

## **Profile of Junior High School Students' Problem-Solving Ability on The Topic of Human Relationship to Ecosystems Through The Role-playing Method**

**Alvi Maidatur Rohmah<sup>1</sup>, Indra Fardhani<sup>\*1</sup>, Dian Nugraheni<sup>1</sup>, Habiddin<sup>1</sup>**

<sup>1</sup>Department of Science Education Universitas Negeri Malang East Java 65145 Indonesia

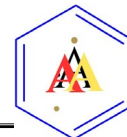
*\*Corresponding author: [indra.fardhani.fmipa@um.ac.id](mailto:indra.fardhani.fmipa@um.ac.id)*

**Abstract:** This research aims to elucidate the problem-solving capabilities of junior high school students about human relationships with ecosystems, particularly river ecosystems, utilising the role-playing method within a debate framework among represented professional groups. This study involved 25 seventh-grade students from an MTs Negeri in Malang Regency. Students were grouped to simulate various occupations, including physicians, government representatives, scientists, and environmental advocates. Data was gathered using LKPD responses, observation forms, and interview protocols. The data analysis indicates that the environmental volunteer profession group scored the highest on the LKPD, scoring 94. Additionally, as assessed by observation, the average percentage derived from the student problem-solving skill profile was 85%, categorised as very good. The interview results indicated that students responded positively to the learning activities.

**Keywords:** Role-playing method, problem Solving, River pollution

### **INTRODUCTION**

Education in Indonesia is experiencing development in line with the changing times. 21st-century skills are one of the aspects of focus in learning using the Merdeka Curriculum, with the hope that they can equip students to face the challenges of the 21st century. The National Education Association (NEA, 2012) states that there are 18 21st-century skills that students need to master. Learning and innovation skills are one of the skills that encompass 4 aspects commonly known as the 4Cs: communication, collaboration, critical thinking, and creativity. One of the skills included in the essential thinking element is problem-solving ability (Partnership for 21st Century Learning, 2009).



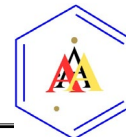
Problems are conditions that can be experienced by someone anytime and anywhere in their life. Therefore, it is important to master problem-solving skills to help overcome challenges. Problem-solving ability is the student's capacity to seek solutions to a problem based on their knowledge, understanding, and abilities (Koswara et al., 2019). Problem-solving activities are a process that requires logical thinking to find a solution to a problem. Students can solve problems by applying their knowledge in new situations. According to Polya (1957), problem-solving ability consists of 4 stages, namely: (1) Understand the Problem, (2) Device a Plan, (3) Carry Out the Plan, (4) Look Back. Problem-solving ability has the following criteria: understanding the problem, planning problem-solving strategies, implementing problem-solving strategies, analysing results, and concluding problem-solving (Runi, 2021). Several factors that influence problem-solving ability include the environment, learning media, learning strategies, critical thinking, the material presented, the complexity of the material, students' initial abilities, and motivation (Vega Artinta et al., 2021).

The 2022 PISA report shows Indonesia has an average science proficiency score of 383. The average science proficiency score remains low (OCDE, 2023). The research conducted by Ermawan & Fauziah (2023) regarding students' problem-solving abilities in science subjects found that students' problem-solving skills are still low. This result was obtained because students were not yet able to understand the given problems, making it difficult to plan and determine solutions to the problems. In addition, the low problem-solving abilities of students may also be due to the use of conventional teaching methods and lectures that still dominate science instruction in the classroom, making students less trained to face complex and diverse problems (Monika et al., 2022). Therefore, innovation in science education is urgently needed to improve students' problem-solving skills, which are still low.

Students' low problem-solving skills can be improved using the role-playing method (Runi, 2021). Role-playing is a learning method that conditions students to participate directly in the learning process and serves as a tool to understand other people's perspectives (Lewin, 1948). The role-playing method's benefits are that students gain different learning experiences and a new learning atmosphere. It also makes students more active and think creatively (Iftita et al., 2023). Role-playing can be used in the classroom in many ways. This method can enhance the efficiency of academic learning by depicting current events or social conditions (Chesler & Fox, 1966). Some skills and abilities that can be developed through role-playing include self-confidence, teamwork, a sense of responsibility and leadership in learning, peer learning/teaching, and creative problem-solving, which would be difficult to develop if only using conventional learning methods (Craciun, 2010).

The role-playing method has proven effective in achieving learning outcomes in three main aspects of learning: affective, cognitive, and behavioural. Learning by placing students in specific roles can train empathy and perspective-taking. Research (Acharya et al., 2019) shows that applying the role-playing method is more effective than learning with conventional methods. Several studies have reported that role-playing positively impacts student learning; the role-playing method allows students to gain a deeper understanding of an issue. Several studies have found that role-playing games significantly impact student learning; the role-playing method allows students to obtain a deeper grasp of a topic and encourages their interest in studying the problem

---



further (Hidayati & Pardjono, 2018). The employment of role-playing strategies might strengthen students' problem-solving abilities, especially on the link between living things and their surroundings (Ismawati et al., 2016). The application of the role-playing method in school learning activities should be linked to events or difficulties around the pupils (Iftita et al., 2023). The issue of environmental contamination is related to occurrences and natural symptoms that can arise owing to numerous factors. Problems relating to environmental contamination can readily be noticed around the pupils. For example, home, agricultural, and industrial waste are disposed of in waterways (Rahayu et al., 2021).

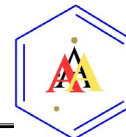
Based on the explanation above, the author is encouraged to examine how the problem-solving abilities of students in science disciplines, mainly connected to the issue of river pollution, utilise the role-playing learning technique. This study intends to describe students' problem-solving abilities and answers after participating in learning activities using the role-playing method on the link between humans and ecosystems sub-topic.

## METHOD

This descriptive research occurred at a public Islamic junior high school in Malang Regency in the second term of the 2023/2024 academic year. This study involved 25 seventh-grade students. The study commences with developing instruments designed to assess students' problem-solving abilities, encompassing instructional modules, student worksheets, and observation sheets. Before utilising the research instruments, they are validated by specialist faculty members at the university. Furthermore, an interview guideline is employed to assess students' responses following their engagement in learning through the role-playing method. The specifics of the research instruments used are presented in Table 1.

**Table 1.** Research Instruments

Research objective	Instrument	Data	Participant
Students' problem-solving abilities profile	Students' worksheet (LKPD)	<ol style="list-style-type: none"> <li>1) Problem topic</li> <li>2) Response regarding the problem</li> <li>3) Causes of the problems</li> <li>4) Preventive measures that can be taken</li> <li>5) Preventive measures that can be taken by collaborating with other professions</li> <li>6) Conclusion of the discussed issue</li> </ol>	25 students
	Observation sheet	Observation sheets are assessed using a Likert scale and problem-solving indicators: <ol style="list-style-type: none"> <li>1) Understanding of the problem</li> <li>2) Problem analysis</li> <li>3) Solution planning</li> <li>4) Execution of solution</li> <li>5) Conclusion and reflection</li> </ol>	4 observers
Students' responses	Interview guidelines	Interview questions: <ol style="list-style-type: none"> <li>1) Students feelings</li> <li>2) Students' confidence before participating in learning activities using the role-playing method</li> <li>3) Students' self-confidence after participating in learning activities using the role-playing method</li> <li>4) The difficulties experienced by students during the learning activities using the role-playing method</li> <li>5) Suggestions related to the learning that has been conducted</li> </ol>	4 students



The implementation of learning to assess students' problem-solving abilities using the role-playing method is divided into two sessions with procedures. During the learning process, both in the first and second meetings, 4 observers attended to collect observational data on students' problem-solving abilities. The role-playing learning with a debate scenario was conducted following the procedure outlined in Table 2.

**Table 2.** Role Playing Procedures for Meeting 2

No.	Activities
1.	Students alternately present the topic of the issues discussed based on the images presented in the LKPD.
2.	The student conveyed their group's response regarding the topic discussed.
3.	The student presented the group's argument regarding the causes of river pollution issues.
3.	The student presented the group's argument regarding the causes of river pollution issues.
4.	The student presented their group's arguments regarding preventive measures that can be taken to address the issue of river pollution.
5.	The student presented their group's argument regarding preventive measures that can be taken by collaborating with other professions.
6.	The student presented the group's argument regarding the conclusion of the discussed environmental pollution issue.

Indicators of problem-solving ability include understanding the problem, analysing the problem, planning the solution, implementing the solution, drawing conclusions, and reflecting (Polya, 1957). The formula used to calculate the level of achievement in students' problem-solving abilities is as follows (Yuanari, 2011).

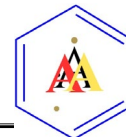
$$Score = \frac{Obtained\ score}{Maximum\ score} \times 100$$

The results of calculating students' problem-solving ability scores are then classified as problem-solving ability according to (Bwefar et al., 2019).

**Table 3.** Problem-Solving abilities indicators

Indicators	Observation	LKPD
Problem understanding	2 statements	2 statements
Problem analysis	2 statements	1 statement
Solution planning	2 statements	1 statement
Execution of the solution	2 statements	1 statement
Conclusion and reflection	2 statements	2 statements

After conducting the learning activities, the data results from the LKPD are presented as percentages for each indicator in graphical form, and the answers to the LKPD completed by the students are transcribed. The interview results are transcribed and grouped based on the responses that emerged. Meanwhile, the data from the observation sheets are presented in tables based on each indicator's percentage results and then described. Data is analysed using triangulation techniques, which involve comparing research results from data collection that vary from the same data source or subject (Alfansyur & Mariyani, 2020). Data on students' problem-solving abilities were obtained from LKPD answers and observation sheets, which were then compared to determine the profile of students' problem-solving skills.

**Table 4.** Category of Problem-Solving Abilities

Interval	Criteria
81-100	Excellent
61-80	Good
41-60	Moderate
21-40	weak
0-20	Poor

## RESULTS AND DISCUSSION

### Description of Students' Problem-Solving Abilities

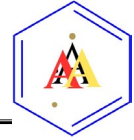
The profile of students' problem-solving abilities is reflected in the outcomes of their LKPD responses. The scores of the students' LKPD answers, completed in groups, are shown in Table 5.

**Table 5.** Students' LKPD Score

No.	Professional Role in Role-Playing	Score
1.	Doctor	93
2.	Scientist	91
3.	Government official	91
4.	Environmental volunteers	94

Based on the students' LKPD answers, it is known that the group of doctors received a score of 93, the group of scientists received a score of 91, the group of government officials received a score of 91, and the group of environmental volunteers received a score of 94. Based on the scores obtained, the problem-solving abilities of each group fall into the excellent category (Bwefar et al., 2019). Students can answer each question well. As an introduction, two images showing cause and effect are presented, from which it can be inferred that the topic to be discussed in the lesson using the role-playing method with a debate scenario is "The Impact of Humans on River Pollution." In the section on student responses related to the discussed issue, students were able to convey their group's response regarding the problem of river pollution. In the section on the causes of river pollution, students can clearly mention several activities that lead to river pollution. In questions related to prevention efforts to address river pollution issues from the perspective of the assigned profession, students can design prevention efforts that align with the assigned profession. Next, in the mitigation efforts that can be collaborated with other professions, students can design effective mitigation strategies. In the conclusion section, students can conclude the discussed topic of river pollution issues.

The students' problem-solving abilities can be observed through their responses in the LKPD. Although they answer the LKPD adequately, several points require further clarification. Answers related to the subject of the problem and the student's responses to it fall under the problem-solving indicator, which is understanding the issue. Through this indicator, it is anticipated that students will be able to articulate the presented problem and identify its key elements. Students are asked to ascertain the topic of the problem through two related images: one of a person throwing rubbish into a river and another of a polluted river. However, some groups do not concentrate



on human influence but solely on river pollution. For instance, the response from the group of medical professionals is as follows:

*"Pollution of the river by garbage"*

Based on the answer above, it is evident that the students still struggle to comprehend the cause-and-effect relationship depicted in the image. In contrast, the more accurate response comes from the following group of scientists:

*"The impact of humans on river ecosystem pollution."*

The answers above indicate that the group of medical professionals still cannot comprehend the presented problem, whereas the scientists already understand it. This aligns with research (Chiang & Lee, 2016), which suggests that low problem-solving ability in students may arise from not fully grasping the issue at hand. The limited capacity of students to understand a problem may stem from their insufficient conceptual understanding. Students often struggle with the fundamental concepts of the issues presented (Price et al., 2021). Furthermore, their low comprehension can also be attributed to a lack of attention to the problems presented (Tan et al., 2023). Students tend to be less meticulous in examining the relationship between the two images provided, often concentrating on only one, which results in inaccuracies in identifying the problem topic.

In the section on group responses to the issue, several similar answers were noted, primarily concerns regarding river pollution caused by humans dumping waste into the river. A notable response comes from a doctor:

*"River pollution is a serious problem that affects human health and the environment. In 2016, based on data from the Ministry of Environment and Forestry, out of 140 rivers in 34 provinces, 73.24% were in a polluted status. The pollution of these rivers can affect water quality and impact public health."*

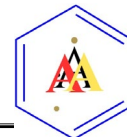
Through the above answer, it is known that the ability of the medical profession group to understand issues is classified as good because they use data from polluted rivers and can see from the perspective of their profession, which is related to human health. Through the above answer, the ability of the medical professional group to understand the issues is excellent. This can be influenced by the group's understanding of the medical profession's role and the availability of sources or references related to the profession and the issues presented (Ermawan & Fauziah, 2023).

The next indicator of problem-solving ability is analysing the problem. This indicator can be seen through the students' group answers to the causes of river pollution problems. In this section, students can convey the causes of river pollution but have not yet approached it from the perspective of the portrayed profession. For example, in the following response from a scientist profession:

*"Because many residents throw waste into the river, it can cause floods, etc."*

Based on this answer, the student's response has not yet adopted the viewpoint of a scientist. Scientists are expected to possess a broader knowledge base than the general public. When students can view the issue of river pollution from a scientific perspective,

---



they can relate it to the inadequate waste management tools or technologies in Indonesia, which contributes to river pollution being a significant problem in the country. This may stem from students being less familiar with the roles of the professions being portrayed (Aura et al., 2023). Furthermore, monotonous learning and the limited availability of books make students accustomed to viewing problems in a general manner (Castro, 2023).

The next indicator of problem-solving is planning a solution. In this planning phase, students design solutions according to their profession. Students can devise preventive measures to address river pollution based on the responses gathered. Through the solution planning indicators, students' ability to create solutions relevant to the profession they are portraying is evident. Here is the answer from the group of scientists that aligns with the scientists' perspective.

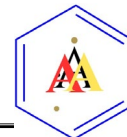
*"Creating trash bins based on their types, creating nets provided around the river area, building channels for waste so that it does not mix with river water."*

Based on the answer, it can be seen that students can design preventive measures from a scientific perspective related to developing and producing something. The preventive measure of creating nets around the river is a creative prevention effort that is still rarely applied in daily life. When asked why such an effort was being designed, the group of professional scientists argued that most people throw trash from above the river or bridge. Through the designed preventive measures, it is hoped that the waste thrown away will not fall into the river, thus preventing river pollution. Students can explain the reasons for creating detailed problem-solving solutions because the issues discussed are related to their daily lives, allowing them to plan preventive measures based on observed facts. (Chesler & Fox, 1966). The appropriate topic to be used in learning activities with the role-playing method is a topic that is related to or close to the student's daily lives.

The students' answers regarding preventive efforts that can be undertaken in collaboration with other professions aim to consider various possible solutions to address river pollution. Based on the students' answers, the group of doctors collaborates with the group of scientists, and the group of government professionals works with environmental volunteers. The collaboration formed is a variation and desire of the students themselves. Through this collaboration, new variations of preventive efforts emerged, carried out by government professionals working with volunteers as follows.

*"Agreeing with the government and volunteers to tackle river waste by directly engaging in the area to set an example for the community."*

Based on that answer, it is known that the government profession wants to collaborate with environmental volunteers by directly participating in river cleaning activities to set an example for the community. After being asked further about the plan made, the students opined that the government should be able to set an example for its community. According to research (Permata & Sandri, 2020), group work is one factor that can support students' ability to plan a solution. Because the learning is conducted



in groups and there is collaboration, students can plan diverse and creative solutions to problems.

The conclusion of the topic on the impact of humans on river pollution is that cooperation between various parties is necessary to address the issue of river pollution. All professional groups can conclude the discussed issue well. Students' problem-solving abilities can be classified as good if they can conclude the presented problems accurately (Rahmayani & Fadly, 2022). In this case, students can conclude that the issue of river pollution discussed requires cooperation among various parties to be resolved.

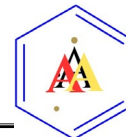
Students' problem-solving ability is evident in the learning process and outcomes. Based on the results obtained, it is known that the group of environmental volunteer professionals received the highest scores. This may be influenced by good cooperation among groups. The improvement in students' problem-solving skills will enhance their mindset. Thus, by using appropriate problem-solving skills, students can develop concrete and more apparent ideas. These skills help students face and simplify complex problems, making them easier to understand and solve (Pratiwi & Musdi, 2021). In the context of role-playing learning, most students can understand the presented problems. However, they are less accurate in designing problem-solving solutions and still find it challenging to solve problems according to their roles.

Based on the description related to student responses in the LKPD, it is known that the following factors influence students' problem-solving abilities using the role-playing method: 1) some groups are still unable to understand and solve the problem because they only pay attention to the problem in general; 2) some groups have difficulty finding information related to the profession they are portraying, making it hard to plan problem-solving solutions; 3) each group plans and implements problem-solving strategies by working together or discussing within the group to obtain more accurate answers; 4) cooperation between groups can influence students' problem-solving abilities.

Besides the LKPD answers, students' problem-solving abilities are assessed through observation sheets. Based on the percentage results of the observation sheet, it is known that the problem understanding indicator received a score of 91% with good criteria. On the problem analysis indicator, a score of 81% was achieved with good criteria. The solution planning indicator received a score of 87% with good criteria. The implementation solution indicator received a score of 84% with good criteria. Meanwhile, the conclusion and reflection indicator received a score of 81% with a good criterion. Observation of students' problem-solving abilities showed an average score of 85% with excellent criteria (Bwefar et al., 2019).

Through the results of the observation sheet above, it can be seen that students' problem-solving abilities fall into the excellent category, with the highest percentage on the problem-understanding indicator. In contrast, the lowest percentage is on the problem analysis, conclusion, and reflection indicators, which received the same percentage. The problem-understanding indicator, the basic indicator of problem-solving ability, is already good because it has received the highest percentage. Meanwhile, the problem planning indicator, which produced a low percentage, may be due to students being confused about making plans that align with their profession.





The conclusion and reflection indicators also received a low percentage, although still within the good category. In this section, students can draw good conclusions about the learning. However, the low percentage results were obtained from the observer's observations, with notes provided by the observer regarding the reflection section that has not been fully implemented. Thus, this can affect the percentage of the conclusion and reflection indicators. The reflection stage was not maximally implemented due to time constraints in the learning process. One of the drawbacks of the role-playing method is that it requires a considerable amount of learning time, which can affect the problem-solving stage that cannot be maximally completed (Sari et al., 2019).

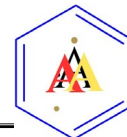
The difference in LKPD answer results can be caused by varying levels of cooperation among group members. In group activities, the role of each group member is crucial to achieving optimal results (Wiria & Alberida, 2023). As seen from the learning process, students' problem-solving ability can be determined through observation sheets, with the observation results related to the student's self-confidence in presenting the answers they have written in the LKPD. Thus, even though the answers on the LKPD received good results, they were not conveyed well when observed. Based on the results of the LKPD answers and observation sheets, it is known that students' problem-solving abilities encompass all indicators and fall into the excellent category (Bwefar et al., 2019). Although it falls within the excellent category, the problem analysis and conclusion indicators received lower scores than the others. This is due to the student's lack of understanding of the presented problems or the lack of learning related to problem-solving, so the students are not yet accustomed to solving problems, especially environmental pollution issues. Both external and internal factors influence students' problem-solving abilities. These internal factors include the cognitive abilities and interests possessed by the students. At the same time, the external factors include the learning environment created, the motivation provided by teachers, and the models/methods of teaching used (Bhadargade et al., 2020).

### Students Responses Regarding Learning Using the Role-Playing Method

Students' responses regarding the learning experiences obtained after participating in lessons using the role-playing method can be seen through the interview results presented in Table 6.

**Table 6.** Students Responses Recorded from The Interview

No.	Question	Answer
1.	Feelings after the learning	Happy, because they can express their opinion.
2.	The courage to express opinions before participating in learning activities using the role-playing method.	Lack of confidence in one's own opinion
3.	The courage to express opinions after participating in learning activities using role-playing.	It is more daring because it involves playing a profession in groups.
4.	Cooperation among group members	There are group members who did not participate in the group discussion.
5.	Difficulties during learning	Adjusting the answers to match the portrayed profession
6.	Suggestion	<ul style="list-style-type: none"><li>• The debate is conducted one by one.</li><li>• Be more patient with friends.</li><li>• Done in front of the class, not sitting.</li></ul>

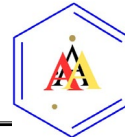


Through the results of the interviews, it was found that the majority of students stated they enjoyed learning using the role-playing method because it allowed them to express their opinions in class, unlike learning with conventional methods, which made students less interested in voicing their opinions or asking questions during class. In line with the research (Khamouja et al., 2023), the role-playing method can encourage students to be more interested in learning activities. Additionally, students' confidence also increased compared to when using conventional teaching methods such as lectures. Based on the results of student interviews, students' confidence in expressing their opinions increased because they role-played a profession and learning was conducted in groups. Several studies state that role-playing can influence students' confidence in learning activities or expressing opinions during the classroom learning (Dohaney et al., 2018; Steube et al., 2024). Based on the results of student interviews, it was found that in each group, group members did not participate in the discussion, which could lead to less optimal answers (Fadillah, 2023). Although students responded positively to the learning that had been conducted, they expressed some difficulties during the learning activities using the role-playing method. Most students stated that the obstacles encountered during the learning process using the role-playing method were the difficulty in adjusting their answers to the portrayed profession. Additionally, students provided suggestions regarding the teaching methods that had been implemented.

The interview results show that students respond well to the learning process using the implemented role-playing method. It is evident from how the students answered the questions posed. In addition, students also stated that they enjoyed gaining experience through role-playing learning because it allowed them to solve problems from the perspective of other professions. In addition to problem-solving skills, students gain the courage to express their opinions after participating in role-playing learning, as in groups, making them feel more confident in expressing their views. The role-playing method is enjoyable engaging, and can foster student interaction. Through this method, the skills and abilities that can be developed include teamwork, leadership in the learning process, responsibility, peer learning/teaching, self-confidence, and creative problem-solving (Craciun, 2010). Although there are difficulties in role-playing activities, such as the adjustment between opinions and the professions portrayed by students, they can overcome these by effectively expressing their views and participating in the learning activities.

## **CONCLUSIONS**

Based on the results obtained, it is known that the group of environmental volunteer professionals received the highest problem-solving ability score, 94. Meanwhile, the average observation result was 85%, an excellent category. Through interviews related to learning using role-playing, positive responses were received from students, indicating that the learning activities can help train students' problem-solving abilities and that students can see the efforts to solve a problem from the perspective of different people or professions. However, some group members did not participate in the group discussion. Based on the research, students' problem-solving abilities can be influenced by the teaching methods applied and cooperation in group activities. Therefore, students' problem-solving abilities in science education can be enhanced



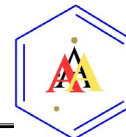
through role-playing methods, making learning activities more varied and creating new learning experiences for students.

## ACKNOWLEDGEMENT

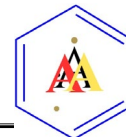
We would like to thank all parties who participated in this research.

## REFERENCES

- Acharya, H., Reddy, R., Hussein, A., Bagga, J., & Pettit, T. (2019). The effectiveness of applied learning: an empirical evaluation using role playing in the classroom. *Journal of Research in Innovative Teaching and Learning*, *12*(3), 295–310. <https://doi.org/10.1108/JRIT-06-2018-0013>
- Alfansyur, A., & Mariyani. (2020). Seni Mengelola Data : Penerapan Triangulasi Teknik , Sumber Dan Waktu pada Penelitian Pendidikan Sosial. *Historis*, *5*(2), 146–150.
- Aura, I., Järvelä, S., Hassan, L., & Hamari, J. (2023). Role-play experience's effect on students' 21st century skills propensity. *Journal of Educational Research*, *116*(3), 159–170. <https://doi.org/10.1080/00220671.2023.2227596>
- Bhadargade, S. L., Kaushik, M., & Joshi, G. (2020). A study of factors influencing the problem-solving skills of engineering students. *Journal of Engineering Education Transformations*, *33*(4), 8–19. <https://doi.org/10.16920/jeet/2020/v33i4/143655>
- Bwefar, M. I., Hala, Y., & Palennari, M. (2019). Pembentukan Keterampilan Pemecahan Masalah Biologi Melalui Penerapan Model Problem Based Learning ( PBL ). *Prosiding Seminar Nasional Biologi VI*, 382–392.
- Castro, E. A. M. (2023). Analysis of Problem Solving Ability of First Middle School Students in Learning Science. *Integrated Science Education Journal*, *4*(2), 43–53. <https://doi.org/10.37251/isej.v4i2.329>
- Chesler, M., & Fox, R. (1966). Role-playing methods in the classroom. In *Role-playing Methods in the Classroom* (Science Re, Issue Chapter 3).
- Chiang, C. L., & Lee, H. (2016). The Effect of Project-Based Learning on Learning Motivation and Problem-Solving Ability of Vocational High School Students. *International Journal of Information and Education Technology*, *6*(9), 709–712. <https://doi.org/10.7763/ijiet.2016.v6.779>
- Craciun, D. (2010). Role – Playing As a Creative Method in Science Education. *Journal of Science and Arts Year*, *10*(112), 175–182.
- Cropley, A. (2022). Introduction To Qualitative Research Methods. In *In Vitro Methods in Cell-Mediated Immunity*. <https://doi.org/10.1016/b978-0-12-107750-1.50012-1>
- Daniel, E. (2016). The Usefulness of Qualitative and Quantitative Approaches and Methods in Researching Problem-Solving Ability in Science Education Curriculum. *Journal of Education and Practice*, *7*(15), 91–100. <https://doi.org/2222-288X>
- Dohaney, J., Brogt, E., Wilson, T. M., & Kennedy, B. (2018). Using Role-play to Improve Students' Confidence and Perceptions of Communication in a Simulated Volcanic Crisis. *Advances in Volcanology*, 691–714. [https://doi.org/10.1007/11157\\_2016\\_50](https://doi.org/10.1007/11157_2016_50)
- Ermawan, M. Z. F., & Fauziah, A. N. M. (2023). Analisis Kemampuan Pemecahan Masalah IPA pada Siswa SMP dalam Menyelesaikan Soal IPA. *Lentera: Multidisciplinary Studies*, *1*(2), 75–82. <https://lentera.publikasiku.id/index.php>
- Etikan, I. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American*



- Journal of Theoretical and Applied Statistics*, 5(1), 1.  
<https://doi.org/10.11648/j.ajtas.20160501.11>
- Fadillah, N. (2023). The Effect Of Models Solving Collaborative Learning Problems Of Motivation And Ability Solving Problems In Learning Ips Elementary School Students In Moncongloe District Maros District. *Tesis, VIII*(1), 1–19.
- Hidayati, L., & Pardjono, P. (2018). The implementation of role play in education of pre-service vocational teacher. *IOP Conference Series: Materials Science and Engineering*, 296(1). <https://doi.org/10.1088/1757-899X/296/1/012016>
- Iftita RH, N., Bachri, A., & Rauf, I. (2023). Meningkatkan Hasil Belajar IPA Menggunakan Metode Role Playing Pada Materi Sistem Tata Surya Kelas VII SMP Negeri 23 Makassar. *Jurnal Pemikiran Dan Pengembangan Pembelajaran*, 5(2), 998–1003.
- Jua, S. K., Sarwanto, & Sukarmin. (2018). The profile of students' problem-solving skill in physics across interest program in the secondary school. *Journal of Physics: Conference Series*, 1022(1). <https://doi.org/10.1088/1742-6596/1022/1/012027>
- Khamouja, A., Abdessallam, K., Mohamed, M. Ben, & Ghouati, A. El. (2023). The Importance of Role-playing Activities in Developing Students' Speaking Competence Azize el Ghouati The Importance of Role-playing Activities in Developing Students' Speaking Competence. *International Journal of Innovation and Scientific Research*, 66(1), 225–230. <http://www.ijisr.issr-journals.org/>
- Koswara, T., Muslim, M., & Sanjaya, Y. (2019). Profile of problem solving ability of junior high school students in science. *Journal of Physics: Conference Series*, 1157(2). <https://doi.org/10.1088/1742-6596/1157/2/022041>
- Lewin, K. (1948). *Resolving Social Conflicts: Selected Papers on Group Dynamics*. Harper & Row.
- Monika, N., Juliandini, A., Rahman Munandar, D., Karawang, U. S., Ronggo Waluyo, J. H., Jaya, P., Telukjambe Timur, K., Karawang, J., & Barat, I. (2022). Kemampuan Problem-Solving Siswa Sma Dalam Menyelesaikan Masalah Plsv. *Jurnal Pembelajaran Matematika Inovatif*, 5(5), 1411–1418. <https://doi.org/10.22460/jpmi.v5i5.1411-1418>
- Morch, A. I., Hartley, M. D., & Caruso, V. (2015). Teaching interpersonal problem solving skills using role-play in a 3D virtual world for special education: A case study in second life. *Proceedings - IEEE 15th International Conference on Advanced Learning Technologies: Advanced Technologies for Supporting Open Access to Formal and Informal Learning, ICALT 2015, August*, 464–468. <https://doi.org/10.1109/ICALT.2015.139>
- NEA. (2012). *Preparing 21st Century Students for a Global Society: An educator's guide to the "Four Cs"*.
- OCDE. (2023). PISA 2022 Results (Volume I): The State of Learning and Equity in Education. In *Perfiles Educativos* (Vol. 46, Issue 183). OCDE. <https://doi.org/10.22201/iisue.24486167e.2024.183.61714>
- Partnership for 21st Century learning. (2009). *21st Century Student Outcomes*. 1–9. <http://www.p21.org/our-work/p21-framework>
- Permata, J. I., & Sandri, Y. (2020). Analisis Kemampuan Pemecahan Masalah Pada Siswa Smp Maniamas Ngabang. *Riemann Research of Mathematics and Mathematics Education*, 2(1), 10–22.
- Pike, J. C., Spangler, W., Williams, V., Kollar, R., & Donahue, P.-. (2017). Role-playing and Problem-Based Learning: The Use of Cross-Functional Student Teams in Business Application Development. *Information Systems Education Journal (ISEDJ)*, 15(4), 75–83.
-



- Polya, G. (1957). "How to Solve It" list. In *How to Solve It*. <https://doi.org/10.2307/j.ctvc773pk.6>
- Pratiwi, R., & Musdi, E. (2021). Meningkatkan Kemampuan Pemecahan Masalah Matematis Peserta Didik Melalui Model Pembelajaran Problem Based Learning. *Jurnal Edukasi Dan Penelitian Matematika / Hal*, 10(1), 85–91.
- Price, A. M., Kim, C. J., Burkholder, E. W., Fritz, A. V., & Wieman, C. E. (2021). A detailed characterisation of the expert problem-solving process in science and engineering: Guidance for teaching and assessment. *CBE Life Sciences Education*, 20(3), 1–15. <https://doi.org/10.1187/cbe.20-12-0276>
- Rahayu, O.-, Siburian, M. F., & Suryana, A. (2021). Analisis Kemampuan Pemecahan Masalah IPA Siswa Kelas VII Pada Konsep Pencemaran Lingkungan di MTs. Asnawiyah Kab. Bogor. *EduBiologia: Biological Science and Education Journal*, 1(1), 15. <https://doi.org/10.30998/edubiologia.v1i1.8080>
- Rahmayani, E. S., & Fadly, W. (2022). Analisis Kemampuan Siswa dalam Membuat Kesimpulan dari Hasil Pratikum. *Jurnal Tadris IPA Indonesia*, 2(2), 217–227. <https://doi.org/10.21154/jtii.v2i2.765>
- Runi. (2021). Meningkatkan Kemampuan Pemecahan Masalah Siswa pada Mata Pelajaran IPA Materi Pencemaran Lingkungan di Kelas VII SMP Melalui Pembelajaran Berbasis Masalah (Problem Based Learning). *Jurnal Amanah Pendidikan Dan Pengajaran*, 2(1), 18–29. <https://jurnal.pgrisultra.or.id/ojs/>
- Sari, N. H., Sutiarto, S., & Dahlan, S. (2019). Analysis of students problem solving ability by using polya steps in linear program material. *International Conference on Mathematics and Science Education*, 4, 39–44.
- Steube, M., Wilde, M., & Basten, M. (2024). Does role play manipulate students? Persuasive effects of role play on students' attitude and behavior regarding a socioscientific issue. *Journal of Research in Science Teaching*, 61(7), 1609–1640. <https://doi.org/10.1002/tea.21910>
- Tan, A. L., Ong, Y. S., Ng, Y. S., & Tan, J. H. J. (2023). STEM Problem Solving: Inquiry, Concepts, and Reasoning. *Science and Education*, 32(2), 381–397. <https://doi.org/10.1007/s11191-021-00310-2>
- Vega Artinta, S., Fauziah, H. N., & Artikel, R. (2021). *Faktor yang Mempengaruhi Rasa Ingin Tahu dan Kemampuan Memecahkan Masalah Siswa pada Mata Pelajaran IPA SMP Info Artikel ABSTRAK*. <http://ejournal.iainponorogo.ac.id/index.php/jtii>
- Wiria, W., & Alberida, H. (2023). Pengaruh model Pembelajaran Problem Solving Terhadap Collaboration Skill Siswa Pada Pembelajaran Biologi: Literature Review. *BIOCHEPHY: Journal of Science Education*, 03(2), 111–121. <https://doi.org/10.52562/biochephy.v3i2.537>
- Yuanari. (2011). *Penerapan Strategi think-talk-write sebagai upaya meningkatkan kemampuan pemecahan masalah dan disposisi matematis siswa kelas VII SMPN 5 Wates Kulonprogo*. 55.