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Mathematical Modeling Problem Solving Viewed from Students' Mathematical Self-Concept on Means-Ends Analysis Based on Blended Learning

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Abstract

Students are less able to work on mathematical problems due to difficulties understanding information and connecting real problems into mathematical models, resulting in low problem-solving abilities and mathematical self-concept. This study aims to (1) determine students' problem solving ability with mathematical modeling through the Means-Ends Analysis (MEA) model based on blended learning to achieve classical completeness (2) to determine students' problem solving ability with mathematical modeling through the MEA model based on blended learning and online PBL learning, (3) to determine the effect of mathematical self-concept on students' problem solving abilities, (4) describe the students' problem solving ability with mathematical modeling based on the mathematical self-concept. The research method used was a mixed-method. The population of this study was students of class VIII Junior High School 2 Purbalingga in the academic year 2021/2022, with students of class VIII B (experimental group) and VIII H (control group) taken by simple random sampling method. In the qualitative study, six subjects were taken from the experimental group using purposive sampling. The results showed that the problem-solving ability with mathematical modeling through the MEA model based on blended learning had not yet achieved classical completeness, but the test results with this model were better than the results of the online PBL model. Mathematical self-concept has a positive effect on students' problem solving abilities by 41.3%. Previously, subjects with high mathematical self-concept tended to fulfill all indicators of problem solving ability with mathematical modeling, while subjects with mathematical self-concept tended to have different achievement indicators.

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1. Introduction

One of the functions of education is to develop cognitive abilities and potentials to improve the quality of human resources. There are many subjects in the educational curriculum in schools including mathematics. Mathematics learning is expected to be able to contribute in order to develop the ability of students so that they are equipped to live life, and can follow the development of modern information and technology. In addition, "Mathematics is used in science, the social science, medicine and commerce" (NCTM, 2000). Mathematics is an important science, but in reality mathematics lessons are less desirable, feared, and boring for students (Novriani & Surya, 2018). Then, according to NCTM (2000) there are five standard processes in learning mathematics, namely the process of problem solving, reasoning and proof, communicating, connection, and representation. Problem solving is one of the most important cognitive aspects used in everyday life, and mathematical problem solving is also the most important part in the field of mathematics (Aljaberi, 2015).

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From the description above, it can be underlined that one of the abilities that must be mastered by students in learning mathematics is problem solving ability. Similarly, Maciejewski (2016) argues that problem solving has become the main focus of mathematics education. The importance of problem solving in learning mathematics is also in line with the statement of NCTM (2000), that problem solving is an integral part of learning mathematics, so that in learning mathematics problem solving cannot be separated. So that students are accustomed to solving mathematical problems related to everyday life, tools are needed to connect concrete problems into mathematical models where solutions will be sought later. The model is a simplification of real-life problems in the form of mathematics (Rahmawati et al., 2018). Mathematical modeling is the ability to apply concepts learned in class to real-world applications and use models to analyze situations, draw conclusions, and make predictions (Santos et al., 2015). Mathematical modeling is the process of solving real-world problems through mathematics, from a cognitive point of view (Blum, 2015). Mathematical modeling is closely related to problem solving. This is in line with the research conducted by Santos et al. (2015) with the results that mathematical modeling is effective in learning problem solving topics in mathematics. Thus, one of the lessons that can be used to improve problem solving skills is learning by using mathematical modeling.

Mathematical problem solving ability is the ability of a student to solve mathematical problems. Problem solving is done by taking steps and references. Similarly, the opinion of Nurliastuti et al. (2018) that problem solving is the focus in learning mathematics which includes problems with alternative solutions in various ways, so an effective strategy is needed to improve students' ability in solving mathematical problems. Polya formulated four stages of problem solving, namely: 1) understanding the problem, 2) planning a solution, 3) carrying out a settlement plan, 4) re-examining the solution (Polya, 1973).

The 2013 curriculum places problem solving as an important aspect that is useful for developing students' skills in the future. However, the current students' mathematical problem solving abilities have not shown satisfactory numbers. This can be seen from the results of the TIMSS (Trend in International Mathematics and Science) and Program International for Student Assessment (PISA) surveys as international indicators to see the mathematics achievement or ability of students in Indonesia, both of which show that OECD, (2018) in PISA 2018 Indonesia's mathematical ability is ranked 72 with a score of 379 below the average, which is 489 out of 78 countries. In addition, look at the results of the 2019 AKSI (Indonesian Student Competency Assessment) conducted by Puspendik (Center for Educational Assessment) in collaboration with the Ministry of Education and Culture (Kemdikbud) in 34 provinces in Indonesia to measure the ability of students in three subjects, namely Indonesian. , Mathematics, and Natural Sciences specifically to measure higher order thinking skills, including problem solving abilities, shows that the national average of students' mathematical abilities is still low, 79.44% with less criteria, 18.98% with sufficient criteria, and only 1.58% with good criteria. So that the results of research both nationally and internationally show that the mathematical ability of students in Indonesia is still in the low category, including problem solving abilities.

The 2019 National Examination, mathematics ranks the lowest, so mathematical problem solving skills, especially at Junior High School 2 Purbalingga still need to be developed. Data on the absorption capacity of the 2019 National Examination for Junior High School 2 Purbalingga from 40 indicators, there are still 19 indicators that are low. In particular, the indicator for solving straight-line equations at Junior High School 2 Purbalingga is still not optimal. In addition, according to the results of interviews with mathematics teachers at Junior High School 2 Purbalingga, the problem solving abilities of students at Junior High School 2 Purbalingga are still not optimal and need to be improved. Students still have difficulty identifying questions, writing down what is known and asked, and determining the completion of a non-routine problem. Students also still have difficulty solving problems that are different from what is exemplified.

Every student has a different way of thinking. The way students think also affects the success of students in solving mathematical problems in their own way from the abilities they have in mind. This success is related to the self-concept of each student. Self-concept can be used to predict the level of students' mathematical problem solving abilities (Musriandi, 2017). Self-concept is generally defined as the perception of oneself (Wu & Cheung, 2012). Self-concept is an attitude or affective aspect that must be possessed by students. According to Shavelson et al. (1976) there are several self-concepts in the academic field, one of which is mathematics, which is then called the mathematical self-concept. Self-concept in mathematics can be defined as students' assessment of their skills, abilities, enjoyment, and interest in mathematics as an important factor in their achievement in mathematics (Peteros et al., 2020). Someone who has confidence in himself makes him more daring to take action in solving problems so that he gets success. This is in line with the research of Wu & Cheung (2012) which states that there is a strong relationship between self-concept and one's success.

The learning model that is thought to be able to improve problem solving skills is Means-Ends Analysis (MEA). MEA is the process of solving a problem into several sub-goals and being completed sequentially so as to achieve the final goal (Nurhadi, 2017). Learning MEA can improve problem solving skills, think creatively and carefully in dealing with mathematical problems (Juanda et al., 2014). The MEA learning model begins with giving students problems, then the problems are broken down into existing sub-problems by first understanding the problem and the final goal to be achieved. After the sub-problems are formed, students can solve them sequentially with their abilities.

Difficulty in understanding the information contained in the questions and the inaccuracy of the adjustment steps used resulted in the low problem-solving abilities of students (Mulasari et al., 2020). Through MEA learning, students are directed to understand the problem by dividing it into simpler parts, thus students can distinguish the information and objectives of the given problem, then develop effective strategies to solve it.

There are many challenges in the implementation of mathematics learning in schools that are faced by students and educators, especially in this era of the COVID-19 pandemic, where learning is carried out online and in very limited meetings. Efforts to improve the quality of learning continue to be made. One of them is using the development of technology and information. Currently learning in schools, including mathematics, must adapt to the development of science and technology to face society 5.0 by integrating various innovations in the era of the industrial revolution 4.0. To face the challenges of society 5.0, it takes individuals with good problem-solving skills in facing the challenges of an increasingly complex era.

Blended learning is a learning system that combines traditional systems with modern systems in this case the use of technology, if viewed in theory and practice it is very appropriate if applied during the COVID-19 pandemic (Budiyono, 2020). Viewed from the perspective of space and time (synchronicity) blended learning is a learning that combines the most relevant synchronous and asynchronous learning activities to create an optimal learning experience (Chaeruman et al., 2018). Research by Sulistiyoningsih et al. (2015) and Yanti et al. (2019) results that there is an increase in students' mathematical problem solving abilities after the implementation of e-learning and blended learning models.

Based on the statement above, the purpose of this study were to find out (1) determine students’ problem solving ability with mathematical modeling through the MEA model based on blended learning to achieve classical completeness (2) to determine students’ problem solving ability with mathematical modeling through the MEA model based on blended learning and online PBL learning, (3) to determine the effect of mathematical self-concept on students’ problem solving abilities, (4) describe the students’ problem solving ability with mathematical modeling based on the mathematical self-concept. The research method used was a mixed-method.

2. Methods

The type of research used in this study was a mixed method with explanatory sequential design. According to Creswell & Creswell (2018) explanatory sequential is a method in which the researcher first conducts quantitative research, analyzes the results and then builds the results to explain them in more detail with qualitative research. The quantitative research design used was a quasi-experimental (quasi-experimental). The use of this quasi-experimental method is based on the consideration that the existing classes have been formed previously so that groupings are not carried out randomly. The form of quasi-experimental design used by the researcher was posttest-only with nonequivalent group design. In this design the experimental group and the control group were chosen randomly with both groups only being given a posttest (Sugiyono, 2016).

The research was conducted at Junior High School 2 Purbalingga which is located at Jalan Letkol Isdiman No. 194, Bancar, Purbalingga District, Purbalingga Regency. The study was conducted on October 11 – November 16, 2021. The population in this study were students of class VIII Junior High School 2

Purbalingga in the academic year 2021/2022. Class VIII Junior High School 2 Purbalingga consists of 8 classes. Simple random sampling was chosen as the sampling method in this study. Two classes were chosen, namely class VIII B as the experimental group and VIII H as the control group. The experimental group received problem-solving learning with mathematical modeling through the MEA model based on blended learning, while the control group received online Problem Based Learning. Research subjects were taken as many as 6 students from the experimental group with purposive sampling method.

The variables of this research are problem solving skills with mathematical modeling and students' mathematical self-concepts. Data collection methods used are test methods, mathematical self-concept questionnaires, and interviews. The test method was used to collect data on problem-solving abilities with mathematical modeling after learning mathematics with the Means-Ends Analysis model based on blended learning and online Problem Based Learning. The questionnaire method was used to measure the mathematical self-concept of experimental group students as the basis for grouping students into high, medium, and low categories. The interview method in this study was carried out in an unstructured manner to obtain data on problem solving abilities with mathematical modeling based on students' mathematical self-concepts.

3. Results & Discussions

3.1. Quantitative Data Analysis

Problem solving ability in this study was measured by tests given to the experimental group and the control group after learning the straight-line equation was completed. The posttest is done individually by students with a description of 8 items according to the material that has been delivered. Giving is done by researchers with a reference to the assessment rubric.

Table 1. Descriptive Statistics of Problem-Solving Ability Data.

Group	N	Mean	SMI	SD	Min	Max
Experiment	27	74.444	100	10.916	48	90
Control	28	66.964	100	13.569	46	90

The test data were tested for normality and homogeneity before testing the hypothesis. From the test, it was found that the two sample groups came from populations that were normally distributed and had homogeneous variances. Therefore, hypothesis testing can be continued.

3.1.1. Hypothesis 1

Hypothesis 1 test was conducted to determine the problem-solving ability of students with mathematical modeling through MEA based on blended learning, especially in the material of straight-line equations whether or not they had achieved classical learning completeness. The mathematical problem-solving ability of students achieves classical completeness if at least 70% of students reach the mastery learning of 70. Thus, the statistical test used to prove the classical mastery of students is the right-hand proportion test. Based on the results of the calculation of the proportion test with π_0 = 0.70 and z_{table} = 1.64, the value of z_{count} = 0.46 is obtained. Based on the test criteria $z < z_{(0.5-\alpha)}$ then H_0 is accepted. So, it was concluded that the problem-solving ability of students with mathematical modeling through MEA based on blended learning did not achieve classical completeness.

In its application, MEA based on blended learning has two learning phases, namely, the asynchronous phase and the synchronous phase. In the asynchronous phase, students can learn independently outside of class hours. Learners can learn anywhere, anytime, and adapt to their respective abilities and learning conditions. Students can study material, such as reading teaching materials, viewing other material references online to deepen what has been learned by participating in discussion groups and applying what has been learned by doing the given online assignments.

In the synchronous phase, the learning syntax used is (1) heuristic problem presentation, (2) simple problem solving, (3) identifying differences, (4) compiling sub-problems and problem solving strategies,

(5) evaluating and concluding. The first stage is presenting the problem heuristically in the MEA model, which aims to make students have a high curiosity about a problem and can design problem-solving strategies. The second stage, which is breaking down the problem into simple ones, aims that students can detail the problem or elaborate the problem so that the problem can be solved part by part. At this stage, students are given worksheet and are directed to understand the problem-solving process and can discuss it with the groups that have been created. The third stage, which is compiling sub-problems and problem-solving strategies, aims to enable students to obtain information from the results of discussions in their groups and from presentations from other groups, so that they are able to find out which group-solving strategy is the best. The fourth stage, evaluating and concluding aims that students can evaluate the results of their discussions after seeing the results of other group discussions, so that they are able to conclude the final results of solving problems that have been done.

These stages can make students trained in developing problem solving skills with mathematical modeling. This agrees with research by Mariani & Susanti (2019), which shows that students' problem-solving abilities using the MEA learning model can be categorized as good. However, the results of research conducted by researchers show that the problem-solving ability of mathematical modeling through the MEA model based on blended learning has not yet achieved classical completeness. According to the researcher's assumptions, there are several factors that cause students to have not achieved classical completeness, namely they are not familiar with distance learning, especially in mathematics subjects which most students find difficult. According to Pietro et al., (2020) distance learning makes students less externally motivated to engage in learning activities. The researcher also observed that there were some students who did not show their enthusiasm in participating in distance learning. The shift from offline to online learning caused by the COVID-19 pandemic tends to have a negative impact on primary and secondary school children who have higher difficulties in adapting to new learning environments, in this case the virtual environment (Pietro et al., 2020).

Another cause of incomplete learning is that there are many assignments given by other subject teachers. The reduction in class hours due to the COVID-19 pandemic has resulted in the material being taught to students becoming increasingly dense. Teachers tend to give more assignments to pursue the material that must be mastered by students. This causes students' learning anxiety, especially mathematics anxiety. Wu & Cheung (2012) found that math anxiety had a pronounced effect on more demanding computations and found that math anxiety had an equally detrimental impact on math achievement regardless of whether children had number-related anxiety or situational and social experiences at work. mathematics.

In addition, the relatively short research time also affects the failure to achieve classical completeness. Suggestions from researchers to realize the achievement of classical completeness in problem solving abilities should research be carried out in a longer period of time so that the research results obtained are more accurate and valid and researchers can develop and observe the development of problem solving abilities with mathematical modeling on each student in more detail.

Although not achieving classical completeness, the mathematics learning process with the MEA model shows the enthusiasm of students in learning which continues to change for the better. This can be seen from the implementation of learning at the first meeting and the second meeting which showed changes for the better. With the asynchronous learning, students get a wider discussion space, but still under the observation of researchers. Students can ask and answer questions which are then clarified by the researcher if something is not quite right.

3.1.2. Hypothesis 2.

Hypothesis 2 test was conducted to determine the problem-solving ability of students with mathematical modeling through the MEA based on blended learning which is better than the problem-solving abilities of students by learning Problem Based Learning online on straight-line equation material. Thus, the statistical test used is the t-test with the Independent Sample T-Test and the one-sided Proportion Test. The t-test was used to test the average similarity of the two sample groups with a significance level of 5%, a significance value of $0.0145 < 0.05$ was obtained, so H_0 was rejected. Thus, it is concluded that the average problem-solving ability of students using mathematical modeling through the MEA based on blended learning is more than the average problem-solving ability of students using Problem Based Learning.

In addition to the average test to strengthen hypothesis 2, a proportion test was also carried out. The proportion test used is the right side proportion test. This test is used to determine whether the proportion of problem solving ability in the experimental group is better than the proportion in the control group. Based on the results of the calculation of the proportion test with z_{table} = 1.64 and value of z_{count} = 17.401 means H_0 was rejected. So, it can be concluded that the proportion of students' problem-solving abilities with mathematical modeling through the MEA based on blended learning is more than or equal to the proportion of students' problem-solving abilities using Problem Based Learning.

From the two statistical tests, it can be concluded that the results of the problem-solving ability test using mathematical modeling through the MEA based on blended learning are better than the results of the problem-solving ability test using the Problem Based Learning Model. This is also corroborated by the opinion of Juanda et al. (2014) with his research obtained the results that the improvement of problem solving and mathematical communication skills of students who received learning using the MEA model was better than students who received conventional learning. Therefore, problem solving learning with mathematical modeling through the MEA based on blended learning can be used as an alternative for teachers so that students are able to grow mathematical problem solving skills.

In the experimental group learning, namely MEA based on blended learning, the researcher gave part A of the worksheet to observe and find the concepts of straight-line equations, line gradients, and straight-line gradient properties as asynchronous learning. This is done before synchronous learning with the aim of stimulating students to prepare and have a lot of time to understand the material given. The researcher also opened an asynchronous discussion room in the WhatsApp group with the previously formed group. Then in the synchronous phase, students are given worksheet containing questions to develop mathematical problem-solving ability with mathematical modelling, so that distance learning takes place quite actively and effectively. Meanwhile, for online problem-based learning, students are given worksheet only during core activities. This results in students being less prepared for online learning because the material provided is too much.

The achievement of mathematics learning is not only influenced by cognitive aspects, but is also influenced by psychological aspects of students (Elita et al., 2019). One of the psychological aspects is the mathematical self-concept. In particular, mathematical self-concept is a person's perspective in seeing the strengths and weaknesses of himself. A person's mathematical self-concept is driven by a feeling of confidence in his ability to succeed in mathematics (Wilkins, 2010). Students will find it difficult to solve problems if they have low self-concept (Kharisudin & Cahyati, 2019). This shows that someone with high self-concept has high confidence that they will also succeed in learning mathematics, while someone with low self-concept will feel less confident in their ability to mathematics (Ayodele, 2011).

3.1.3. Hypothesis 3.

Hypothesis 3 test was conducted to determine the effect of mathematical self-concept (X) on students' problem-solving abilities (Y) in the MEA based on blended learning. Thus, the statistical test used is a simple linear regression test. Researchers tested the classical assumptions before testing linear regression analysis. After the classical assumption test showed that the data met the requirements for a simple linear regression test.

The calculation results in the ANOVA table show that the value of sig. is 0.000. Based on the test criteria, 0.000 < 0.05, so H_0 was rejected. Thus, it is concluded that there is an effect of mathematical self-concept on the problem solving ability of students in the experimental group. Because there is a linear relationship or influence between the mathematical self-concept variable and the problem-solving ability variable, the linear regression model can be used.

The output results in the Coefficients table show the value of sig. 0.000 < 0.05, so it can be concluded that the regression coefficient is significant. The regression model for the X_SCM variable to the Y_KPM variable can be written in the form of the equation Y =38.815 + 0.543X.

Based on the output of the Summary Model, the correlation coefficient between the mathematical self-concept variables and the problem-solving ability is 0.642. This shows a substantial and positive relationship between the two. The value of the coefficient of determination of the mathematical self-concept on problem-solving abilities is 0.413. This means that the contribution of mathematical self-concept to variations in the ups and downs of students' problem-solving abilities is 41.3% and the rest is caused by other factors.

In this study, the results of grouping mathematical self-concepts and mathematical modeling problem solving abilities showed a relationship that students with high mathematical self-concepts had problem-solving abilities in the high and medium categories, students with moderate mathematical self-concepts had problem solving abilities in the high, low and medium. Students with low mathematical self-concept had problem-solving abilities in the medium and low categories.

3.2. Qualitative Data Analysis

After the data on the results of the problem-solving ability test with mathematical modeling were obtained by the researchers, then the data were grouped based on the level of students' mathematical self-concepts into three groups of levels, namely high, medium, and low.

Measurement of the mathematical self-concept questionnaire using a Likert scale. The mathematical self concept scale in this study was adapted from the mathematical self concept scale developed by Gourgey (1982). The mathematical self-concept indicators used in this study include (1) students' views on their mathematical abilities, (2) students' views on their ideal self-image or ideal mathematical abilities that they want to have, (3) students' assessment of whether they are he is included as a person who is relatively successful or relatively failed in learning mathematics (Susilawati et al., 2020).

This study uses four indicators of problem-solving ability with mathematical modeling, namely: (1) identifying quantities and units correctly, characterized by students being able to write down what is known and asked correctly and provide symbols/variables from questions correctly; (2) develop a mathematical model based on the controlling law; (3) determine the model solution correctly; (4) interpreting the model solution in the form of a problem solution.

Of the 27 students in the experimental group, there were 3 students in the high mathematical self-concept category, 19 students in the medium mathematical self-concept category, and 5 students in the low mathematical self-concept category.

The selection of research subjects using purposive sampling technique. After obtaining data from the results of the student's mathematical self-concept questionnaire, then they are sorted from the highest to the lowest score. After that, two students were selected from each category of mathematical self-concept representing the high, medium, and low categories by considering the results of the problem-solving ability test, student activities during mathematics learning, and suggestions from the homeroom teacher. The selected subject will conduct an interview. In the following, the research subjects selected for the interview are presented.

Table 2. Recapitulation of Problem-Solving Ability Score and Mathematical Self-Concept Score

Student Code	Subject Code	Category Of Mathematical Self-Concept	Problem-Solving Ability Score	Mathematical Self-Concept Score
E-4	S-1	Hight	90.36	88
E-16	S-2		89.64	90
E-6	S-3	Medium	66.21	84
E-23	S-4		60.80	65
E-19	S-5	Low	51.08	62
E-21	S-6		47.25	63

The work of the selected subject is then used as the basis for conducting interviews. The interview aims to describe the thought process of each subject and ensure that the data obtained are valid. Interviews were conducted based on the results of the posttest of mathematical modeling problem solving abilities given after the experimental group received treatment. The following will show one of the results of the work of the undergraduate research subject at number 1.

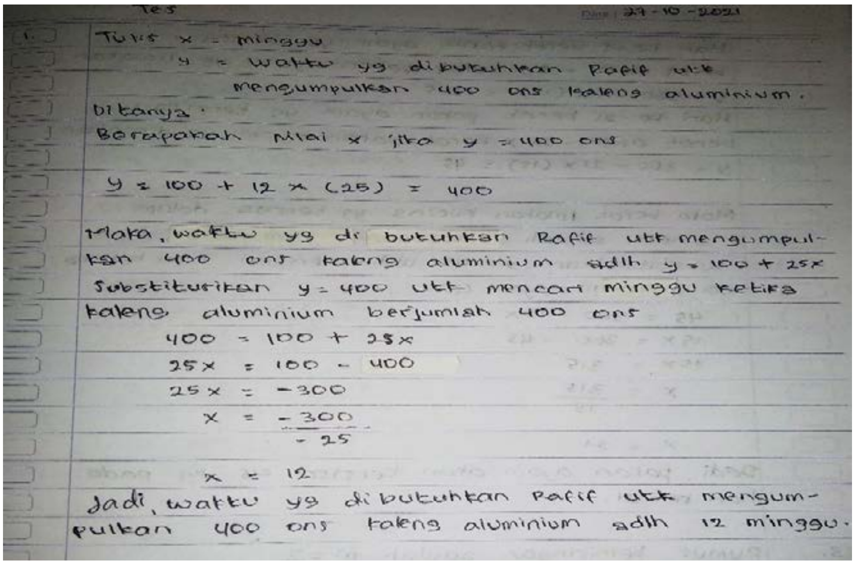

Figure 1. The Result of S-1 Subject

Based on the results of S1's written work on item number 1, it appears that S1 has met four indicators of problem-solving ability with mathematical modeling. S-1 can write down what is known, asked, and provide symbols/variables of the magnitude or problem in the problem. S-1 can write a mathematical model of the problem in the form of a function or a linear equation. S-1 can carry out exact calculation steps to determine the model solution by finding the y-value of the straight-line equation. S-1 can determine the time required to collect aluminium cans based on the model solution.

Based on the results of the interview, S-1 categorizes question number 1 as an easy question. S-1 can mention the information that is known and the purpose or what is asked of the question and distinguish it. S-1 can tell a strategy to solve problem number 1 that suppose the time is x and the weight of the aluminium can is y, from there S-1 makes the equation $y = 100 + 25x$. Then substitute the value of $y = 400$, then look for the value of x. S-1 can perform calculations precisely to get the model solution without difficulty and is sure of the answer. S-1 can also mention other alternative solutions and double-check the answers that have been obtained. S-1 can write the conclusion of the answer based on the model solution. At the time of the S-1 interview, he could also state the conclusion of the answer, namely the time it took Rafif to collect aluminium was 12 weeks.

Based on the analysis of written results and interviews, it can be concluded that S-1 can understand the questions well and can solve problems with mathematical modelling and appropriate steps. S-1 can also write and mention problem solutions based on model solutions appropriately. So that there is consistency in the written results and interviews.

Based on data from each research subject, students with high mathematical self-concept namely S1 and S2 have high problem-solving abilities. S-1 and S-2 are capable of problem-solving with mathematical modeling indicators 1 to 4. S-1 and S-2 can consistently understand the questions marked on almost all questions S-1 and S-2 can write what is known, asked, and provides symbols/variables from suggestions or problems in the problem. In almost all S-1 and S-2 questions, you can write a mathematical model of the problem. S-1 and S-2 can work on all the questions according to the right steps, although there are some questions that are wrong in the calculations. on almost all questions S-1 and S-2 can determine the solution of the problem based on the model solution. The following is an example of the work of S-1 using mathematical modeling steps.

The interview subjects for the problem-solving ability of mathematical modeling with moderate self-concept are S-3 and S-4. Based on the results of the analysis, it is concluded that S-3 and S-4 have different achievement indicators of problem-solving abilities with mathematical modeling. S-3 is able to achieve problem solving indicators with mathematical modeling 1 to 3, while S-4 is able to achieve indicator 1, but indicator 2 is not able to be achieved perfectly and indicators 3 and 4 have not been achieved.

Interview subjects for mathematical modeling problem solving skills with low self-concept are S-5 and S-6. Based on the results of the analysis, it is concluded that there are differences in the achievement of indicators of problem-solving ability with mathematical modeling for S-5 and S-6. S-5 is capable of problem-solving indicators with the first mathematical modeling, but indicators 2, 3, and 4 are not able to be achieved perfectly, while S-6 are able to achieve indicator 2, while indicator 3 is less able to be achieved perfectly and indicator 1 and 4 has not been reached.

4. Conclusion

The results of research on problem-solving skills using mathematical modeling through the MEA learning model based on blended learning in class VIII students of Junior High School 2 Purbalingga show that (1) problem-solving abilities with mathematical modeling students through the Means-Ends Analysis model based on blended learning has not reached classical completeness; (2) problem solving ability with mathematical modeling of students through the MEA learning model based on blended learning is better than the problem solving ability of Problem Based Learning; (3) students' mathematical self-concept has a positive effect on problem solving abilities by 41.3%; (4) Subjects in the high self-concept category tend to fulfill all indicators of mathematical modeling problem solving abilities, medium and low self-concept category subjects tend to have various indicators of mathematical modeling problem solving ability indicators.

References

Aljaberi, N. M. (2015). University Students' Learning Styles and Their Ability to Solve Mathematical Problems. *International Journal of Business and Social Science*, *6*(41), 152–165.

Ayodele, O. J. (2011). Self-concept and performance of secondary school students in mathematics. *Journal Od Education and Developent Psychology*, *1*(1), 176–183. https://doi.org/10.5539/jedp.v1n1p176

Blum, W. (2015). Quality Teaching of Mathematical Modelling: What Do We Know, What Can We Do? *The Proceedings of the 12th International Congress on Mathematical Education*, 73–96. https://doi.org/10.1007/978-3-319-12688-3

Budiyono, F. (2020). Implementasi Blended Learning di Masa Pandemi Covid 19. *Prosiding Diskusi Daring Tematik Nasional 2020 "Pendidikan Di Masa Pandemi: Menelaah Dari Daerah," September*, 9-12. Malang.

Chaeruman, A. U., Wibawa, B., & Syahrial, Z. (2018). Creating a blended learning model for online learning system in Indonesia. *International Journal of Engineering & Technology*, *7*(3.36), 156. https://doi.org/10.14419/ijet.v7i3.36.29098

Creswell, J. W., & Creswell, J. D. (2018). *Research Design Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.). SAGE Publications, Inc.

Elita, G. S., Habibi, M., Putra, A., & Ulandari, N. (2019). Pengaruh pembelajaran problem based learning dengan pendekatan metakognisi terhadap kemampuan pemecahan masalah matematis. *Mosharafa: Jurnal Pendidikan Matematika*, *8*(September), 447–458. https://doi.org/10.31980/mosharafa.v8i3.517

Gourgey, A. F. (1982). *Development of a Scale for the Measurement of Self-Concept in Mathematics*.

Juanda, M., Johar, R., & Ikhsan, M. (2014). Peningkatan Kemampuan Pemecahan Masalah dan Komunikasi Matematis Siswa SMP melalui Model Pembelajaran Means-ends Analysis (MeA). *Jurnal Kreano*, *5*(2), 105–113. https://doi.org/10.15294/kreano.v5i2.3322

Kharisudin, I., & Cahyati, N. E. (2019). Problem-solving ability using mathematical modeling strategy on model eliciting activities based on mathematics self-concept Problem-solving ability using mathematical modeling strategy on model eliciting activities based on mathematics self-concept. *Journal of Physics: Conference Series*, 1–7. https://doi.org/10.1088/1742-6596/1567/3/032067

Maciejewski, W. (2016). Future-Oriented Thinking and Activity in Mathematical Problem Solving. In P. Liljedahl & M. Santos-Trigo (Eds.), *Mathematical Problem Solving Current Themes, Trends, and Research* (pp. 21–38). ICME-13 Monographs.

Mariani, Y., & Susanti, E. (2019). Kemampuan Pemecahan Masalah Siswa Menggunakan Model Pembelajaran Mea (Means Ends Analysis). *Lentera Sriwijaya : Jurnal Ilmiah Pendidikan*

Matematika, *1*(1), 13–26. https://doi.org/10.36706/jls.v1i1.9566

Mulasari, M. R., Wulandari, I., & Putra, M. (2020). Model pembelajaran means ends analysis terhadap hasil belajar matematika siswa SD. *Jurnal Pedagogi Dan Pembelajaran*, *3*(3), 358–366. https://doi.org/10.23887/jp2.v3i3.25812

Musriandi, R. (2017). Hubungan Antara Self-Concept Kemampuan Pemecahan Masalah Matematis Siswa. *Jurnal Dedikasi Pendidikan*, *1*(2), 150–160.

NCTM. (2000). *Principles and Standards for School Mathematics*. The National Council of Teachers of Mathematics, Inc.

Novriani, M. R., & Surya, E. (2018). Analysis of Student Difficulties in Mathematics Problem Solving Ability at MTs SWASTA IRA Medan. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, *33*(July 2017), 37–63.

Nurhadi, M. (2017). Pengaruh Strategi Means-Ends Analysis dalam Meningkatkan Kemampuan Penalaran Matematis Siswa Sekolah Menengah Pertama. *Jurnal Penelitian Dan Pembelajaran Matematika*, *10*(1), 89–98. https://doi.org/http://dx.doi.org/10.30870/jppm.v10i1.1201

Nurliastuti, E., Dewi, N. R., & Priyatno, S. (2018). Penerapan Model PBL Bernuansa Etnomatematika untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis dan Motivasi Belajar Siswa. *PRISMA 1*, *1*, 99–104.

OECD. (2018). *PISA 2018 Results What Students Know And Can Do Volume I: Vol. I*. OECH Publishing. https://doi.org/10.1787/5f07c754-en

Peteros, E., Gamboa, A., Etcuban, J. O., Dinauanao, A., Sitoy, R., & Arcadio, R. (2020). Factors Affecting Mathematics Performance of Junior High School Students. *International Electronic Journal of Mathematics Education*, *15*(1), 1–13. https://doi.org/10.29333/iejme/5938

Pietro, D., Costa, P., & Karpiński, Z. (2020). *The likely impact of COVID-19 on education : Reflections based on the existing literature and recent international datasets*. Luxembourg: Publications Office of the European Union. https://doi.org/10.2760/126686

Polya, G. (1973). *Polya How To Solve It*. Princeton University Press.

Rahmawati, D., Darmawijoyo, & Hapizah. (2018). Desain pembelajaran materi fungsi linier menggunakan pemodelan matematika. *Aksioma Jurnal Pendidikan Matematika FKIP Univ. Muhammadiyah Metro*, *7*(1), 65 – 81. https://doi.org/10.24127/ajpm.v7i1.1311

Santos, M. L. K. P., Dias, R. V, & Belecina, R. R. (2015). Mathematical modeling : effects on problem solving performance and math anxiety of students. *International Letters of Social and Humanistic Sciences*, *65*, 103–115. https://doi.org/10.18052/www.scipress.com/ILSHS.65.103

Shavelson, R. J., Hubner, J. J., & Stanton, G. C. (1976). Self-Concept: Validation of Construct Interpretations. *Review of Educational Research*, *46*(3), 407–441. https://doi.org/10.3102/00346543046003407

Sugiyono. (2016). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Sulistiyoningsih, T., Kartono, & Mulyono. (2015). Pbl bernuansa adiwiyata dengan blended learning untuk meningkatkan kemampuan pemecahan masalah dan karakter peduli lingkungan. *Unnes Journal of Mathematics Education Research*, *4*(2), 84–92.

Susilawati, S., Pujiastuti, H., & Sukirwan, S. (2020). Analisis Kemampuan Berpikir Kreatif Matematis Ditinjau Dari Self-Concept Matematis Siswa. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *4*(2), 512–525. https://doi.org/10.31004/cendekia.v4i2.244

Wilkins, J. L. M. (2010). Mathematics and Science Self-Concept. *The Journal of Experimental Education*, *72*(4), 331–346. https://doi.org/10.3200/JEXE.72.4.331-346

Wu, J., & Cheung, H. Y. (2012). The Relations Of Academic Cheating With Academic Self-Concept And Perceived Autonomy Support Among Chinese University Students. In K. Gana (Ed.), *Psichology of Self-Concept* (pp. 61–72). Nova Science Publishers, Inc.

Yanti, F. N., Sugiharta, I., & Farida. (2019). Analisis Kemampuan Pemecahan Masalah Matematis : Dampak Blended Learning Menggunakan Edmodo. *Desimal: Jurnal Matematika*, *2*(2), 173–180. https://doi.org/10.24042/djm.v2i2.4035