Description of Problem Solving Ability of Class X Students of Al-Azhar 10 Pontianak Islamic High School on Chemical Bonding Subject Material

Tri Indri Yani, Eny Enawaty*, Tulus Junanto , Rini Muharini, Rahmat Rasmawan

Department of Chemistry Education, Faculty of Mathematics and Natural Sciences, Tanjungpura University of Education, Jl. Prof. Dr. H. Nawawi, Indonesia 78124

* Corresponding Author e-mail*:* eny.enawati@fkip.untan.ac.id

Abstract
This research was conducted to determine the problem solving ability of class X students of Al-Azhar 10 Pontianak Islamic High School on chemical bonding material. The type of research is descriptive qualitative problem solving ability. The research subjects were X IPA 1 class students of Al - Azhar 10 Pontianak Islamic High School totaling 21 people. Data collection tools include test questions designed based on problem-solving and interview guidelines developed based on problem-solving data collection techniques using measurement techniques and direct communication techniques, namely written tests and unstructured interviews.The results of the problem solving ability data analysis were calculated using a problem solving ability assessment instrument and were presented as a whole based on the problem solving criteria instrument. The results of the analysis obtained students' problem solving ability on chemical bonding material, namely indicators of understanding the problem 49% (sufficient), making a plan 56% (sufficient), implementing a plan 63% (good), and checking back 70% (good) with an average percentage of 60% (sufficient). So it can be concluded that students' problem solving skills on chemical bonding material have an adequate predicate.

INTRODUCTION

In Permendikbudristek No. 16 of 2022 concerning Process Standards, namely Article 7 paragraph 2 which reads "Learning strategies designed to provide quality learning experiences". Furthermore, it is explained in letter C, namely that the learning strategy must optimize the use of resources available in the education unit environment and / or the community. This causes the need to apply a problem-based learning model to achieve learning that can train students in problem solving.

Problem solving ability is one of the competencies needed in the 21st century. A person who is able to solve a problem is expected to face various similar problems that arise in everyday life (Siagian, 2019). Therefore, the learning process carried out by teachers must be able to improve students' ability to solve problems (Nuralifah & Hidayah, 2020), Problem solving ability refers to the potential possessed by students in solving problems and applying their solutions to everyday life (Gayatri et al., 2020).

Chemistry is a theoretical lesson about material whose mathematical logic can explain the truth. The aspects that are owned are tangible. Concrete facts can be made, and other abstract aspects can be proven by mathematical logic. Chemistry teachers must master these

characteristics to develop their learning strategies. Then, it is expected to be able to choose appropriate models, approaches, and methods and develop various learning media to make it easier for students to understand (Irsyam, 2020).

Problem-Based Learning is a problem-solving learning model that can provide active learning conditions for students because it is triggered by real-world problems. This can encourage students to find solutions, think critically, and analytically so that they use learning resources properly and accordingly (Hotimah, 2020).

Learning conducted at SMA Islam Al-Azhar 10 Pontianak uses problem-based learning emphasizing problem-solving. Problem-based learning emphasizes problem-solving. The application is in the learning media used by teachers for students at school. Based on the results of interviews with the school chemistry teacher, the implementation of problem-based learning is not optimal because of the lack of time. Due to lack of time, problem-based learning is less than optimal, so some students are left behind. Some students need to catch up on the material; this makes the teacher use other learning models, such as teacher-centered, because of the efficiency of learning time. However, the teacher has trained problem-solving students by giving exercises and exams using problems based on level. Furthermore, exams use questions based on the C4 (analyze) and C5 (evaluate) levels. (evaluate). The results or scores obtained by students on daily practice questions on chemical bonds are 90%. Daily problem exercises on chemical bonds are 90%. Teachers have never analyzed students in solving problems. Considering that there is no archive of student exercise answers from the school, the student's problem-solving abilities at that school cannot be analyzed by researchers. Therefore, the researcher researched to prove students' problem-solving ability. The power of problem-solving ability is significant for students, so the teacher responded very well to the research about problem-solving ability.

In research (Yanti, 2016), PBL (problem-based learning) model learning is a model that can hone students' learning curiosity about the material. A model that can hone students' learning curiosity about the material presented by the teacher with contextual problems. Presented by the teacher with contextual problems. The maturity of students in reasoning and being directly involved is part of what is needed in problem-solving. Students can more easily understand the relationship between concepts, especially in chemical bonding material. Research conducted (Damayanti et al., 2022) suggests that students' difficulties in solving problems are caused by their unfamiliarity with working on problems in the form of case studies, so there are many mistakes in understanding the problem, doing calculations, and not checking the answers. Tend to avoid re-checking the answer. Students who can understand the problem well tend to be able to analyze the problem and relate it to various information found well (Hidayatullah, 2013).

The competence of students' problem-solving skills greatly influences the thinking process in solving problems found during learning. This study was conducted to determine the extent of student's ability to solve chemical problems so that they can evaluate the learning process or learning model used so that students can solve problems well. Solving chemical problems so that they can evaluate the learning process or learning model used so that students can solve problems correctly.

METHOD

This research is descriptive research with a qualitative approach. Descriptive research is to describe an event and event that is the center of attention without giving special treatment to the event. Withdrawing data and field information using a problem solving ability test instrument. (Trianto, 2011).

Population is all members of a group of people, events, or objects in a planned area. In a planned area. A sample is a portion of the population selected for a data source. (Sukardi, 2016). The subjects of this study were some students of class X IPA class, so the students of class X IPA 1 SMA Islam Al-Azhar 10 Pontianak, totaling 21 people, were used. They were totaling 21 people. X IPA 1 students were used based on the teacher's recommendations, namely students with a higher KKM score on chemical bonding material.

The instruments in this study are a test instrument of problem-solving ability and unstructured interview guidelines—problem-solving ability test in the form of contextual questions totaling 5 items. The questions were made based on chemical bonding material, namely chemical bonds, namely ion bonds, covalent bonds, and polarization in covalent bonds. Then, interview guidelines were developed based on 4 indicators of problem-solving. Problem-solving indicators. Interviews that have been conducted measure students' ability to solve based on the indicators determined as reinforcing data from the test results.

The problem solving ability test instrument has been validated by a validator, namely from a chemistry education lecturer at Tanjungpura University. The validity used in this study is the content validity of Gregory (2016) with a value of 1. After the test instrument is valid, its reliability is calculated using the Cronbach's Alpha method with an rii value close to 1. The rii value obtained is 0.71.

The problem solving ability test results were calculated using the problem solving ability assessment instrument. The test results of students in solving problem solving problems of chemical bonding material are presented as a whole based on the problem solving criteria instrument using Sugiyono's formula (2017).

$$\%P = \frac{Total\ Score}{Maximum\ Score}\ x\ 100$$

The percentage results are then grouped based on the average problem-solving ability guidelines as follows.

Table 1. Guidelines for average problem-solving ability.

Persentase (100%)	Kriteria
81 – 100	Excellence
61 – 80	Good
41 – 60	Fair
21 – 40	Poor
<21	Bad

(Arikunto, 2007:18)

The percentage that has been obtained is 60% in the sufficient criteria. Then the students' ability to solve problems on chemical bonding material is described.

RESULTS AND DISCUSSION

Research data regarding the description of the problem solving ability of class X students on chemical bonding material at Al-Azhar 10 Pontianak Islamic High School was carried out using a test instrument in the form of questions that were valid and reliable, with a reliability value of 0, 71. The number of test questions used as a tool to measure problem solving ability, amounted to 5. Students' problem solving ability is categorized in the predicate enough with an average percentage of 60%.
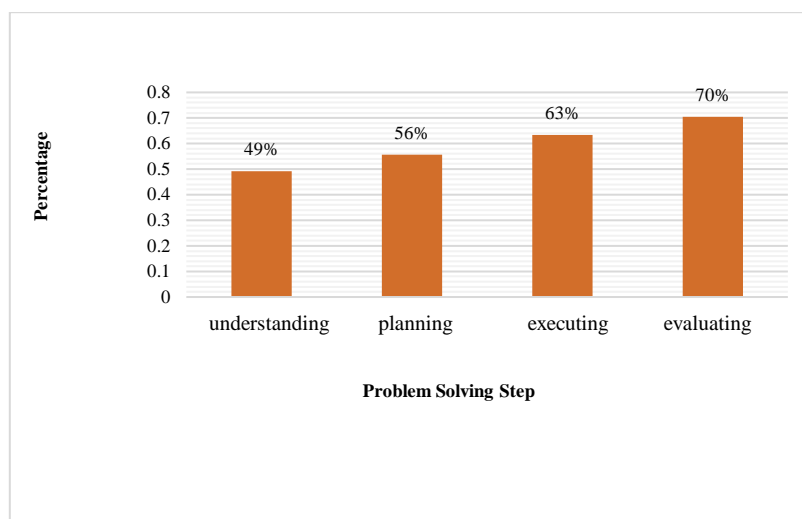
Figure 1. Level of Achievement of Problem Solving Indicators

Based on Figure 1, it can be seen that problem solving skills with sufficient criteria are indicators 1 and 2 with an average percentage of 49% and 56%. Meanwhile, the good criteria are indicators 3 and 4 with an average percentage of 63% and 70%. This means that students' problem solving skills are categorized as quite good.

To find out a more detailed discussion can be seen below. The average value of students' overall problem solving ability on each question can be seen in the following table.

Table 3. Average Case Question Score for Each Indicator

Case	Problem Solving Indicator			
	1	2	3	4
1	1,9	1,5	2,2	2,9
2	2,2	2,0	2,5	2,9
3	1,9	3,7	2,4	2,8
4	2,1	2,7	3,2	2,8
5	1,6	1,2	2,3	2,8

Indicator 1: Understanding the Problem

Understanding the problem is the student's ability to identify relevant information in the problem, and form an understanding of the problem. The test results on indicator 1 resulted in an average percentage of 49% so that it can be categorized as sufficient.

The sufficient predicate in indicator 1 proves that students are quite capable of identifying relevant information in the problem and understand the problem quite thoroughly and well. However, students have not been able to complete the data completely.

Based on table 3, it can be seen that the lowest average of students' ability to understand the problem is in case number 5, with a value of 1.6. Problem number 5 is ion bonding material that discusses the use of sap in the moth tree trunk as an electrical conductor. The question has the lowest score because students are still lacking in using the right concept/theory. Students find it difficult to relate the problem to the ionic bond material (Astutiani, 2019).

Figure 2 is the answer of one example of a low-value student answer in the category of understanding the problem. Seen in Figure 2 that students do not include related information from the problem (what is known and what is asked). This is because students are not too focused on the data but on the problem. In the indicator of understanding the problem,

students are asked to include the data contained in the problem and the main problem in the form of a question.
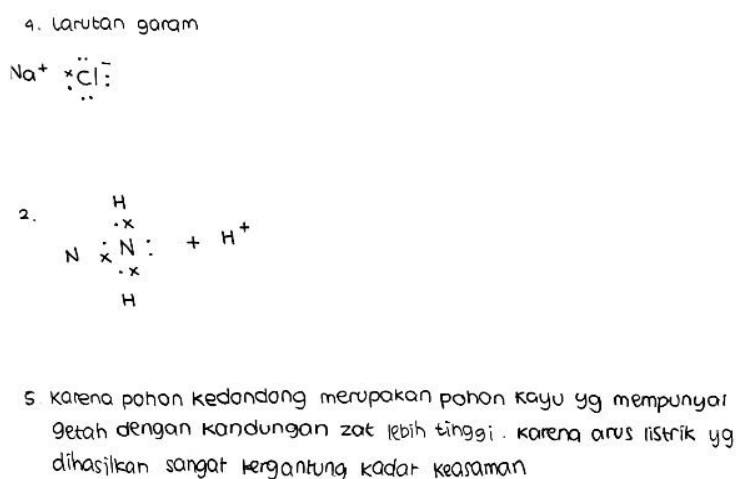

Figure 2. Students' answers in understanding the problem.

When seen on the answer sheet, students wrote it incompletely, namely some students wrote the data only but did not write the subject matter. While other students wrote the opposite. In the problem that has the highest score on the indicator of understanding the problem, namely problem number 2 with a score of 2.2 contains relevant information (what is known and asked in the problem. Can be seen in the picture 3.
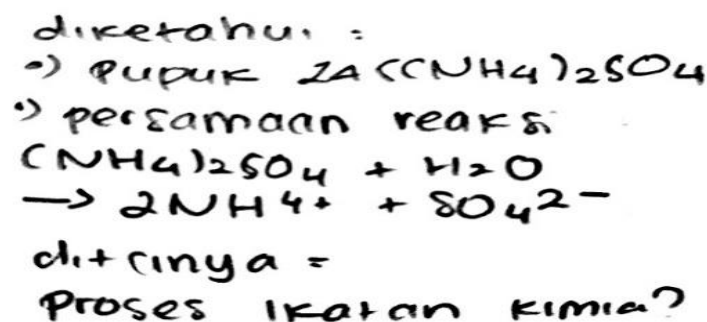

Figure 3. Students' good point answers in understanding the problem

Supported by student interviews, that some students suggested only writing familiar data, namely writing data that is often heard such as H2O. So it can be said that student literacy is low. This is in line with research conducted from (Utami, 2020) that the lack of student literacy skills can be seen from the answers of students who do not write related information completely. So the average percentage of indicators of understanding the problem obtained by students is 49%.

Indicator 2: Planning

Making a plan is a strategy in finding solutions and methods that are suitable for answering problems or problem-solving approaches. The test results on indicator 2 resulted in an average percentage of 56% so that it can be categorized as sufficient.

The sufficient predicate in indicator 2 proves that students are quite capable of finding suitable methods used to answer problems or using problem-solving approaches.

Based on table 3, it can be seen that the lowest average student ability in making plans is in case questions number 1 and 5 with values of 1.5 and 1.2. Problem number 1 is polarization material in covalent bonds which discusses the content of CO (NH2)2 found in urea fertilizer. The question has the lowest score because students are still lacking in using the right concept/theory. Students find it difficult to distinguish related to covalent bonding and polarization material in bonding kovalen (Hanifa, 2018).

Figure 4: Students' low answers in making a plan.

Figure 4 is the answer of one of the students who was low in the indicator of making a plan. In the indicator of making a plan, students must write the solution in the form of a mathematical model of the problem or item given correctly and clearly. However, it can be seen in Figure 4 that students do not make plans according to the concept/theory, students also do not write plans but directly write solutions or solve problems. Students have not been introduced to how to make a good plan. In the problem that has the highest score on the indicator of making a plan, namely problem number 3 with a score of 3.7, it contains a procedure for solving a good plan. It can be seen in the following figure 5 (Safitri, 2021).
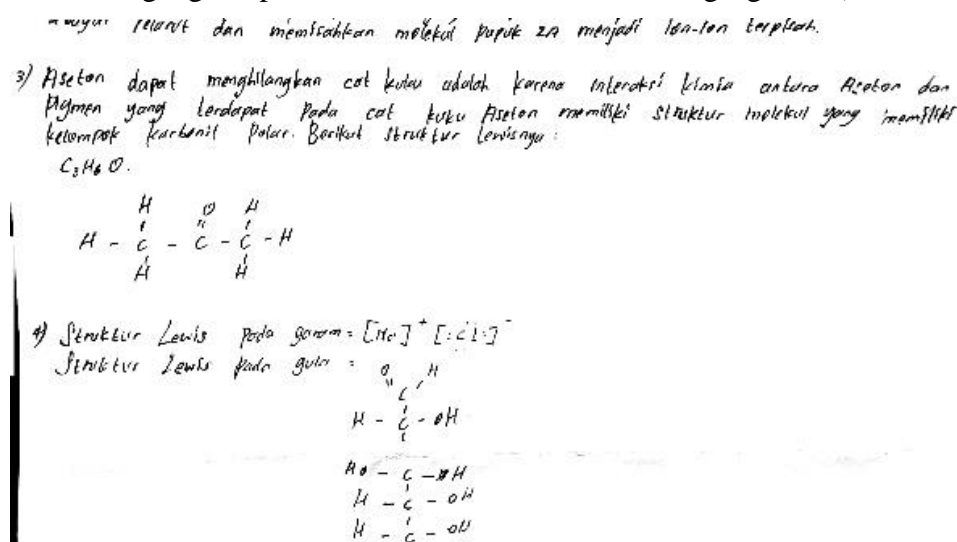

Figure 5: Students' good point answers in making a plan.

In line with the results of interviews with several students, they stated that in answering the problem, students immediately wrote down the problem solving without making a good plan first (not systematic). This is related to students' knowledge of good methods in answering chemistry problems.

In addition, chemical bonding material has been studied in the previous semester, which affects students' memory and understanding of the material. So the average percentage of indicators of making plans obtained by students is 56%.

Indicator 3: Executing Problem Solving Plan

Plan implementation is the skill of using a predetermined plan/strategy. The test results from this study on indicator 3 resulted in an average percentage of 63% so that it can be categorized as good.

The good predicate in indicator 3 proves that students have implemented the plan that has been determined well. Students know the direction of the plan made (procedure) to solve problems or solve problems.

Based on table 3, it can be seen that the lowest average student ability in implementing the plan is in case questions number 1 and 5 with scores of 2.2 and 2.3. Problem 1 is a case problem for students about the content of $CO(NH_2)_2$ in urea fertilizer. Problems number 1 and 5 have low scores on the implementation of the plan because it is related to the writing of planning in the indicator of making plans, namely students are still lacking in using the right concepts/theories (Hidayatullah, 2020).

Figure 6 is the answer of one of the students who scored low in the plan completion category.

Figure 6. Answers from students who are low in plan completion

Seen in Figure 6 that students' answers are still not correct. This is because the planning in numbers 1 and 5 is lacking so that the problem solving also has an effect, namely students do not make plans according to the concepts/theories that should be. In the question that has the highest score on the plan implementation indicator, question number 4 with a score of 3.2 contains the completion of the plan by following the procedure that has been determined properly. Can be seen in Figure 7 below (Safitri, 2021).
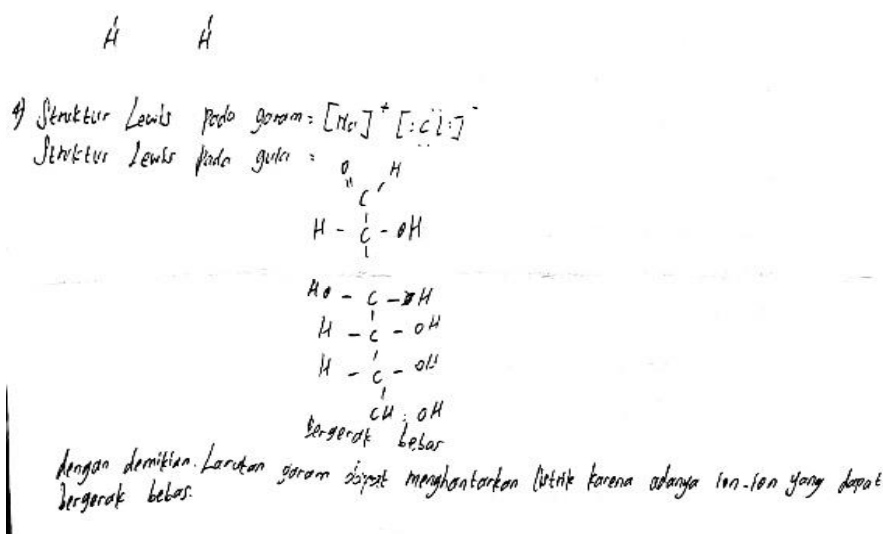

Figure 7: Students' good point answers in plan completion.

This is also supported by students who are less familiar with the forms of problem solving at the stage of making a plan that has a moderate predicate. In the problem solving indicator, students are required to write the solution with the correct procedure and have a clear solution

(showing the exact formation of the compound and explaining the compound bond that occurs completely).

This is in accordance with research conducted by (Yanti, 2016) which suggests that when students make illogical plans it will make the implementation of the plan less precise or not as it should be. The results of student interviews stated that some students forgot about the material that had been studied previously. This is related to the lack of student literacy. Then the average percentage of plan implementation indicators obtained by students is 63%.

Indicator 4: Evaluating/Rechecking Solution

Checking back is the stage of evaluating the process and results regarding the solution that has been made to solve the problem. To find out the students' ability to check back, at this stage an examination of the student's answer paper is carried out and supported by conducting interviews with students in the questionnaire rechecking results and processes. The research test results from indicator 4 resulted in an average percentage of 70% so that it can be categorized as good (Hanifa, 2018)

The good predicate in indicator 4 proves that students are good at checking back.

Based on table 3, it can be seen that the average ability of students in checking back is worth 2.8 and 2.9. It is shown in Figure 8 which is the result of students' answers in doing the re-examination (Safitri, 2021).
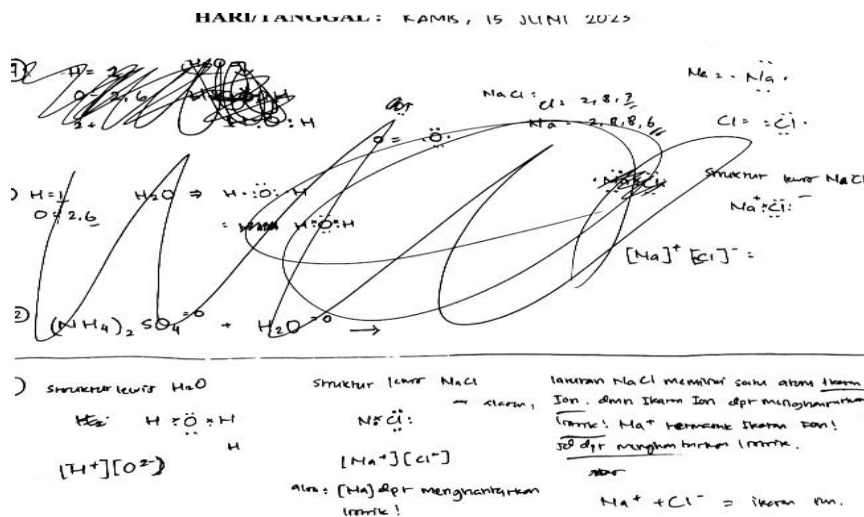

Figure 8. The answer of the student who checked back.

They see in Figure 8 that students have scribbled on the answer paper, namely, students replacing the previous answer using a new answer because they have done a re-check and get a better conclusion. Checking again and getting a better conclusion. This was also found in the answers of several other students, namely by giving scribbles on the previous answer. Then, the answer they think is correct is written at the bottom of the wrong answer. The wrong answer. This was reinforced by interviews conducted with students who conducted the re-checking.

In the indicator of checking back, students must re-examine the answer, starting from checking the process or method used and the results of solving the problem written to get maximum results. Problem-solving results written down to get maximum results. This is also done so that students do not quickly feel satisfied with the results obtained so that they can minimize errors in the methods and results used. Can minimize errors in the methods and results used. Students do check back at least 2 times for all problems. Some students got high results when re-checking because they checked the whole problem, process, and result. And

results. However, some students need to check the whole problem as a result only, not in the process. Students feel satisfied and do not need to evaluate their answers. Supported by research conducted by (Sanjaya et al., 2017), students tend to feel confident with the answers that have been developed without looking for solutions or other alternatives, developed without looking for other solutions or alternatives. Research (Damayanti, 2022) said that many students still need to be corrected in working on problem-solving-based problems because they are not used to and do not check the answers found. This is related to the lack of student literacy, so the average percentage of indicators of checking back that students get is 70%.

CONCLUSION

Based on data analysis, it can be concluded that the average percentage of students' problem solving ability is 60% (sufficient). In the indicator of understanding the problem 49% (sufficient), making a plan 56% (sufficient), implementing the plan 63% (good), and checking back 70% (good). Researchers suggest that teachers can evaluate the problem-based learning that is applied so that student learning outcomes are maximized.

RECOMMENDATIONS

This study aims to deeply investigate the problem-solving skills of grade X students at SMA Islam Al-Azhar 10 Pontianak in understanding and applying the concept of chemical bonding, with the main objective of providing better insight into the learning challenges and effective strategies to improve their understanding in this material.

ACKNOWLEDGEMENTS

The thank you is primarily addressed to research funders or donors. A word of gratitude can also be conveyed to those who assist in the implementation of the research.

BIBLIOGRAPHY

Akramunnisa, & Sulestry, A. I. (2016). Analisis Kemampuan Menyelesaikan Masalah Matematika Ditinjau dari Kemampuan Awal Tinggi dan Gaya Kognitif Field Independent (FI). *Jurnal Pendidikan Matematika, 1(2), 46–56.*

Aldoo, B., Boateng, S. K., & Ofori, I. (2016). Effect of Problem-Based Learning on Students' Achievement in Chemistry. *Journal of Education and Practice.*

Amanah, S.(2023). Peningkatan Hasil Belajar Siswa Pada Materi Konep Mol dengan Menerapkan Model Pembelajaran Problem Solving. *Jurnal Inovasi Tenaga Pendidik dan Kependidikan.*

Argarini, D. F. (2018). Analisis Pemecahan Masalah Berbasis Polya Pada Materi Perkalian Vektor Ditinjau Dari Gaya Belajar. *Jurnal Matematika dan Pembelajaran . 6(1). 91 – 99.*

Arikunto, S. (2007). Prosedur Penelitian Suatu Pendekatan Praktek Edisi Revisi VI hal 134. Jakarta: Rineka Apta.

Astutiani, R., Isnarto, & Hidayah, I. (2019). Kemampuan Pemecahan Masalah Matematika dalam Menyelesaikan Soal Cerita Berdasarkan Langkah Polya. *Seminar Nasional Pascasarjana.*

Cahyani, H., & Setyawati, R. W. (2016). Pentingnya Peningkatan Kemampuan Pemecahan Masalah Melalui PBL untuk Mempersiapkan Generasi Unggul Menghadapi MEA. *Seminar Nasional Matematika.*

Christina, E. N., & Adirakasiwi, A. G. (2021). Analisis Kemampuan Pemecahan Masalah Tahap Polya dalam Menyelesaikan Persamaan dan Pertidaksamaan Linear Satu Variabel. *Jurnal Pembelajaran Matematika Ovatif. 4(2)*

Damayanti, N., & Kartini. (2022). Analisis Kemampuan Pemecahan Masalah Matematis Siswa SMA Pada Materi Barisan dan Deret Geometri. *Jurnal Mosharafa: Jurnal Pendidikan Matematika, 11(1). 107-118.*

Ekawati, N. W., Musa, W. J. A., & Laliyo, L. A. R. (2014). Tingkat Kemampuan Menyelesaikan Soal-Soal Perhitungan Kimia Siswa Kelas XI IPA 2 di SMA Negeri 1 Telaga.

Enawaty, E. (2023). Development of Basic Chemistry E-Module Based on Problem-Based Learning for Chemistry Education Students. *Jurnal Penelitian Pendidikan IPA.*

Fadillah, S. (2009) Kemampuan Pemecahan Masalah Matematis dalam Pembelajaran Matematika, Artikel Prosiding Seminar Nasional Penelitian, Pendidikan dan Penerapan MIPA Fakultas MIPA, UNY.

Fatmawati, F., & MurtFIh. (201 8). Deskripsi Kemampuan Pemecahan Masalah Peserta Didik Kelas XI SMA Negeri 1 Majene. *Jurnal Saintifik. 4(1).*

Gayatri, G., Absari, M., Studi, P., Kimia, P., & Tadulako, U. (2020). Analisis Kemampuan Pemecahan Masalah Kimia Siswa Kelas XI di SMAN Kota Palu. *Jurnal Dinamika Pendidikan, 13(3), 255–263.* https://doi.org/10.33541/jdp.v12i3.1295

Hamzah, Ali. (2014). Evaluasi Pembelajaran Matematika. Jakarta: Rajawali Press.Haryono. (2017). Teknologi Pendidikan Dan Pembelajaran Abad 21. *Seminar Nasional Teknologi Pendidikan.*

Hanifa, N. I., Akbar, B., & Abdullah, S., Susio. (2018). Analisis Kemampuan Pemecahan Masalah Siswa Kelas X IPA Pada Materi Perubahan Lingkungan dan Faktor yang Mempengaruhinya. *Jurnal Penelitian Pendidikan Biologi. Vol 2(2), 121 – 128.*

Hanun, L., & Azizah, U. (2022). Applicatin of Problem-Solving Learning Model Bases Blended Learning to Improve Students Metacognitive Skills on Reaction Rate Material. *International Journal of Scientific and Research*

Hidayatullah, R., Suyono, & Azizah, U. (2020). Analisis Keterampilan Pemecahan Masalah Siswa Pada Topik Laju Reaksi. *Jurnal Penelitian Pendidikan Sains, Vol 10, No 01.*

Haryani, S., Prasetya, A., & Bahron, H. (2017). Building the Character of Pre-Service Teachers Through the Learning Model of Problem-Based Analytical Chemistry Lab Work. *Jurnal Pendidikan IPA Indonesia.*

Hasan, R., Lukitasari, M., Juniarti, V., & Irwandi. (2019). Improving Student Problem-Solving Skill and Cognitive Learning Outcome Through The Implementation of Problem-Based Learning. *Jurnal BIOEDUKATIKA.*

Hotimah, H. (2020). Penerapan Metode Pembelajaran Problem Based Learning dalam Meningkatkan Kemampuan Bercerita pada Siswa Sekolah Dasar. *Jurnal Edukasi, VII(3): 5-11.*

Ineng, J., Sihaloho, M., & Tangio, J. S. (2016). Deskripsi Hirarki Kemampuan Siswa Kelas XI SMA Negeri 1 Gorontalo dalam Memahami Materi Ikatan Kimia dengan Menggunakan Instrument Tes Terstruktur. *Jurnal Entropi. 11(1).*

Ipilo, S. R., Sihalolo, M., & Paputungan, M. (2018). Mahasiswa Yang Memiliki Gaya Kognitif Field Dependent dalam Memecahkan Masalah Stoikiometri. *Jurnal Entropi. 13(2).*

Jayadiningrat, M. G., & Ati, E. M. (201 8). Peningkatan Keterampilan Memecahkan Masalah melalui Model Pembelajaran Problem Based Learning (PBL) Pada Mata Pelajaran Kimia. *Jurnal Pendidikan Kimia Indonesia. 2(1). 1 - 10.*

Kartamiharja, M. R., Sopandi, W., & Anggraeni, D. (2020). Implementation of Problem Based Learning (PBL) APPROACH IN Chemistry Instructionalwith Context of Tofu Liquid Waste Treatment. *International Journal of Learning, Teaching and Educational Research.*

Khoiriyah, A. J., & Husamah, H. (2018). Problem-Based Learning: Creative Thinking Skills, Problem-Solving Skills, and Learning Outcome of Seventh Grade Students. *Jurnal Penddikan Biologi Indonesia.*

Kusumah, R. G. T., Walid, A., Sugiharta, A., Perdana, E. P., Wicaksono, I., & Erfan, M. (2020). Construction of High chool Chemistry Module, Based on Problem-based learning (PBL) on Salt Hydrolysis Material for Gifted Students. *Journal of Physics: Conference Series*

Mardhiyah, R., H., Aldriani, N. F., Chitta, F., & Zulfikar, M. R. (2021). Pentingnya Keterampilan Belajar di Abad 21 sebagai Tuntutan Alam Pengembangan Sumber Daya Manusia. *Jurnal Pendidikan. 122(1).*

Mawaddah, S., & Anisah, H. (2015). Kemampuan Pemecahan Masalah Matematis Siswa Pada Pembelajaran Matematika dengan Menggunakan Model Pembelajaran Generatif (Generative Learning) di SMP. EDU-MAT: *Jurnal Pendidikan Matematika, 3(2), 166– 175.* https://doi.org/10.20527/edumat.v3i2.644

Menteri Pendidikan. (2022). Peraturan Menteri Pendidikan, Kebudayaan, Riset, dan Teknologi Republik Indonesia Nomor 16 Tahun 2022 Tentang Standar Proses pada Pendidikan Anak Usia Dini, Jenjang Pendidikan Dasar, dan Jenjang Pendidikan Menengah.

Muhali, M. (2021). Pengaruh Implementasi Mode Creative Problem Solving terhadap Peningkatan Kemampuan Pemecahan Masalah, Keterampilan Proses Sains, dan Kesadaran Metakognisi Peserta Didik. *Jurnal Kependidikan Fisika.*

Nugroho, Nuralifah, R. N., & Hidayah, R. (2020). Profil Keterampilan Pemecahan Masalah Peserta Didik dan Penerapan Strategi Ideal Problem Solving Berbantuan Lembar Kegiatan Peserta Didik (LKPD) di SMA. *Prosiding Seminar Nasional Kimia (SNK). 144–153.*

Nur, A. S.,Waluya, S., Rochmad, R., & Wardono, W. (2020). Contextual Learning with Ethonomathematics in enhancing the problem solving based on thinking levels. *JRAMathEdu (Journal of Research and Advances in Mathematics Education).*

Pirmanto, Y., Anwar, M. F., & Bernard, M. (2020). Analisis Kesulitan Siswa SMA dalam Menyelesaikan Soal Pemecahan Masalah Pada Materi Barisan dan Deret Dengan Langkah – Langkah Menurut Polya. *Jurnal Pembelajaran Matematika Inovatif. 3(4).*

Polya. (1957). How to Solve It A New Aspect of Mathematical Method. United States Of America: Princeton University Press.

Purba, D, Zulfadli, & Lubis, R. (2021). Pemikiran George Polya Tentang Pemecahan Masalah. *Jurnal Mathedu. Mathematic Education Journal. 4(1).*

Putra, A. A. I., Aminah, N. S., & Marzuki, A. (2020). Analysis of Student 'Multiple representation-based Problem – solving Skills. *Journal of Educational Science and Tecnology. Volume 6 number 1.*

Purwanti, Kristi, L., Adriyani, Z., & Fatmawati, E. (2022). Analisis Pembelajaran Aktif Berbasis Keterampilan Abad 21 pada Guru MI di Kota Semarang. *Jurnal Madrasah Ibtidaiyah.*

Purwanto, A., Pramono, R., Asbari, M., Santoso, P. B., Wijayanti, L. M., Hyun, C. C., & Putri, R. S. (2020). Studi Eksploratif Dampak Pandemi COVID-19 terhadap Proses Pembelajaran Online di Sekolah Dasar. EduPsyCouns: *Journal of Education, Psychology and Counseling, 2(1), 1–12.*https://ummaspul.e-journal.id/Edupsycouns/article/view/397

Rahmatjati, A. N. (2018). Penerapan Model Pembelajaran Problem Solving untuk Meningkatkan Hasil Belajar Siswa pada Materi Konsep Mol di Kelas X MIPA Di SMA Negeri 6 Kota Bekasi. *Jurnal Dinamika Pendidikan.*

Redhana, I, W. (2019). Mengembangkan Keterapilan Abad Ke – 21 dalam Pembelajaran Kimia. *Jurnal Inovasi Pendidikan Kimia.*

Safitri, E., Sartika, R. P., & Hadi, L. (2021). Deskripsi Kemampuan Pemecahan Masalah Bentuk Molekul MAS Al-Mustaqim. *Ar-Razi Jurnal Ilmiah.Vol. 9 No. 1.*

Sambada, D. (2012). Peranan Kreativitas Siswa Terhadap Kemampuan Memecahkan Masalah Fisika dalam Pembelajaran Kontekstual. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA). 2(2).*

Sampurna, A. M., Mulawi., & Sadiana, I. M. (2020). Profil Penguasaan Konsep 41 Ikatan Kimia pada Siswa Kelas X SMA Negeri 4 Palangka Raya Tahun Ajaran 2017/2018. J*urnal Ilmiah Kanderang Tingang. 11(1).*

Sanjaya, R. E., Syahmani, S., & Suharto, B. (2017). Penggunaan Metode Improve untuk Meningkatkan Kemampuan Siswa dalam Memecahkan Masalah pada Materi Larutan Penyangga, Kelarutan dan Hasil Kali Kelarutan di Kelas XI IPA 4 SMA Negeri 1 Banjarmasin. *Jurnal Inovasi Pendidikan Sains, 5(1), 57-68.*

Santika, I., Parwati, N., & Divayana, D. (2020). Pengaruh Model Pembelajaran Berbasis Masalah dalam Setting Pembelajaran Daring terhadap Prestasi Belajar Matematika dan Kemampuan Pemecahan Masalah Siswa Kelas X SMA. *Jurnal Teknologi Pembelajaran Indonesia. 10(10), 105–117.* https://ejournal-pasca.undiksha.ac.id/index.php/jurnal_tp/article/view/3397

Sari, R. M. (2020). Measuring Students Environmental Problem Solving Ability Across Gender and School Differences Using Paper Based Testing. *Int. J. Emerg. Technol. Learn*

Serevina, V., Sunaryo, Raihanti, Astra, I. M., & Sari, I. J. (2018). Development of E-Module Based on Problem Based Learning (PBL) on Heat and Temperature to Improve Student's Science Process Skill.*The Turkish Online Journal of Educational Technology.*

Sholihah, A., Dj, L., & Efendi, J. (2017). Development of Stoichiometry Module Based on Problem Solving for 10th Grade of High School Students. *International Journal of Research in Counseling and Education. Volme 01 Number 01*

Simangunsong, A. D. (2023). Implementation of The Problem Based :earning (PBL) Learning Model To Improve Skills Creative Thinking of Students on The Material Coligative. *Jurnal Ilmiah Pendidikan.*

Siagian, M. V., Saragih, S., & Sinaga, B. (2019). Development of Learning Materials Oriented on Proble,M-Based Learning Model to Improve Students Mathematical Probleem Solving Ability and Metacognition Ability. *International Electronic Journal of Mathematics Education. 14(2). 331-340.*

Sophia, A., Enawaty, E., & Sartika, R. P. (2017). Deskripsi Kemampuan Pemecahan Masalah dalam Materi Perhitungan Kimia pada Siswa Kelas XI SMA. *Jurnal Pendidikan Dan Pembelajaran, 7(2), 1–10.*

Sugiarto, M. Amin, B. D., & Yani, A. (2016). Studi Kemampuan Menyelesaikan Soal – Soal Fisika Menurut Langkah Pemecahan Masalah Polya pada Peserta Didik XI IPA SMA Negeri Baraka Kabupaten Enrekang. *Jurnal Sains Dan Pendidikan Fisika. 12(2). 183 – 191.*

Sugiyono. (2017). Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta.

Sukardi. (2016). Metodologi Penelitian Pendidikan. Jakarta: PT Bumi Aksara.

Sumartini. (2016). Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa melalui Pembelajaran Bebasis Masalah. *Jurnal Pendidikan Matematika STKIP. 8(3). 11-21.*

Syahmani, Iriani, R., & Aisyah, N. (2018). The Effect of E-Learning Based Schoology on the Learning Outcomes and Problem Solving Skills in Chemistry. *Advances in Social Science, Education and Humanities Research, Volume 274.*

Syifaiyah, R., Tukiran, T., & Erman, E. (2018). Development of Chemistry Instruction Material Using Problem Based Learning Model for Increasing The Student of Senior High School Learning Achievement. *JPPS(Jurnal Penelitian Pendidikan Sains).*

Thorndahl, K. L., Stentoft,D. (2020). Thinking Critically About Critical Thinking and Problem-Based Learning in Higher Education: A Scoping Review. *Interdisciplinary Journal of Problem-Based Learning.*

Trianto. (2011*).* Pengantar Penelitian Pendidikan bagi Pengembangan Profesi Pendidikan dan Tenaga Kependidikan. Jakarta: Kencana Prenada Meda Group.

Utami, N., Sukestiyarno, Y. L., & Hidayah, I. (2020). Kemampuan Literasi dalam Menyelesaikan Soal Cerita Siswa Kelas XI A. *Prosiding Seminar Nasional Matematika.*

Yanti, N. R., Suharto, B., & Syahmani. (2016).Implementasi Model Problem Based Learning Berbantuan Tes Superitem terhadap Kemampuan Pemecahan Masalah Materi Kelarutan dan Hasil Kali Kelarutan. *Jurnal Inovasi Pendidikan Sains, Vol 7. No. 2.*