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Improving 8th-grade students' problem-solving skills and self-efficacy in probability using discovery learning

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Abstract
This study aims to improve students' problem-solving skills and self-efficacy with the discovery learning model on the probability material for grade of VIII SMP. This type of research is classroom action research which is carried out in two cycles, with each cycle consisting of planning, action, observation and reflection stages. The subjects of this research were 32 students from grades of VIII. Data collection was used using questionnaires, observation and test techniques. Research data were analyzed through data reduction, data presentation and concluding. Based on the study's results, it is known that implementing the discovery learning model can improve students' problem-solving skills and self-efficacy. This can be seen from the increase in the average score of students in the first cycle, which is 71 to 76.66 in the second cycle. The percentage of completeness in the first cycle also increased from 78% to 90% in the second cycle. This increase was also accompanied by an improved student self-efficacy from the percentage of 43.75% of students with high minimum criteria in cycle 1 to 66% in cycle II.

Keywords: discovery learning, problem-solving, self-efficacy

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INTRODUCTION

The 21st-century skills are needed in facing the challenges of the society 5.0 era (Kartika et al., 2022; Usmaedi, 2021), where one of the basic implications of these challenges lies in the element of education (Nurjani, 2019). From here the quality of education must be improved through the development of integrated skills in learning (Savendra and Opfer in Kartika et al., 2022; Septikasari & Frasandy, 2018). According to Septikasari & Frasandiy (2018), skill development is the main thing in the learning process in the 21st century. One of the 21st-century skills that students must have is a problem-solving skills (Toni in Kurniawati et al., 2019).

According to Polya, the problem-solving skills is an attempt to find a way out of a difficulty to achieve certain goals that are not easily achieved (Amir, 2015; Maulyda, 2020). In line with this, according to Rambe and Afri (2020) problem-solving skills contain a series of mental activities carried out to find solutions to achieving certain goals. These skills become characteristics (Amir, 2015; Nurhasanah et al., 2018) and are fundamentally important activities in learning mathematics (Amir, 2015; Siniguian in Islamiati et al., 2021). Even according to Holmes in NCTM (Haryani, 2011), problem-solving is the "heart" of mathematics. This means that in learning mathematics, problem-solving is important (Marhaeni et al., 2021).

The important role of problem-solving does not make teacher learning oriented to the achievement of students' problem-solving skills because there are still many teachers who only provide mathematical concepts in finished form, so students must memorize mathematical formulas (Nur Hayati & Khotimah, 2017). Khotimah (2017) revealed that this resulted in the low mathematical problem-solving skills of students, including students who were not used to solving problems in the form of problem-solving and students who had difficulty when given non-routine questions. This happens because students are not used to solving problems that require understanding, planning, solving and finding results (Nur Hayati & Khotimah, 2017; Yarmayani, 2016).

This lack of problem-solving skills is in line with the initial research that the researchers conducted at SMP Negeri 9 Buru. based on the results of interviews conducted by researchers with mathematics teachers on April 6, 2022, it was found that students still had difficulties in understanding concepts related to understanding the meaning of problems and how to solve problems that required understanding, planning, solving, and finding results. These difficulties show that there is still a lack of problem-solving skills for grades of VIII B students at SMP Negeri 9 Buru, including in learning probabilities.

In addition to the lack of problem-solving skills, based on the results of interviews that researchers conducted with mathematics teachers at SMP Negeri 9 Buru on April 6, 2022, it was also found that students were less focused on paying attention to mathematics learning and tended to avoid it, lack of collaboration between students, boredom in learning, lack of student discipline. in doing assignments, as well as the lack of independence of students in learning mathematics, especially probability material. The lack of students in these activities shows that students' self-efficacy is still low. This is in line with the research results of Andriyani et al. (2022) which show that students' self-efficacy in mathematical problem-solving activities is still low which is indicated by the tendency of students who are less confident, hesitant, and afraid to make mistakes when asked to communicate their work results.

When the teacher asks students to solve problems and communicate problem-solving individually in discussion forums, it turns out that students do not want to communicate the results of their solutions for fear of making mistakes and lack of confidence. The results of student work seem hesitant in writing the completion steps or expressing them in the presentation of mathematical symbols, even though the initial concept of completion is correct. This raises the assumption that students' self-efficacy is still low.

Referring to the results of initial observations by conducting interviews, regarding problem-solving skills and self-efficacy which are still low in grade of VIII B of SMP Negeri 9 Buru, one of them is influenced by the teacher's learning model which is still teacher center. In learning the teacher conveys more concepts, formulas, and problems of probability that can be solved by applying the formula directly, without presenting contextual problems related to the problem of probability. So that students aren't trained to develop investigations and solve contextual problems both individually and in groups. Teachers also pay less attention to increasing students' mathematical self-efficacy in problem-solving.

Therefore, in learning opportunities at SMP Negeri 9 Buru, learning is needed that makes contextual problems a starting point for learning and is oriented towards achieving student problem-solving skills and self-efficacy. One of the learning models that can accommodate these learning needs is the discovery learning model. The discovery learning model can encourage students

to actively investigate and then find alternative solutions to problems by exploring data to foster scientific attitudes (Nahdi, 2018; Yuszahra et al., 2018). In investigating and finding alternative solutions to problems, individuals must believe in their skills to carry out these tasks (Nahdi, 2018). With this model students become closer to what is the source of their learning, students' self-confidence will increase because they feel that what they have understood is found by themselves, cooperation with their friends will increase, and of course increase student experience (Mariani, 2019; Putrayasa et al., 2014).

According to Mariani (2019), the discovery learning model is learning that emphasizes direct experience and the importance of understanding the structure or important ideas of a discipline, through active student involvement in learning. The stages of the discovery learning model consist of observations to find problems, formulate problems, propose hypotheses, plan problem-solving through experiments or other means, carry out observations and data collection, analyze data, and draw conclusions. (Mariani, 2019; Rosarina et al., 2016). Furthermore, Rosarina et al. (2016) argue that the advantages of the discovery learning model compared to the lecture method include being able to create a sense of pleasure in students because of the growing sense of investigating and succeeding and can encourage students to think and work on their initiative.

Based on the description of the problems above and the advantages of the discovery learning model, this study will be seen how to increase students' problem-solving skills and self-efficacy with the discovery learning model on the probability material for grade of VIII SMP.

RESEARCH METHOD

This research is a Classroom Action Research (CAR) using Kemmis and MC designs. Taggart. According to Septantiningtyas et al. (2020), CAR or classroom action research is an action taken by the teacher in his class to improve or improve a certain situation, so that student learning outcomes increase.

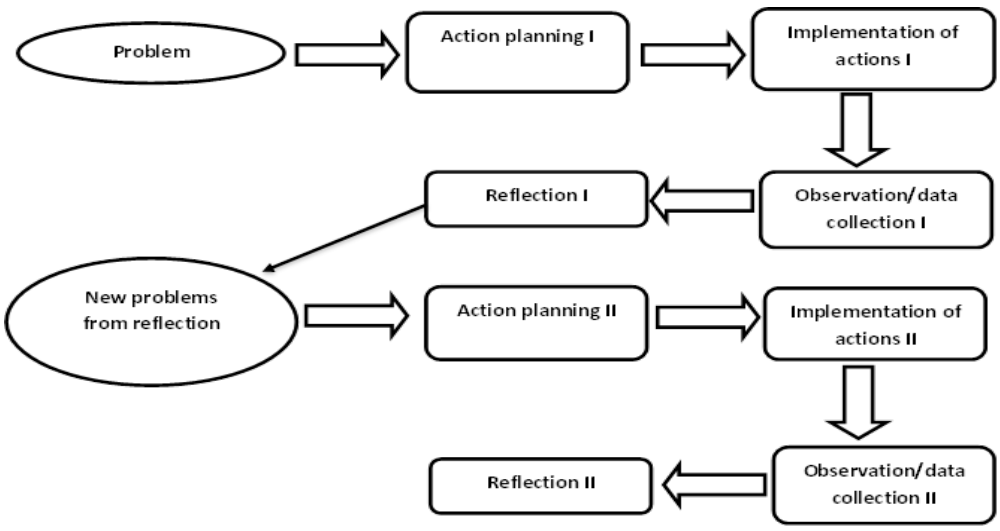


Figure 1. Classroom action research flow

Meanwhile, according to Arikunto (in Septantiningtyas et al., 2020) CAR is a combination of the words "research and classroom action", which aims to improve the quality of learning and help empower teachers to solve learning problems in schools.

This classroom action research was conducted by researchers, trying to find an idea that was then applied to improve the learning practices carried out. This action research tries to apply variations of the new learning model, namely the learning model using the discovery learning model which is expected to provide changes towards improvement in a learning process. The CAR design used in this study adopted the Kemmis and MC models. Taggart.

The research was conducted at SMP Negeri 9 Buru, which is located at Jalan Pendidikan No. 02, Buru Regency. This research was conducted from April 07 to May 18, 2022. The subjects in this study were grade of VIII B students with 32 students (18 boys and 16 girls). This research procedure is divided into two cycles and each cycle goes through four stages, namely planning, action, observation, and reflection. Each cycle is depicted in Figure 1.

The data needed in this study include data on problem-solving skills and students' self-efficacy toward the application of the discovery learning model. In detail, the types of data to be collected, instruments, types of evaluations, data sources, and time of data collection in the study are presented in Table 1.

Table 1. Research data collection

Data	Data collection technique	Data Collection Instruments	Data source	Time
Problem-solving skill	Test	Problem-Solving Skills Essay Test Sheet	Student	At the beginning of the study and the end of the cycle
Self-efficacy	Questionnaire	Questionnaire sheet	Student	At the beginning of the study and the end of the cycle
Student behavior during learning	Observation	Observation sheet	Teacher	Every meeting

Data obtained from tests and observations will be processed/analyzed to become information. The information will be used to determine the problem-solving skills, self-efficacy, and student behavior during learning. Analysis of the data in this study in the form of an analysis of the problem-solving skills test. Data on students' problem-solving skills were analyzed by determining the average math test scores of students in one class with the following formula.

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

Information:

$\bar{x}$ = the average value of students' problem-solving skills

x_i = student grade i

n = many students

The data obtained from the student test results are qualified based on the Minimum Completeness Criteria (MCC) for grade of VIII Mathematics at SMP

Negeri 9 Buru, which is 64. The criteria for student completeness are shown in Table 2.

Table 2. Completeness criteria for students' mathematics scores

Student Math Score	Category
$64 \leq \bar{X} \leq 100$	Complete
$0 \leq \bar{X}64$	Not Completed

To determine student self-efficacy, an analysis will be carried out by determining the average student score with the following formula.

$$\bar{E} = \frac{\sum_{i=1}^{n} E_i}{n}$$

Information:
$\bar{E}$ = average *self-efficacy* score
E_i = i-th student *self-efficacy* score
n = many students

Furthermore, student self-efficacy score data were analyzed descriptively based on the average score ($\bar{E}$), ideal mean (M_i), and standard deviation (SD_i), determined by the criteria in Table 3.

Table 3. Criteria for classification of self-efficacy

Score Range	Qualitative Criteria
$\bar{E} \geq M_i + 1{,}8SD_i$	Very high
$M_i + 0{,}6SD_i \leq \bar{E} < M_i + 1{,}8SD_i$	High
$M_i - 0{,}6SD_i \leq \bar{E} < M_i + 0{,}6SD_i$	Enough
$M_i - 1{,}8SD_i \leq \bar{E} < M_i - 0{,}6SD_i$	Not enough
$\bar{E} < M_i - 1{,}8SD_i$	Poor

(Widoyoko,2018)

With,
M_i = $\frac{1}{2}$ (ideal maximum score + ideal minimum score)
SD_i = $\frac{1}{6}$ (ideal maximum score - ideal minimum score)

Indicators of success in this study are a) the average value of students' problem-solving skills has increased from cycle to cycle or after the action and classical student learning completeness is at least 60%. b) the average score of students' self-efficacy has increased from cycle to cycle or after the action and at least more than 50 percent of students are in high criteria.

RESULTS AND DISCUSSION

From the results of the initial test (pre-cycle) conducted by the researcher, the problem-solving skills of grade of VIII students at SMP Negeri 9 Buru is said to be low because there are still 17 students whose scores are below 64 which is the Minimum Completeness Criteria. While the self-efficacy of students with a minimum high criterion of 12 people, there are still many who are in the criteria of sufficient or less. This is because the learning used is still the teacher center

so that students only receive the material provided by the teacher and if it is not followed up, it will certainly result in the learning process being not optimal.

Seeing such class conditions, it is necessary to improve the learning model that does not involve the active participation of students. The model chosen by the researcher as an alternative to learning to improve students' problem-solving skills and self-efficacy is the discovery learning model. To facilitate the implementation of the action, it is necessary to make a plan. The plans made include: making lesson plans with the material to be taught, making observation sheets to observe students in learning, making test questions, and preparing learning media that will be used to achieve learning objectives. Through planning before taking action, it will be easier to determine the success of the actions carried out. Planning can be used as a guide for implementing actions so that the research carried out does not deviate far from the research objective of applying a discovery learning model of learning media to improve student problem-solving skills and self-efficacy.

Description of Cycle I and Cycle II

By applying the discovery learning model, the teacher provides a stimulus about the module that has been given previously, then students are given contextual problems in the form of videos and asked to find their problems in the video. Students work in groups on contextual problems given in the prepared LKPD. The teacher supervises the group discussion and provides direction if a group has difficulties. The next step is for each group to present their findings.

The results of student discussions presented by each group were discussed by the teacher and the teacher underlined the important things found by the group and provided direction for finding the right answer, and together concluding. In the closing activity, the teacher provides reinforcement, assigns assignments, provides information on the material to be studied at the upcoming meeting, and closes the learning activities by pronouncing hamdalah and greetings. To determine the problem-solving skills, a description test is given with indicators to identify the elements needed, formulate problems, apply problem-solving strategies, and interpret problem-solving. Meanwhile, to determine self-efficacy, the researcher gave a questionnaire to be filled in by students. The results of the problem-solving skills test and numbers in cycle I and cycle II can be seen in Tables 4-7.

Table 4. Cycle I Problem-Solving Skills Test Result

Criteria	Total number of students	Many students	Completeness presentation	Average value
Complete	32	25	78%	71
Not Complete		7	22%	

Table 5. Cycle II Problem-Solving Skills Test Result

Criteria	Total number of students	Many students	Completeness presentation	Average value
Complete	32	29	90%	76,66
Not Complete		3	10%	

Table 6. Cycle I Self-Efficacy Questionnaire Results

Criteria	Total number of students	*Self-efficacy*	
		Total students	Percentage
Very high	32	2	6,25%
High		12	37,5%
Enough		8	25%
Not Enough		10	31,25%
Poor		0	0%

Table 7. Cycle II Self Efficacy Questionnaire Results

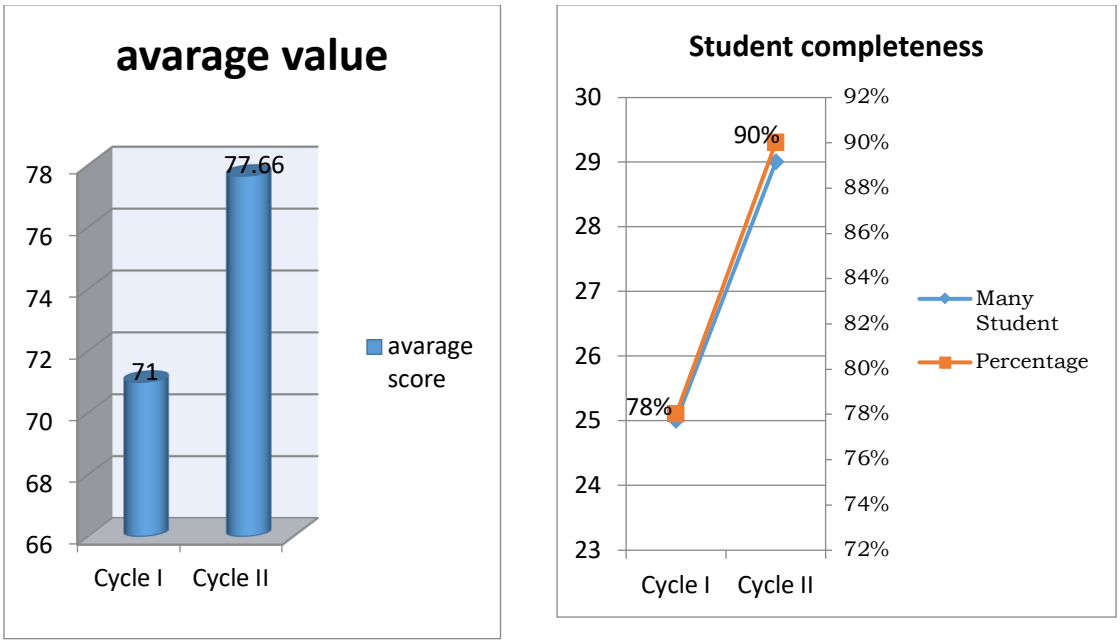
Criteria	Total number of students	*Self-efficacy*	
		Total students	Percentage
Very high	32	4	13%
High		17	53%
Enough		7	21%
Not Enough		4	13%
Poor		0	0%

Learning in the first cycle has not been fully implemented properly for several reasons including students are still awkward with discovery learning, the distribution of groups is not evenly distributed and there are still students who are not confident in expressing their opinions during learning many students are passive. The problem-solving skills of students in cycle 1 also has not shown maximum results, this can be seen from the results of students' problem-solving skills tests. Of the 32 students, only 25 students met the Minimum Completeness Criteria, the rest did not meet the criteria as shown in Table 4. This condition was not much different from the self-efficacy level of students in cycle I which showed 14 people who had met the minimum criteria high (high and very high). high), while the other 18 people are still in the criteria that are less than that as shown in Table 6. Based on the results of these reflections, it is necessary to take further action to improve or perfect learning using the discovery learning model. Furthermore, the researcher and the teacher agreed to continue the action in cycle II.

In the reflection stage, the researcher and the teacher evaluate the results of tests and questionnaires. From the results of observations and reflections in the second cycle, it is known that there is an increase in students' problem-solving skills and self-efficacy due to the application of the revised discovery learning model from the first cycle. The results of the problem-solving skills test show that 90% of students have achieved the predetermined mastery, namely obtaining a score. 64 with the average value in the second cycle reaching 76.66. This means that there are more than 60% of students have met the criteria for completeness. Improved problem-solving skills and self-efficacy can be seen in Table 8 and Figure 2 below.

Table 8. Improvement of Problem-Solving Skills Test

	Cycle I	Cycle II
Average score	71	77.66
N	25	29
Percentage	78%	90%



(a) (b)

Figure 2. (a), the average value of problem-solving (b), students' completeness

The same condition was also shown by the results of student questionnaires related to student self-efficacy which showed an increase in cycle II. The results of the problem-solving skills test showed that 90% of students had achieved the predetermined completeness, namely obtaining a score of 64 with an average value in the second cycle reaching 76.66. This means that there are more than 60% of students have met the criteria for completeness. The improvement of problem-solving skills and self-efficacy in cycles I and II can be seen in Table 8 and Figure 2 above. While the percentage of the increase in self-efficacy from cycle I to cycle II is qualitatively classified into 5 (five) criteria as presented in Table 9 and Figure 3 below.

Table 9. Improving *Self-Efficacy* Cycle I and Cycle II

Criteria	CYCLE		Participation
	Cycle I	Cycle II	
Very high	6,25%	13%	6,75%
Tall	37,5%	53%	15,5%
Enough	25%	21%	-4 %
Not Enough	31,25%	13%	-18,25%
Very less	0%	0%	0.00%

The results of the research and analysis above illustrate the impact of the implementation of the discovery learning model in improving students' problem-solving skills and self-efficacy during probability learning through 2 (two) cycles. By using the discovery learning model, students are more interested, have high motivation to learn, and have confidence in communicating the results of solving problems. The positive implications of implementing this model need to be

maintained to support the improvement of problem-solving skills supported by the use of audio-visual learning media.

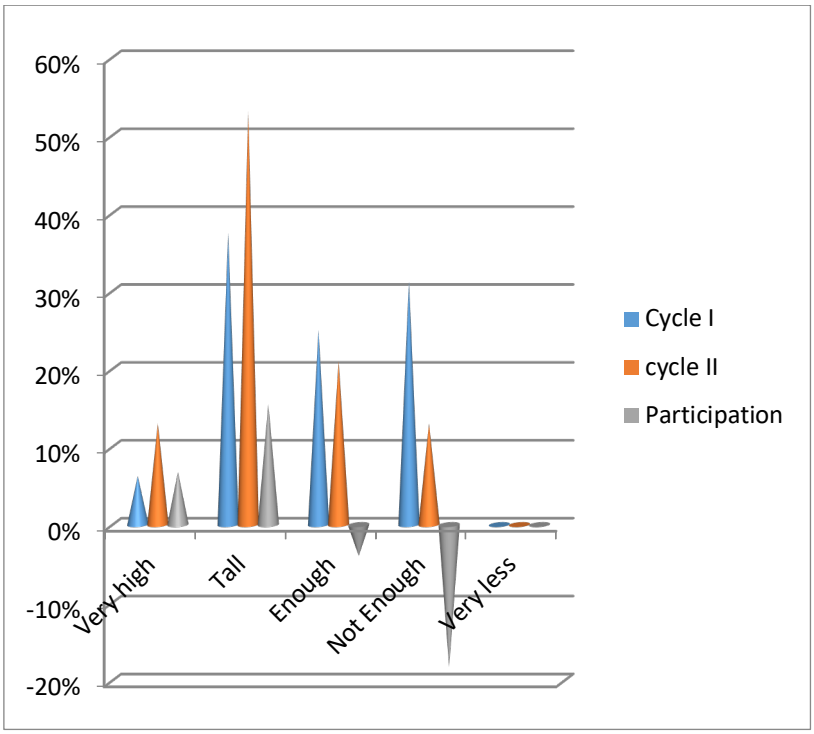


Figure 3. Diagram of Student *Self-efficacy* Percentage

While the weaknesses of audio-visual learning media that still need to be improved will be revised according to the needs of students at the next meeting. This is relevant to the research results of Arohman et al (2020) which show the positive influence of the discovery learning model on mathematical problem-solving skills, critical thinking, active participation, and self-discovery of an understanding so that students can solve problems and draw a solution from the given problem. Meanwhile, according to Jatisunda (2017), a positive relationship between problem-solving skills and student self-efficacy shows the implication of self-efficacy on student problem-solving activities.

CONCLUSION

The application of learning by using the discovery learning model can improve problem-solving skills and self-efficacy in the subjects of probability, especially the sample space, sample points, and empirical opportunities of students. This is evidenced by an increase in the percentage of students' completeness in cycle 1 from 78% to 90% in cycle II. Likewise, the percentage of students' self-efficacy which includes the minimum criteria is high at 66% while the other side still includes sufficient and low criteria.

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REFERENCES

Amir, M. F. (2015). Pengaruh Pembelajaran Konsektual terhadap Kemampuan Pemecahan Masalah Matematika Siswa Sekolah Dasar. *Prosiding Seminar Nasional Pendidikan: Tema "Peningkatan Kualitas Peserta Didik Melalui Implementasi Pembelajaran Abad 21," 2011*, 34–42.

Andriyani, A., Santosa, A. B., & Saryadi, W. (2022). Effectiveness of Microsoft Kaizala and Google Classroom towards students' mathematical communication skills and self-efficacy in learning statistics. *Bulletin of Applied Mathematics and Mathematics Education*, *2*(1), 33–46. https://doi.org/10.12928/bamme.v2i1.5523

Arohman, B., Mustamin, A., & Zamsir. (2020). Pengaruh Model Discovery Learning Terhadap Kemampuan Penalaran Matematis Siswa Kelas VII SMP Negeri 15 Kendari. *Jurnal Penelitian Pendidikan Matematika*, *8*(1), 1–14. https://doi.org/10.36709/jppm.v8i1.11222

Haryani, D. (2011). Pembelajaran Matematika dengan pemecahan masalah untuk menumbuhkembangkan kemampuan berpikir kritis siswa. *Prosiding Seminar Nasional Penelitian, Pendidikan Dan Penerapan MIPA, Fakultas MIPA, Universitas Negeri Yogyakarta*, *14*(1), 20–29.

Islamiati, N., Lapele, D. ., & Sari, B. . (2021). Kemampuan Pemecahan Masalah Matematika Ditinjau dari Disposisi Matematis pada Penerapan Model Pembelajaran Group Investigation (GI) Mathematical Problem Solving Ability in terms of Mathematical Disposition on the Application of Group Investigation (GI. *Edumatika: Jurnal Pendidikan Matematika*, *10*(02), 29–37. https://online-journal.unja.ac.id/edumatica/article/view/12205/11707

Jatisunda, M. G. (2017). Hubungan Self-Efficacy Siswa SMP dengan Kemampuan Pemecahan Masalah Matematis. *Jurnal Theorems (The Original Research of Mathematics)*, *1*(2), 24–30.

Kartika, D. M. R., Sunarno, & Fatmawati. (2022). Mahasiswa Teknik Sipil Di Indonesia Menghadapi. *Jurnal Matematika Dan Aplikasinya (IJMA)*, *2*(2), 51–65.

Kurniawati, I., Raharjo, T. J., & Khumaedi. (2019). Peningkatan Kemampuan Pemecahan Masalah untuk Mempersiapkan Generasi Unggul Menghadapi Tantangan Abad 21. *Seminar Nasinal Pascasarjana*, *21*(2), 702.

Marhaeni, N. H., Andriyani, & Rusmilah. (2021). Efektivitas LKPD berbasis Problem Based Learning untuk meningkatkan kemampuan pemecahan masalah matematis siswa SMA Negeri 1 Imogiri. *Jurnal Pendidikan Surya Edukasi (JPSE)*, *7*(2), 85–96.

Mariani, S. (2019). *Pendalaman Mater Matematika Modul 4 Kombinatorika dan Statistika*.

Maulyda, M. A. (2020). Paradigma Pembelajaran Matematika Berbasis Nctm. In *Humanika, Kajian Ilmiah Mata Kuliah Umum* (1st ed., Vol. 21, Issue January). email:buku.irdh@gmail.com

Nahdi, D. S. (2018). Eksperimentasi Model Problem Based Learning Dan Model Guided Discovery Learning Terhadap Kemampuan Pemecahan Masalah Matematis Ditinjau Dari Self Efficacy Siswa. *Jurnal Cakrawala Pendas*, *4*(1), 50–56.

Nur Hayati, T., & Khotimah, R. P. (2017). Peningkatan Kemampuan Pemecahan Masalah Dan Hasil Belajar Matematika Siswa Melalui Model Pembelajaran Problem Posing. *Prosiding Seminar Nasional Pendidikan Matematika*, 1–9.

Nurhasanah, D. E., Kania, N., & Sunendar, A. (2018). Penggunaan Model

Pembelajaran Discovery Learning untuk Meningkatkan Kemampuan Pemecahan Masalah pada Siswa SMP. *Didactical Mathematics*, *1*(1), 21–33. https://doi.org/10.31949/dmj.v1i1.1113

Nurjani. (2019). Urgensi Model Discovery Learning Bagi Peserta Didik dalam Beradaptasi Diera Society 5.0. *International Conference on Education*, 189–196.

Putrayasa, I. M., Syahruddin, H., & Margunayasa, I. G. (2014). Pengaruh Model Pembelajaran Discovery Learning. *Jurnal Mimbar PGSD Universitas Pendidikan Ganesha*, *2*(1).

Rambe, A. Y. F., & Afri, L. D. (2020). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Dalam Menyelesaikan Soal Materi Barisan Dan Deret. *AXIOM : Jurnal Pendidikan Dan Matematika*, *9*(2), 175. https://doi.org/10.30821/axiom.v9i2.8069

Rosarina, G., Sudin, A., & Sujana, A. (2016). Penerapan Model Discovery Learning Untuk Meningkatkan Hasil Belajar Siswa Kelas Ix Pada Pembelajaran Ipa. *BIO EDUCATIO : (The Journal of Science and Biology Education)*, *1*(1), 371–380. https://doi.org/10.31949/be.v5i2.2597

Septantiningtyas M.Pd, N., Dhofir, M., & Maghfirah, W. (2020). *PTK (Penelitian Tindakan Kelas)* (A. sanjaya, M. R. L. Hakim, & A. N. M. Sulaiman (eds.); 1st ed.). Penerbit Lakeisha.

Septikasari, R., & Frasandy, R. (2018). Keterampilan 4C Abad 21 Dalam Pembelajaran Pendidikan Dasar. *Jurnal Tarbiyah Al Awlad*, *VIII*, 107–117.

Usmaedi. (2021). Education Curriculum For Society 5.0 In The Next Decade. *Jurnal Pendidikan Dasar Setiabudhi*, *2*(3), 63–79.

Yarmayani, A. (2016). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Kelas Xi Mipa Sma Negeri 1 Kota Jambi. *Jurnal Ilmiah Dikdaya*, *6*(2), 12–19.

Yuszahra, R., Maryani, & Bambang Supriadi. (2018). Model Discovery Learning Dengan Media E-Learning Pada Pembelajaran Fisika Saat Covid-19 Di Sma. *Angewandte Chemie International Edition, 6(11), 951–952.*, *5*(1), 33–39.

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