and pre-test scores (Bi). From the results of the calculation of Bi using Microsoft Excel, the average value of Bi (B) is 42.15 and the standard deviation value of Bi (SB) is 17.921.

Based on the calculation obtained, t-count = 12.67. Then with α = 0.05 and dk = n-1 = 29-1 = 28, the obtained t-table = 1.70. Because t-count > t-table is 12.67 > 1.70, it can be decided that the results of hypothesis testing in this study are H_0 rejected and H_1 accepted. Based on this statement, it can be seen that there is an increase in students' mathematical modelling ability on SPLDV material through the problem-based learning model at SMPN 1 Lhoknga.

In line with the similar research conducted by Novianti, Yuanita, and Maimunah (2020) with different dependent variables, the results of this research revealed that the application of the problem-based learning model improved students' mathematical abilities. Pitriani (2016), with different independent variables, stated that RME is a suitable learning method to improve students' mathematical modelling ability. One of the factors that contribute to the improvements of students' modelling skills through the application of problem-based learning model is the direct involvement of students in determining and expressing the ideas obtained to solve the problems presented by the researchers.

Scoring students' answers is based on five indicators of mathematical modelling ability. Students' answers illustrate that there are several indicators of modelling ability that are not applied as problem-solving strategies. The results of scoring students' mathematical modelling skills are presented in Table 2 below.

Table 2. Scoring Results Based on Indicators of Mathematical Modelling Ability

Indicators	**No. Question**	**Number of Students on the Rating Scale**							
		Pre-Test				***Post-Test***			
		0	**1**	**2**	**3**	**0**	**1**	**2**	**3**
Understanding problem	1	21	6	1	1	4	4	4	17
	2	17	8	4	0	0	1	4	24
	3	16	10	3	0	3	0	11	15
Building a mathematical model	1	29	0	0	0	4	2	10	13
	2	29	0	0	0	1	1	4	23
	3	29	0	0	0	8	0	6	17
Solving problems with mathematical models	1	29	0	0	0	11	5	2	11
	2	29	0	0	0	3	1	11	14
	3	29	0	0	0	12	1	5	12
Interpret mathematical results into real-life situations	1	8	11	10	0	25	2	0	2
	2	19	7	2	1	23	1	0	5
	3	13	10	5	1	22	2	0	5
Validating the solution	1	29	0	0	0	21	0	0	6
	2	29	0	0	0	22	0	0	5
	3	29	0	0	0	23	0	0	3

Based on the results of the pre-test, students' answers on the indicator of understanding the problem are still not correct. As a result, students cannot make a mathematical model of the problem and are confused in using the right solution method. While in the indicator of interpreting mathematical results into real situations, students' statements are almost all correct, but the results obtained are still not correct. Based on the results of the post-test,

students' answers on the indicator of understanding the problem are correct. Students are able to write what is known and what is asked in the problem, so that students are able to make mathematical models and determine the right solution method. However, for the indicator of interpreting mathematical results into real situations, there are only a few students who return the results to the real-world context. For the indicator of validating the solution, it is dominated by students who do not recheck; this is because they are not accustomed to rechecking the results that have been obtained since they think the results are correct.

The most dominant indicator not applied is interpreting the results obtained into real situations and validating solutions. Putra, Thahiram, Ganiati, and Nuryana (2018) also stated that students are not careful in solving problems because they want to submit immediately without checking their answers again. For students who have not been able to make mathematical models, one of the factors is that they have not been able to understand the problems in the problem so that they have difficulty in determining what is known and asked.

Conclusion

The conclusion of this research is that there is an increase in the mathematical modelling ability of grade VIII students on SPLDV material through the problem-based learning model. The modelling ability of all students has increased compared to before learning by applying the problem-based learning model. In the pre-test, all students did not apply the indicators of building mathematical models and solving problems with mathematical models. However, in the post-test, all students applied both indicators although there were still students who did not get a perfect score for both indicators. Then, students still need enrichment related to the last two indicators of mathematical modelling ability, namely interpreting mathematical results into real situations and validating solutions.

The implications of the results of this study are (1) the need for follow-up in the form of enrichment related to indicators of interpreting mathematical results into real situations and validating solutions, (2) it is necessary to know the factors that cause students to have difficulty in these two indicators as anticipation by the teacher before being applied in class, and (3) it is necessary to conduct research on the development of learning tools that accommodate students' modelling skills. The limitations of this study are that learning tools to support mathematical modelling skills have not been fully implemented, and learning cannot be carried out according to the planned time because SPLDV material is at the end of the semester before the implementation of the AKM and midterm exam.

References

Agustini, D., & Pujiastuti, H. (2020). Analisis Kesulitan Siswa Berdasarkan Kemampuan Pemahaman Matematis dalam Menyelesaikan Soal Cerita Pada Materi SPLDV. *Media Pendidikan Matematika*, *8*(1), 18.

Brinus, K. S. W., Makur, A. P., & Nendi, F. (2019). Pengaruh Model Pembelajaran Kontekstual terhadap Pemahaman Konsep Matematika Siswa SMP. *Mosharafa: Jurnal Pendidikan Matematika*, *8*(2), 261–272.

Djonomiarjo, T. (2020). Pengaruh Model Problem Based Learning Terhadap Hasil Belajar. *Aksara: Jurnal Ilmu Pendidikan Nonformal*, *5*(1), 39.

Haerullah, A., & Hasan, S. (2017). *Model & Pendekatan Pembelajaran Inovatif (Teori dan Aplikasi)* (T. Abdullah, Ed.). Yogyakarta: Lintas Nalar.

Hartono, J. A., & Karnasih, I. (2017). Pentingnya Pemodelan Matematis dalam Pembelajaran Matematika. *Semnastika Unimed*, 1–8.

Jayanti, I., Arifin, N., & Nur, D. R. (2020). Analisis Faktor Internal dan Eksternal Kesulitan Belajar Matematika di Sekolah Dasar. *Sistema : Jurnal Pendidikan*, *01*(01), 1–7.

Johar, R., & Hanum, L. (2021). *Strategi Belajar Mengajar untuk Menjadi Guru yang Profesional* (C. R. Zahara, Ed.; Revisi). Banda Aceh: Syiah Kuala University Press.

Khusna, H., & Ulfah, S. (2021). Kemampuan Pemodelan Matematis dalam Menyelesaikan Soal Matematika Kontekstual. *Mosharafa: Jurnal Pendidikan Matematika*, *10*(1), 153–164.

Maaß, K. (2006). What are modelling competencies? *ZDM - International Journal on Mathematics Education*, *38*(2), 113–142.

Novianti, E., Yuanita, P., & Maimunah, M. (2020). Pembelajaran Berbasis Masalah dalam Meningkatkan Kemampuan Pemecahan Masalah Matematika. *Journal of Education and Learning Mathematics Research*, *1*(1), 65–73.

Nugroho, H., & Meisaroh, L. (2009). *Matematika SMP dan MTs Kelas VIII*. Jakarta : Pusat Perbukuan, Departemen Pendidikan Nasional.

Nursyarifah, N., Suryana, Y., Abdul, D., & Lidinillah, M. (2017). Penggunaan Pemodelan Matematik Untuk Meningkatkan Kemampuan Pemecahan Masalah Aritmatika Sosial Siswa Sekolah Dasar. *PEDADIDAKTIKA: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, *3*(1), 138–149.

Nuryadi, A., Santoso, B., & Indaryanti, I. (2018). Kemampuan Pemodelan Matematika Siswa Dengan Strategi Scaffolding With A Solution Plan Pada Materi Trigonometri Di Kelas X SMAN 2 Palembang. *Jurnal Gantang*, *3*(2), 73–81.

Nuryadi, Astuti, T. D., Utami, E. S., & Budiantara, M. (2017). *Dasar-Dasar Statistik Penelitian*. Yogyakarta: Sibuku Media.

OECD. (2019). *PISA 2018 Results: Combined Executive Summaries*. *I*.

Pitriani. (2016). Kemampuan Pemodelan Matematika dalam Realistic Mathematics Education (RME). *JES-MAT*, *2*(1), 65–82.

Pusat Asesmen dan Pembelajaran. (2020). *AKM dan Implikasinya pada Pembelajaran*.

Pusat Asesmen dan Pembelajaran. (2021). *Asesmen Nasional Lembar Tanya Jawab*. Jakarta: Badan Penelitian dan Pengembangan dan Perbukuan Kementerian Pendidikan dan Kebudayaan.

Putra, H. D., Thahiram, N. F., Ganiati, M., & Nuryana, D. (2018). Kemampuan Pemecahan Masalah Matematis Siswa SMP pada Materi Bangun Ruang. *Jurnal Ilmiah Pendidikan Matematika)*, *6*(2), 82–90.

Santoso, H. B., Yahya, L., & Isa, D. R. (2023). Model Problem Based Learning: Efektivitasnya Dalam Meningkatkan Hasil Belajar Sistem Persamaan Linear Dua Variabel. *Euler : Jurnal Ilmiah Matematika, Sains Dan Teknologi*, *11*(1), 16–21.

Sudjana. (2005). *Metoda Statistika*. Bandung: Tarsito.