

Description Of Problem-Solving Skills For High School Students On Virus Materials

Marini^{1*}, Afandi², Anisyah Yuniarti³

^{1,2,3}Biology Education Department, Faculty of Teacher Training and Education, Universitas Tanjungpura, Indonesia

Email: ¹ marini.rini@student.untan.ac.id,

² afandi@fkip.untan.ac.id,

³ anisyah.yuniarti@fkip.untan.ac.id,

*Corresponding Author

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Abstract

This study aims to determine the description of students' problem-solving skills and the description of skills on each indicator of IDEAL problem-solving for high school students in class X on virus material. The subjects of this study were students of class X MIA at a private high school as many as 29 students who had studied virus material. The instrument was used as a test description of IDEAL problem-solving skills, totaling 20 questions consisting of 5 IDEAL Problem-Solving indicators from Bransford and Stein. The results showed that the description of students' problem-solving skills had a percentage of 53% in the unskilled category. The details of the research data on problem-solving skills in the moderately skilled category are indicators identifying problems by 68% and setting goals by 75%, unskilled categories, namely indicators exploring possible strategies by 36%, anticipating results and acting by 47%, and indicators seeing and study by 40%. This study revealed that the factors that hindered unskilled problem-solving skills were student interest, low cognitive ability, and lack of habit of solving problem-solving problems. Ask their English teacher about the current situation of the learning process.

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Introduction

The development of the 21st-century world demands to compete on a global level. National Education Association has identified 21st-century skills as "The 4C" skills which include critical thinking and problem solving, creativity, communication, and collaboration. (King, et al, 2010). So that it can be seen that only 21st-century skills are problem-solving skills. Problem-solving skills can help students make decisions that are careful, precise, logical, systematic, and consider various points of view. If students lack this skill, it will result in students doing various activities without knowing the purpose and reasons for doing them (Novitasari et al., 2015). Problem-solving skills have a very important role in education because one of the goals of education is to train individuals who can overcome the problems they face in real life (Memnun et al., 2012). However, learning carried out in schools does not get used to solving problems that are Problem Solving. Several studies show that students' problem-solving skills are moderate and sufficient criteria, but when viewed during a pandemic after students are given online learning, they fall into the less category (Apriadi et al., 2021; Hanifa et al., 2018; Hidayatullah et al., 2020). So that it can be seen that learning activities are carried out online, resulting in teachers not being able to see the responses and expressions of students during learning, and it is difficult to know the mastery of students' material concepts after the material is taught.

Students must also be literate in information, media, and technology (Information, media, and technology skills). The word "literacy" means not only knowing and being able to use it, but with the ability to think critically and problem-solving, it will be able to choose and sort them out so that it is not

easily swayed by fake news (hoax). In life and career (life and career skills), students are trained to be adaptive and flexible, take initiative and be independent, proficient in social and cultural fields, productive and accountable, and have a servant leadership spirit. The learning environment is important in the 21st-century dimensions. The most appropriate and suitable environment in learning is the real environment that students are currently facing and can provide new and challenging experiences. Through this experience, later they will get used to dealing with more complex environmental situations (Nugroho, 2018). This is what causes the need for problem-solving skills in students in the face of increasingly complex environmental developments.

Problem solving skills are a person's ability to try to find problems and solve them based on the information collected so that they get the right conclusions. These problem-solving skills are basic skills that a person must have that can be used in various fields in everyday life (Kaya et al, 2014). Problem solving skills are also a series of thought processes in getting solutions to find the right way either by using non-automatic strategies so that students will be able to solve their own problems and work more effectively (Widiasih et al., 2018; Nugroho, 2018). Increased student problem solving skills are supported by activeness by students to work together in groups with the aim of finding solutions to problems, and supported by a comfortable environment. So that the emergence of stimulus interaction with response (Destalia et al, 2014).

Bransford and Stein 1993 developed a problem-solving model called IDEAL Problem Solving. In the stages of the IDEAL problem-solving model, it is explained that the model can explore students' creativity in solving problems so that students can have skills in solving the problems they face. Then it can also train students to express their ideas, think critically to solve problems, think systematically and logically according to available data, and train students to interact with friends and teachers (Indriyani, 2016). Bransford and Stein discuss issues such as combining new information, overcoming barriers to creativity, and looking at problems from multiple perspectives. Several experts who contributed to creating this problem-solving model are Alan Newell, George Polya, Max Wertheimer, and Herbert Simon. IDEAL stands for I-Identify problem (Identify the problem), D-Define goal (Define goals), E-Explore possible strategies (Explore possible strategies), A-Anticipate outcomes, and act (Anticipate results and act), and L- Look back and learn. The thing that is different from IDEAL problem solving is in the second step, which is determining goals, this step is not found in solving problems from Polya so that makes it different.

Like other problem-solving strategies, the IDEAL problem-solving model also has advantages, namely (1) increasing awareness of the problem and introducing problem-solving ideas, (2) encouraging positive expectations in problem-solving and distracting from negative or preoccupied thoughts, (3) encouraging persistence in dealing with emotional stress and difficult situations, and (4) to facilitate a positive emotional state (Setyadi et al, 2019). The IDEAL model can also help students so that students do not have to avoid problems. The more students know and practice problem-solving, the easier and more familiar students are with solving problems.

Based on these description, this study aims to determine the description of students' problem-solving skills and to find out the description of skills on each indicator of IDEAL problem solving for class X high school students on virus material.

Methods

This research method uses descriptive quantitative research. This study describes the IDEAL problem-solving skills in viral material in grade X high school students based on the IDEAL problem-solving steps according to Bransford and Stein. The population in this study were all students in a private high school. The research sample was 29 students of class X MIA in a private high school who had studied virus material.

Data collection techniques in this study are essay test instruments (description tests) and interviews. The essay test contains 20 IDEAL problem-solving skills test questions on viral material. The test was validated by five validators and analyzed using Aiken's V calculations with the Microsoft Excel 2010 application so that the minimum value for the validity of the test in this study was 0.80 for each item (V 0.80). Reliability studies involving validators or raters are usually referred to as inter-rater agreements or inter-rater reliability. In this study, the intraclass correlation coefficients (ICC) developed by Pearson (1901) were used to analyze inter-rater reliability (Koo & Li, 2016).

Then the test item instrument was tested on class X high school students who had studied virus material. The reliability measurement technique used is the Cronbach Alpha technique, the results of the test questions that have been given to 29 students as test subjects are calculated for the reliability value

and the results are 0.6008 with a fairly good category. So that the research test instrument is declared reliable and can be used for research.

Results and Discussion

1. Description of Problem Solving Skills Test

The problem-solving skills test given is in the form of an essay question, which consists of 20 questions and a 60-minute working time. The results obtained by students are that out of 29 students, none of them are in the skilled category, 7 are moderately skilled, 7 are less skilled and 15 are unskilled. The results of students' solving skills tests if percentage can be seen in Figure 1.

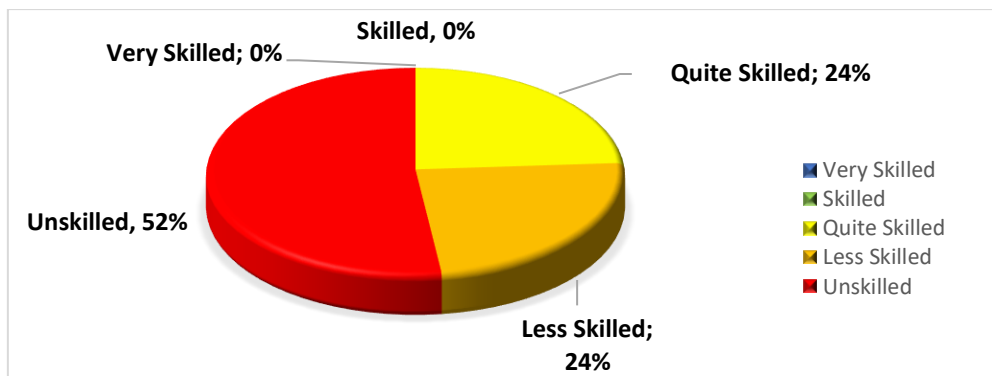


Figure 1. Percentage of the Results Student Problem-Solving Skills Criteria as a Whole

Based on the results of the percentage of problem-solving skills of 29 students in Figure 2, it can be seen that the percentage of highly skilled and skilled is 0%, moderately skilled 24%, less skilled 24%, and dominantly unskilled (52%). So it can be concluded that the results of students' problem-solving skills are unskilled.

2. Test description of each indicator of problem-solving skills IDEAL

The problem-solving skills observed in this study are identifying problems (identifying problems), determining goals (define goals), exploring possible strategies (explore possible strategies), anticipating results and acting (anticipate outcomes), and seeing and learning (look back and learn). The percentage of research results based on the average problem-solving skills on each indicator is shown in Figure 2.

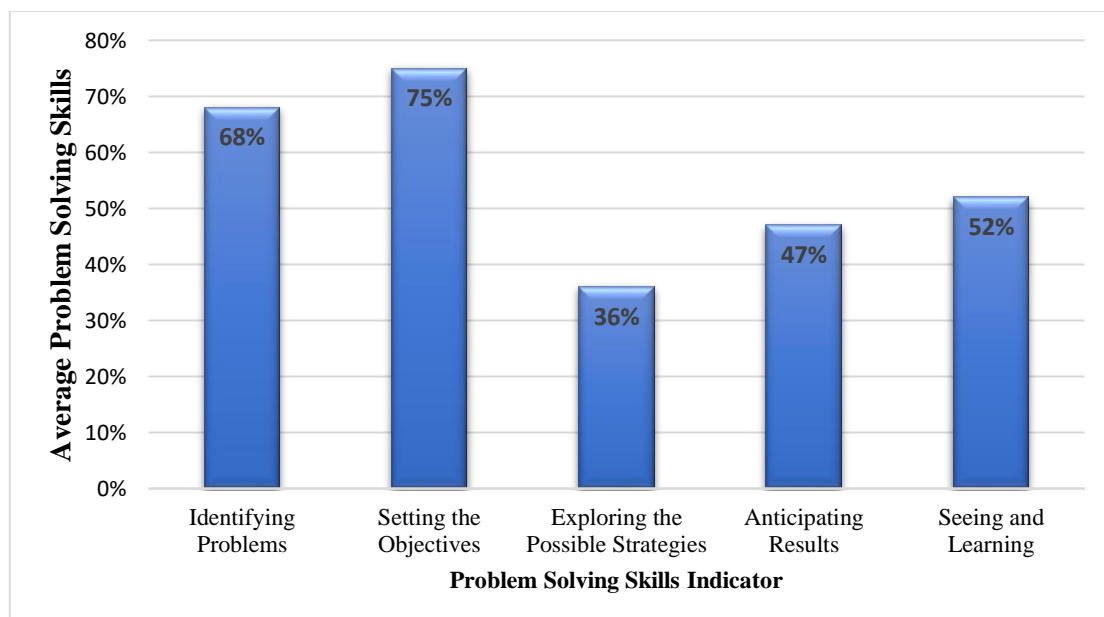


Figure 2. Average Percentage of Problem Solving Skills on Each Indicator

Based on Figure 2. it is known that the skill indicator with the highest average percentage of success answered by students is the indicator of determining goals (75%), then followed by the indicator of identifying problems (68%), seeing and learning (52%), anticipating results and action (47%), and the lowest indicator is exploring possible strategies (36%). So that it can be seen that the average percentage of students' problem-solving skills is 52% in the unskilled category.

The description of the level of students' problem-solving skills based on the IDEAL problem-solving indicators is as follows:

a. Problem-solving skills on indicators identify problems (identify the problem)

This indicator is in questions number 1, 6, 11, and 16. Based on Figure 2, the percentage of students' skills in identifying problems on this indicator is 68%. In this indicator, the average student is able to recognize and identify the problem completely, but there are still some students who are not quite right in identifying the problem being asked. For example in question number 11, students are given a question in the form of discourse about a virus outbreak that attacks an area, then students are asked to identify the problem with the question "Based on the discourse above, what kind of medical assistance are expected by the islanders and what are the obstacles in obtaining this assistance?", then the students wrote down the answer that they needed medical assistance, which means that they did not mention what kind of medical assistance is referred to in number 11. The following is a representative answer inappropriate students.

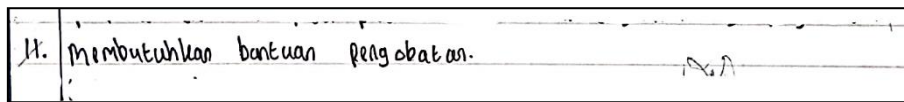


Figure 3. MBCH Students' Answers to Question Number 11

Based on the results of the interview, this error occurred because students did not read the discourse and questions correctly, students tended to rush in reading the questions because they considered the time given was not enough to answer all the questions so some of the students' answers were also answered in an unexplained manner without being clearly explained. . Based on the errors that occur, it can be seen that the weakness of students in this step is that students are not careful in reading the questions and lack of understanding of the problem correctly. This can be done by familiarizing students with the learning process so as to encourage students to understand the problem correctly. Based the results of research by Palennari, Lasmi & Rachmawaty (2021) stated that the main factor that caused students' problem-solving skills to be in a good category was because students had been accustomed to solving problems during the learning process. This means that students are not accustomed to providing problem-solving exercises which can be a factor that affects students' problem-solving skills.

b. accustomed to providing problem-solving exercises which can be a factor that affects students' problem-solving skills.

In this indicator, there are questions number 2, 7, 12, and 17. Based on Figure 2, the percentage of students' skills in determining goals in this indicator is 75%. On this indicator, the average student is able to determine the approach to problem-solving, as can be seen in question number 12, namely "Scientists in the village decided to make a vaccine using samples from the virus that infected the villagers. What is the purpose of making the vaccine?" It turned out that the students answered dominantly correctly. The following is a representative of the students' correct answers.

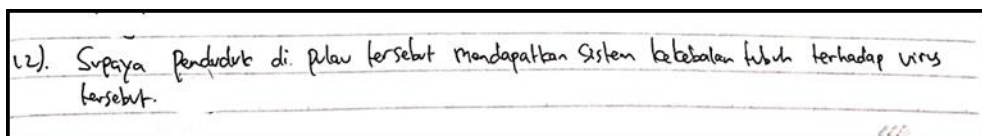


Figure 4. ER Students' Answers to Question Number 12

This means that students are able to determine the approach to problem-solving. Although students are lacking in identifying problems when students read the discourse students can determine the purpose of solving the problem by being able to define and present the problem, there are also students who are still not serious about working on the problem. There are still some students who have not been able to determine the appropriate problem-solving approach. Based on the results of the interviews, students have not been able to determine a problem-solving approach because students are still not serious about working on questions so they consider the questions on this indicator easy and the

answers are given are correct. According to (Afandi & Kurnia, 2020) states that differences in determining goals can be a very strong cause of a person's ability to understand problems, think and solve problems. Different goals make people explore different strategies to solve problems.

c. Students' problem-solving skills on the indicators explore possible strategies,

In this indicator, there are questions number 3, 8, 13, and 18. Based on Figure 2, the percentage of students' skills in exploring possible strategies on this indicator is 36%. The percentage at this stage is the lowest percentage compared to other stages. The error that most often appears is in question number 8, namely "Based on the discourse above, how does Tika prove the type of pathogen (virus/bacteria) that causes the outbreak?", then the dominant student answered by making an extract of chili plant sap and then spraying it on healthy plants without further explanation. Whereas students should explain how to distinguish the types of pathogens that attack chili plants, both viruses and bacteria. The following is a representation of student answers that are less precise.

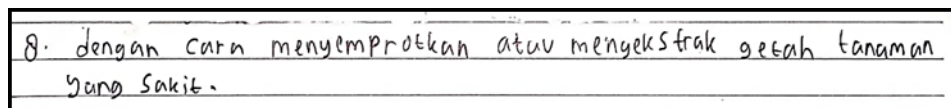


Figure 5. RY Students' Answers to Question Number 8

This is because some students have difficulty understanding the problem and lack understanding of the material so the answers given are not in accordance with what was asked in the question. Students have not been able to write down alternative solutions or problem-solving methods that are relevant to each problem to be solved. Based on the interviews, students considered that in this way students could prove the types of pathogens that attack chili plants. Whereas what should be done is to know in advance the characteristics of the pathogen. Because if you only spray and extract plants without distinguishing between extracts of bacterial and viral pathogens, the result is still not known what type of pathogen attacks chili plants. (Rahma et al, 2020) revealed that the process used to choose an action as a means of solving a meaningful problem in order to solve the problem, decision making is an important action to get the right solution.

d. Students' problem-solving skills on indicators of anticipating results and acting (anticipate outcomes),

In this indicator, there are questions number 4, 9, 14, and 19. Based on Figure 2, the percentage of students' skills in anticipating results and acting on this indicator is 47%. In this indicator, after students choose an alternative strategy or solution, students can anticipate possible outcomes and then act on the chosen strategy. Based on the results obtained, students have not been able to determine the best alternative solution with rational reasons that can solve the problem. Students anticipate the answer from the description of solving the problem but it is not quite right, for example in question number 9, namely "If the results of Tika's analysis in the village laboratory have been completed, what might Tika suggest to farmers in the village regarding infectious agents in chili plants?", Then the students answered that the solution steps that researchers could take to farmers were spraying chili plants and applying fertilizer. In fact, if viewed from the discourse in the question, this has not been able to help reduce the spread of pathogenic infections in chili plants. Because the cause is not known properly. (Afandi & Kurnia, 2020) states that anticipated results will be useful from things that will be regretted in the future. The following is a representation of student answers that are less precise.

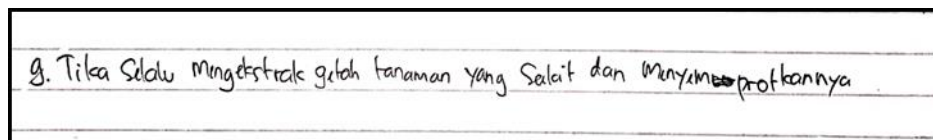
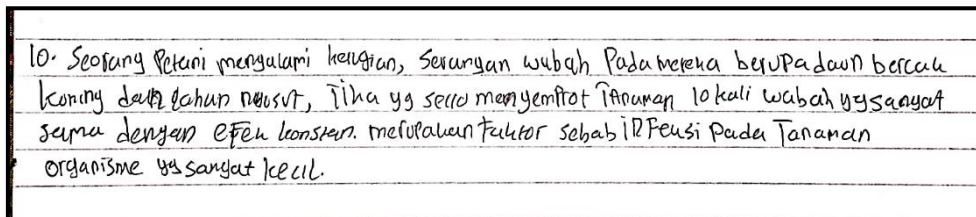


Figure 6. AFI Students' Answers to Question Number 9

e. Students' problem-solving skills on the indicators of seeing and learning (look back and learn).

This indicator is in questions number 5, 10, 15, and 20. Based on Figure 2, the percentage of students' skills in seeing and learning on this indicator is 52%. In this indicator, seeing and learning need to be done because after getting the results, students forget to look back and learn from the problem-solving that has been done. In question number 10, namely "What conclusions can you make based on the description and answers to the previous question?", then the students answered that the factors that

cause infection in plants are very small organisms. In fact, if students are careful in working on the questions at this stage, it can be seen that the invading pathogen is a virus after seeing the discourse that the sap extract of the diseased plant is filtered with a bacterial filter but continues to attack other plants after being sprayed again. This shows that students have not gotten the results of problem-solving so they cannot describe the results obtained after doing the problem-solving stage. Even though this stage is important to do because if students really have not found results, then students can look back at the previous questions and learn from the results obtained previously so that they can describe the results by making conclusions, students do not take this stage seriously so students only write answers from the results found without looking back at the results of the previous problem-solving stage. Based on the interview, It is known that students have not been able to describe the results obtained by making conclusions. Whereas in this stage according to (Afandi & Kurnia, 2020) it is intended that students can reflect on every step of problem-solving and correct if there are mistakes. The following is a representation of student answers that are less precise.



10. Seorang petani mengalami kerugian, serangan wabah pada mereka berupa daun bercah kuning dan daun busuk, Tiba yg serba menyempit tanaman lokal wabah yg sangat sama dengan efek konstan. merupakan faktor sebab IPeusi pada tanaman organisme yg sangat kecil.

Figure 7. MBCH Students' Answers to Question Number 10

Overall, the problem-solving skills of high school students of class X MIA on virus material are in the unskilled category with an average percentage of 69%. This is caused by several factors. Based on the results of observations, the school has used the 2013 curriculum as it should be used in the current Indonesian education system, but it is not optimal in its implementation in the field. This is in accordance with the situation during the pandemic which caused learning activities to be less than optimal with lesson hours being limited to 60 minutes in 1 x meeting. Furthermore, the discussion method did not work well. Whereas the discussion method is considered to have a positive impact on the learning process (Indriastuti, Herlina & Widiyaningrum, 2013).

The main factor that causes students' problem-solving skills to be in the unskilled category is that students are not accustomed to solving problems during the learning process. Based on the teacher's observations, it was stated that the teacher had carried out learning activities well to be able to guide students in practicing problem-solving skills. However, this is not supported by the lack of cognitive abilities of students by not focusing during learning activities and decreasing student interest in learning, as can be seen from the results of student observations which stated that students did not take notes while the teacher explained the learning material. Students assume they understand and can re-read the material presented by the teacher in the student handbook. Students were also not active in asking questions seen during the learning activities, where only 2 people asked questions during 1 x meeting. This also occurs in the results of research conducted by Hanifa et al (2018) which states that the factor that inhibits the results of students' problem-solving abilities is still low, namely that students' cognitive abilities are still low. If students' cognitive abilities are low, students' ability to solve problems will also be hampered, because cognitive abilities are important abilities that must be possessed so that students can apply their knowledge to solve a problem at hand. This also occurs in the results of research conducted by Hanifa et al (2018) which states that the factor that inhibits the results of students' problem-solving abilities is still low, namely that students' cognitive abilities are still low. If students' cognitive abilities are low, students' ability to solve problems will also be hampered, because cognitive abilities are important abilities that must be possessed so that students can apply their knowledge to solve a problem at hand. This also occurs in the results of research conducted by Hanifa et al (2018) which states that the factor that inhibits the results of students' problem-solving abilities is still low, namely that students' cognitive abilities are still low. If students' cognitive abilities are low, students' ability to solve problems will also be hampered, because cognitive abilities are important abilities that must be possessed so that students can apply their knowledge to solve a problem at hand.

In addition to cognitive abilities, a factor that also affects problem-solving skills is the habituation of the learning process that trains problem-solving skills. This is in accordance with the results of research by Palennari, Lasmi & Rachmawaty (2021) which states that the main factor that causes students' problem-solving skills to be in a good category is because students have been accustomed to solving problems during the learning process. So that the learning process that trains problem-solving

skills will make students accustomed to identifying problems (identify problems); defining goals (define goals); exploring possible strategies; anticipating results and acting (anticipate outcomes); seeing and learning (look back and learn).

Based on the discussion above, it can be concluded that the problem-solving skills of high school students of class X MIA are in the unskilled category. This needs to be improved again until it reaches skill. The skilled category can be achieved by familiarizing students to do problem-solving in the learning process. The problems given must be contextual-based problems or those that exist in students' real lives and increase students' interest in learning through the use of various media and teaching techniques.

Conclusions and Recommendations

Based on the results of the study, it can be concluded that the problem-solving skills of class X MIA students on the virus material are classified as unskilled (53%). The inhibiting factors for students' problem-solving skills so that the results of students' problem-solving skills are less than optimal are students' low interest and cognitive abilities and lack of getting used to solving problems that are problem-solving. So that it is necessary to improve learning by providing training or frequently training students in problem-solving skills during the contextual-based learning process or according to students' real lives, as well as increasing interest in learning by using various media and teaching techniques.

References

- Afandi & Kurnia, Ningsih. (2020). *Taksonomi dan Model Pembelajaran Berpikir Tingkat Tinggi*. Pontianak: Untan Press.
- Apriadi, M. A., Rahmatika, E., & Muhammad, S. H. (2021). Analisis Kemampuan Pemecahan Masalah Matematis Siswa Sebelum dan Sesudah Masa Pandemi Covid. *JURNAL MathEdu (Mathematic Education Journal)*, 4(1), 133-144. ISSN. 2621-9832.
- Bransford, J., & B.S. Stein. (1993). *The IDEAL Problem Solver: A Guide for Improving Thinking, Learning, and Creativity* (2nd ed). New York: W.H. Freeman.
- Destalia, Lendy., Suratno., & Sulifah, Aprilya H. (2014). Peningkatan Keterampilan Pemecahan Masalah dan Hasil Belajar Melalui Penerapan Pembelajaran Berbasis Masalah (PBM) dengan Metode Eksperimen pada Materi Pencemaran Lingkungan. *Jurnal UNEJ*, 3(4), 213-224.
- Hanifa, Nur Isnaini., Budhi, Akbar., Sahami, Abdullah., & Susilo. (2018). Analisis Kemampuan Memecahkan Masalah Siswa Kelas X IPA pada Materi Perubahan Lingkungan dan Faktor yang Mempengaruhinya. *Jurnal Penelitian Pendidikan Biologi*, 2(2), 121-128.
- Hidayatullah, R., Suyono., & Utiya, A. (2020). Analisis Keterampilan Pemecahan Masalah Siswa SMA pada Topik Laju Reaksi. *Jurnal Penelitian Pendidikan Sains*, 10(1), 1899-1909.
- Indriastuti, Herlina, L., & Widiyaningrum, P. (2013). Kesiapan Laboratorium Biologi dalam Menunjang Kegiatan Praktikum SMA Negeri di Kabupaten Brebes. *Unnes Journal of Biology Education*, 2(2), 2252-6579.
- Indriyani, R. W. (2016). Penerapan Model Pembelajaran IDEAL Problem Solving dalam Menyelesaikan Masalah Matematika pada Materi Keliling dan Luas Persegi panjang dan Persegi bagi Siswa Kelas VII SMP. *MATHEdunesa*, 5(2).
- Kaya, Deniz., Dilek, Izgiol., & Cank, Kesan. (2014). The Investigation of Elementary Mathematics Teacher Candidates Problem Solving Skill According to Various Variables. *International Electronic Journal of Elementary Education*, 6(2), 295-314.
- King, F.J., Goodson, L., M.S., dan Rohani, F., (2010). Higher Order Thinking Skills. Assessment dan Evaluation Educational Service Program.
- Koo, T.K., & Li, M.Y. (2016). A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J Chiropr Med*. 15(2), 155- 163.

- Memnun, D.S., Hart, L. C., Akkaya, R. (2012). A Research on the Mathematical Problem Solving Beliefs of Mathematics, Science and Elementary Pre- Service Teachers in Turkey in terms of Different Variable. *International Journal of Humanities and Social Science*, 24(2), 172-184.
- Novitasari, N., Ramli, M., & Maridi. (2015). Mengukur Problem Solving Skills Siswa SMA pada Mata Pelajaran Biologi. *Jurnal Biologi Edukasi Edisi* 14, 7(1), 1-6.
- Nugroho, A.R. 2018. HOTS: Kemampuan berpikir tingkat tinggi: konsep, pembelajaran, penilaian dan soal-soal. Jakarta: PT Gramedia
- Palennari, Muhiddin., Lasmi., & Rachmawaty. (2021). Keterampilan pemecahan masalah peserta didik: studi kasus SMA Negeri 1 Wonomulyo. *Jurnal Pendidikan dan Pembelajaran Biologi*, 5(2), 208-216. DOI: 10.33369/diklabio.5.2.208-216.
- Purwanto, Ngalm. (2017). Prinsip-Prinsip dan Teknik Evaluasi Pengajaran. Bandung: PT Remaja Rosdakarya.
- Rahma, Ira., Sistiana, W., & Suhendar. (2020). Profil Kemampuan Pemecahkan Masalah Siswa Sekolah Menengah Atas Pada Materi Ekosistem. *BIODIK (Jurnal Ilmiah Pendidikan Biologi)*, 6(3), 281-289. DOI: 10.22437/bio.v6i3.9551.
- Setyadi, T.Y., Mardiyana., & Triyanto. (2019). Mathematical Problem Solving Skill Using IDEAL Model Based on Personality Type. *AIP Conference Proceedings*, 2194, 020115-1-020115-6. <https://doi.org/10.1063/1.5139847>
- Supiandi, M. I., & Hendrikus, Julung. (2016). Pengaruh Model Problem Based Learning (PBL) Terhadap Kemampuan Memecahkan dan Hasil Belajar Kognitif Siswa Biologi SMA. *Jurnal Pendidikan Sains*, 4(2), 60-64. DOI: 10.17977/jps.v4i2.81.
- Widiasih, Permanasari, A., Riandi, & Damayanti, T. (2018). The Profile of Problem-Solving Ability of Students of Distance Education in Science Learning. *Journal of Physics Conference Series*, 1013(1), 1-6.