



# Problem Based Learning Models on Critical Thinking Ability in Science Lessons of Grade V Elementary School

Ni Putu Sumita Adnyani<sup>1\*</sup>, Ni Wayan Suniasih<sup>2</sup> 

<sup>1,2</sup> Pendidikan Guru Sekolah Dasar, Universitas Pendidikan Ganesha

## ARTICLE INFO

### Article history:

Received May 10, 2023

Accepted September 11, 2023

Available online October 25, 2023

### Kata Kunci:

Kemampuan Berpikir Kritis,

Problem Based Learning,

Pelajaran IPA

### Keywords:

Critical Thinking Ability, Problem

Based Learning, Science Lessons



This is an open access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.

Copyright © 2023 by Author. Published by Universitas Pendidikan Ganesha.

## ABSTRAK

*Pembelajaran abad 21 menuntut siswa memiliki keterampilan 4C salah satunya yaitu berpikir kritis. Berpikir kritis merupakan kompetensi yang harus dilatih siswa sejak dini dan harus terus dikembangkan. Oleh karena itu, proses pelaksanaan pembelajaran di kelas harus mampu melatih dan meningkatkan kemampuan berpikir kritis siswa dengan masalah nyata pada materi IPA. Penelitian ini bertujuan untuk menganalisis pengaruh Model Problem Based Learning terhadap kemampuan berpikir kritis dalam pelajaran IPA siswa kelas V Sekolah Dasar. Jenis penelitian ini adalah penelitian semu dengan rancangan penelitian Nonequivalent Control Group Design. Sampel penelitian adalah siswa kelas V sekolah dasar yang berjumlah 61 siswa. Metode pengumpulan data yang digunakan adalah metode tes dan instrumen yang digunakan soal tes essay yang dilengkapi dengan rubrik penilaian. Teknik analisis menggunakan teknik analisis statistik deskriptif dan statistik inferensial uji-t. Hasil analisis data diperoleh rata-rata kemampuan berpikir kritis kelompok eksperimen 75,8 dan kelompok kontrol 65,5. Berdasarkan hasil analisis uji-t, diperoleh  $t_{hitung} = 5,65 > t_{tabel} = 2,001$  pada taraf signifikansi 5% dengan  $df = 59$ , maka  $H_0$  ditolak dan  $H_a$  diterima. Jadi, dapat disimpulkan bahwa terdapat pengaruh yang signifikan penerapan model problem based learning terhadap kemampuan berpikir kritis dalam pelajaran IPA siswa kelas V Sekolah Dasar.*

## ABSTRACT

21st century learning requires students to have 4C skills, one of which is critical thinking. Critical thinking is a potential that students must train early and must continue to be developed. Therefore, the process of implementing learning in the classroom must be able to train and improve students' critical thinking skills with real problems in science material. This study aims to analyze the effect of Problem Based Learning Model on critical thinking skills in science lessons of grade V elementary school students. This type of research is a pseudo-research with a research design of Nonequivalent Control Group Design. The research sample was grade V elementary school students totaling 61 students. The data collection method used was the test method and the instrument used was an essay test question equipped with an assessment rubric. The analysis technique used descriptive statistical analysis techniques and inferential statistics t-test. The results of data analysis obtained the average critical thinking ability of the experimental group 75.8 and the control group 65.5. Based on the results of the t-test analysis, obtained  $t_{count} = 5.65 > t_{table} = 2.001$  at a significance level of 5% with  $df = 59$ , then  $H_0$  is rejected and  $H_a$  is accepted. So, it can be concluded that there is a significant effect of the application of problem-based learning model on critical thinking skills in science lessons of grade V elementary school students.

## 1. INTRODUCTION

Education is an important thing in human life. Education is a means for humans to develop abilities through the learning process. Education continues to experience renewal and improvement in the learning process. Improving the quality of learning can be achieved by teachers making learning innovations and making students the center of learning so that students are able to understand the meaning of the material being studied. This is consistent with 21st century learning. 21st century learning is a transition of learning from teacher centered to student centered (Astuti, 2021; Nurul Fitri, 2021). In 21st century learning, students are required to be able to master the four learning skills (4C), namely: critical thinking and problem solving, creativity and innovation, communication, collaboration (Husein et al., 2019;

\*Corresponding author

E-mail addresses: [sumitaadnyani1@gmail.com](mailto:sumitaadnyani1@gmail.com) (Ni Putu Sumita Adnyani)

Muttaqin & Rizkiyah, 2022). Critical thinking and problem solving is one of the abilities that students must train have in the learning process.

In reality, students' critical thinking skills are still very low. This is because the learning process is still centered on the teacher so that it makes students less active in participating in the learning process (Arifin et al., 2021; Hartini, 2017). In the learning process in class, the teacher still explains the material only based on the student's handbook. This affects students' critical thinking skills due to the lack of active students in participating in learning (Efendi & Wardani, 2021; Nuzulaeni & Susanto, 2022). Another problem that causes students' critical thinking skills to be low is that teachers have difficulty in designing the learning process so that learning becomes active in training students' critical thinking skills (Primayanti et al., 2020). Teachers have difficulties in choosing models, methods and media with the material being discussed. This problem has an impact on students because in learning students tend to be passive and learning becomes monotonous.

The right solution to train students' critical thinking skills with applying the problem-based learning model to learning. Critical thinking skills are very important to be trained and developed. Critical thinking skills are a person's high-level thinking skills in solving a problem logically and consistently to draw a conclusion (Perdana et al., 2020; Pramana et al., 2020; Sihotang, 2019). Problem based learning is a learning model that involves students to actively solve a real problem which is used as a learning resource (Husein et al., 2019; Winarni et al., 2022). Problem based learning steps require students to be active and think critically so that problems can be solved properly. Problem based learning requires students to be active in solving problems with their own knowledge and experience. Teachers who apply the problem based learning model to learning only act as facilitators and focus on student learning. Therefore, the problem based learning model can help students train and develop critical thinking skills in solving problems (Amris & Desyandri, 2021; Syamsudin, 2020). In solving and solving problems properly, it is necessary to have encouragement so that the problems experienced can be resolved. Teachers can provide encouragement by using an interesting learning design. The learning design used is to apply a problem-based learning model, so that students' critical thinking skills are trained and problems experienced by students can be resolved.

Some previous research findings state that the problem-based learning model has an effect on critical thinking skills (Rahmatia, 2020; Risnawati et al., 2022). Applying the problem-based learning model is the right way to develop critical thinking skills. The problem based-learning model can be used in science lessons on heat material (Al-Fikry et al., 2018; Seibert, 2020). Many studies are related to the application of the problem-based learning model, but this research needs to be done because not all schools implement learning to train critical thinking skills in science lessons. So by doing this research at least schools implement learning by training students' critical thinking skills in science lessons. The purpose of this study was to analyze the effect of the problem-based learning model on critical thinking skills in science lessons for grade V elementary school students in Gugus VI Mengwi District in the 2022/2023 academic year.

## 2. METHOD

The type of research used was quasi-experimental with a research design of nonequivalent control group design. The research design consisted of 2 groups, namely the experimental group and the control group. The design is show in Figure 1.

01	X	02
03	-	04

**Figure 1.** Nonequivalent Control Group Design

The population in this study were fifth grade elementary school students in Gugus VI Mengwi District in the 2022/2023 academic year. The sample selection in this study used a cluster random sampling technique, namely a random draw of classes regardless of the competence of the population and it was obtained that fifth grade students at SD No. 1 Kapal as an experimental group and fifth grade students at SD No. 3 Kapal as the control group. The number of students for the experimental group was 32 students and the number of students for the control group was 29 students. The experimental group was given treatment by applying the problem based learning model to the learning process and the control group was given treatment without applying the problem based learning model to the learning process.

Data collection techniques used test techniques and research instruments using essay test questions equipped with an assessment rubric. The data analysis technique used is descriptive statistical

techniques to determine the average value of each group and t-test inferential statistical techniques to determine the effect of the problem-based learning model. The requirement to conduct a t-test is that the instruments of the experimental group and control group are normally distributed and homogeneous. Before the instrument is used, the research instrument was first tested for validity and reliability. The validity test uses the product moment correlation formula and the reliability test uses the alpha cronbach formula. Validity and reliability testing using Microsoft Excel 2013.

Testing the validity of the items as many as 10 questions. The results of the calculation of the validity test of the questions with  $r_{count} > r_{table} = 0.361$  were declared valid and  $r_{count} < r_{table} = 0.361$  were declared invalid. Of the 10 questions, there are 8 items were valid and 2 items were invalid. Invalid questions were not used in the study and were not tested for reliability, while valid questions were tested for reliability. The results of the reliability test on 8 questions with Cronbach's alpha calculation results were 0.805. The results of the item reliability test with the help of Microsoft Excel showed that the Cronbach's alpha value was between 0.70-0.90. The research instrument was declared valid and reliable, so the normality test was carried out in both study groups. The normality test results are presented in [Table 1](#).

**Table 1. Data Normality Test of Critical Thinking Ability of Experiment Group and Control Group Students**

Data Group	Chi-Square			Category
	X <sup>2</sup> count	X <sup>2</sup> table	df	
Eksperiment	3.927	11.07	5	Normal Distribution
Control	3.608	11.07	5	Normal Distribution

The results of the data normality test for the critical thinking skills of students in the experimental group and the control group showed a normal distribution because of the results of  $X^2_{count} < X^2_{table}$  at a significance level of 5%  $df = 5$ . After the data is normally distributed, the next step is to test the homogeneity of the two study groups using Fisher's test. The homogeneity test results are presented in [Table 2](#).

**Table 2. Homogeneity Test of Critical Thinking Ability of Students in the Experiment Group and the Control Group**

Sample	S <sup>2</sup>	df	Fcount	Ftable	Category
Eksperiment	61.31	32	1.51	4.00	Homogen
Control	40.45	29			

Base on [Table 2](#) show the results of the homogeneity test in the experimental group and the control group obtained  $F_{count} = 1.51$ . While  $F_{table} = 4.00$  at a significance level of 5% with  $db$  in numerator = 1 and  $db$  in denominator = 59. This shows that  $F_{count} = 1.51 < F_{table} = 4.00$ , then the variance of the critical thinking ability of students in the experimental group and the control group is homogeneous.

### 3. RESULT AND DISCUSSION

#### Result

This type of research is a quasi-experimental with a non-equivalent control group research design. The implementation of the lesson uses theme 6 Heat and its Transfer, sub-theme 2 Heat Transfer Around Us. The learning implementation of experimental group by applying the problem-based learning model and the control group with conventional learning. The learning process in the experimental group applies the problem-based learning model through forming study groups consisting of 4-5 students, observing problems that arise during the learning process, dividing tasks to solve problems, collecting data, analyzing data, making discussion reports, and presenting report results. The learning process in the control group with conventional learning through the steps of listening to material explanation of the material, recording the material, asking questions, doing assignments. The learning process in the control group was carried out according to the method used by the teacher at school. After giving the treatment 6 times to the experimental group and the control group, they were given a critical thinking ability test in the form of an essay test with a total of 8 questions. The average results of the critical thinking ability test scores of the two groups are presented in detail in [Table 3](#).

Base on [Table 3](#) the results of the critical thinking ability test scores in the experimental group and the control group can be explained that the maximum score in the experimental group is 93.7, while the maximum score in the control group is 81.2. The minimum score for the experimental group is 59.3, while the minimum score for the control group is 53.1. Both groups have a mode value that is greater than the median and the median is greater than the mean ( $M_o > M_e > M$ ), thus forming a negative skew curve in the

sense that most of the values tend to be high. Even though they both form negative squint curves, there are differences in the results of calculating the average value of critical thinking skills. The average result of the experimental group's critical thinking ability was 75.8, while the control group's critical thinking ability was 65.5.

**Table 3.** Average Critical Thinking Ability Test Scores for Students in the Experiment Group and the Control Group

Data Group	Maximum Score	Minimum Score	Average	Median	Mode
Eksperiment	93.7	59.3	75.8	76.5	78.4
Control	81.2	53.1	65.5	66.0	69.9

Furthermore, the data analysis technique uses the t-test technique which aims to determine the effect of the problem-based learning model on students' critical thinking skills in the experimental group and control group. The two research groups were normally distributed and came from populations with homogeneous variance, so a t-test analysis was performed using the pooled variance formula. The results of the t-test analysis are presented in detail in Table 4.

**Table 4.** Calculation Results of the t-test of Students' Critical Thinking Skills in the Experimental Group and the Control Group

Data Group	n	Average	S <sup>2</sup>	df	t <sub>count</sub>	t <sub>table</sub>
Eksperiment	32	75.8	61.31	59	5.65	2.001
Control	29	65.5	40.45			

Table 4, obtained t<sub>count</sub> = 5.65 and t<sub>table</sub> = 2.001 at a significance level of 5% with degrees of freedom = 59. This means t<sub>count</sub> = 5.65 > t<sub>table</sub> = 2.001, so that H<sub>0</sub> rejected and H<sub>a</sub> accepted, which means that there is a significant effect of the application of the problem-based learning model on critical thinking skills in science lessons for fifth grade students at SD Group VI, Mengwi District.

## Discussion

This research is a quasi-experimental with a research design of nonequivalent control group design. The implementation of the lesson uses theme 6 Heat and its Transfer, sub-theme 2 Heat Transfer Around Us. The research results show several findings. First, the application of the problem-based learning model in the experimental group makes students' critical thinking skills higher than the control group with conventional learning. The application of the problem-based learning model is carried out in the learning process, because learning focuses on students in solving problems so that students can understand the material being studied (Wati & Widiyansyah, 2020; Zuryanty et al., 2019). Students are able to discover, develop, and take responsibility for their new knowledge in the learning process and students become more active and learning becomes more fun. Problem based learning is a learning model that can be varied by the teacher and clarify the flow which will make students more active (Fatma & Budhi, 2019; Syamsudin, 2020). Problem based learning is a learning model that begins with finding problems and requires students to think critically in solving problems by providing opportunities for students to experience problems in the real world directly (Ariyani & Kristin, 2021; Ting et al., 2021). Problem-based learning helps students develop critical thinking skills in solving a problem. Therefore, the problem-based learning model is effectively applied in the learning process in the classroom.

Second, the problem based learning model encourages students to think critically in science lessons. The problem-based learning model requires students to be active in solving their own problems with the knowledge that these students have. Learning focuses on students and teachers only as facilitators who encourage students to think critically. Thinking skills arises when students identify problems, determine problems so that they can provide strategies for solving these problems (Devirita et al., 2021; Laar et al., 2017). Problem-based learning encourages students' critical thinking skills which consist of several indicators, namely analyzing the opinions obtained, being able to ask questions, being able to answer questions, being able to solve problems in their own way and being able to make conclusions from these problems. In curriculum 2013, science lessons in elementary schools are still integrated and integrated with other lessons in the form of themes. Science lessons aim to spur the development of critical thinking skills through discussion, experimentation, and simulation activities (Kwon et al., 2021; Nurhamidah, 2022; Puring C, 2021). In science lessons that apply the Problem-Based Learning model, students find problems when conducting heat transfer experiments from conductors and insulator objects, then students prepare to discuss in groups to solve problems, then present the results of their discussions,

students compare their group's answers with other groups, and students follow up in solving problems. This activity can encourage critical thinking indicators consisting of analyzing opinions, being able to ask questions, being able to answer questions, being able to solve problems and being able to make conclusions (Andarwulan et al., 2021; Hwang et al., 2022).

Based on the findings, it showed that there was a significant influence on critical thinking skills in science lessons of students who are taught using the problem-based learning model with students who are not taught using the problem-based learning model in class V in SD Gugus VI, Mengwi District. This can be seen from the average critical thinking ability of students in the experimental group which is higher than that of students in the control group. This finding is reinforced by the findings of previous research which states that there is an influence of the problem-based model on the critical thinking skills of fifth grade students in elementary schools (Rahmatia, 2020; Risnawati et al., 2022). The application of the problem based learning model is the right way to train and develop critical thinking skills. The problem based learning learning model influences student learning outcomes in elementary schools (Nofziarni et al., 2019; Seibert, 2020). The implication of this research is that teachers are expected to be able to innovate by applying problem-based learning models so that learning in class becomes more active and effective and teachers can apply problem-based learning models to train students' critical thinking skills. However, the application of the problem-based learning model has the disadvantage that the learning takes a long time in each learning step.

#### 4. CONCLUSION

The results of the study showed that there was a difference in the average value of critical thinking skills in science lessons for the group of students who were taught using the problem-based learning model and the group of students who were not taught using the problem-based learning model. The average critical thinking ability in science lessons for the experimental group was higher than that for the control group. Thus, there is a significant influence of the problem-based learning model on critical thinking skills in science lessons of grade V elementary school students in SD Gugus VI Mengwi District. Thanks to this research, it is hoped that other studies can find out the situation and conditions in the learning process in the classroom. Thus, the shortcomings contained in this study can be refined in further research.

#### 5. REFERENCES

- Al-Fikry, I., Yusrizal, Y., & Syukri, M. (2018). Pengaruh model problem based learning terhadap kemampuan berpikir kritis peserta didik pada materi kalor. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, 6(1), 17–23. <https://doi.org/10.24815/jpsi.v6i1.10776>.
- Amris, F. K., & Desyandri. (2021). Pembelajaran Tematik Terpadu menggunakan Model Problem Based Learning di Sekolah Dsaar. *Jurnla Basicedu*, 5(4), 2171–2180. <https://doi.org/10.31004/basicedu.v5i4.1170>.
- Andarwulan, T., Al Fajri, T. A., & Damayanti, G. (2021). Elementary teachers' readiness toward the online learning policy in the new normal era during Covid-19. *International Journal of Instruction*, 14(3), 771–786. <https://doi.org/10.29333/iji.2021.14345a>.
- Arifin, Z., Tegeh, I. M., & Yuda Sukmana, A. I. W. I. (2021). Independent Learning through Interactive Multimedia Based on Problem Based Learning. *Jurnal Edutech Undiksha*, 9(2), 244. <https://doi.org/10.23887/jeu.v9i2.41292>.
- Ariyani, B., & Kristin, F. (2021). Model Pembelajaran Problem Based Learning untuk Meningkatkan Hasil Belajar Siswa SD. *Jurnal Ilmiah Pendidikan Dan Pembelajaran*, 5(3), 353–361. <https://doi.org/10.23887/jipp.v5i3.36230>.
- Astuti, R. Y. (2021). The Importance Of Learning Skills In The 21st Century In Learning In Elementary Schools. *Social, Humanities, and Educational Studies (SHES)*, 4(6), 132–136. <https://doi.org/10.20961/shes.v4i6.68414>.
- Devirita, F., Neviyarni, N., & Daharnis, D. (2021). Pengembangan Buku Ajar Berbasis Problem Based Learning di Sekolah Dasar. *Jurnal Basicedu*, 5(2), 469–478. <https://doi.org/10.31004/basicedu.v5i2.680>.
- Efendi, D. R., & Wardani, K. W. (2021). Komparasi Model Pembelajaran Problem Based Learning dan Inquiry Learning Ditinjau dari Keterampilan Berfikir Kritis Siswa pada Mata Pelajaran IPA di Sekolah Dasar. *Jurnal Basicedu*, 5(3), 1277–1285. <https://doi.org/10.31004/basicedu.v5i3.914>.
- Fatma, A. N., & Budhi, W. (2019). Pengaruh Model Pembelajaran Problem Based Learning terhadap Pretasi Belajar Fisika. *Jurnal Ilmiah Pendidikan Fisika*, 5(1). <https://doi.org/10.30738/cjpf.v5i1.4141>.
- Hartini, A. (2017). Pengembangan Perangkat Pembelajaran Model Project Based Learning Untuk Meningkatkan

- Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Pendidikan Dan Pembelajaran Di Sekolah Dasar*, 1(2). <https://doi.org/10.30651/else.v1i2a.1038>.
- Husein, S., Gunawan, H., A., & Wahyuni, S. (2019). Problem-Based Learning with Interactive Multimedia to Improve Students' Understanding of Thermodynamic Concepts. *Journal of Physics: Conference Series*, 1233(1), 1–5. <https://doi.org/10.1088/1742-6596/1233/1/012028>.
- Hwang, G. J., Chang, C. C., & Chien, S. Y. (2022). A motivational model-based virtual reality approach to prompting learners' sense of presence, learning achievements, and higher-order thinking in professional safety training. *British Journal of Educational Technology*, 53(5). <https://doi.org/10.1111/bjet.13196>.
- Kwon, K., Ottenbreit-Leftwich, A. T., Brush, T. A., Jeon, M., & Yan, G. (2021). Integration of Problem-based Learning in Elementary Computer Science Education: Effects on Computational Thinking and Attitudes. *Educational Technology Research and Development*, 69(5), 2761–2787. <https://doi.org/10.1007/s11423-021-10034-3>.
- Laar, E., Deursen, A. J. A. M., Dijk, J. A. G. M., & Haan, J. (2017). The Relation Between 21st. Century Skills and Digital Skills: A Systematic Literature Review. *Computers in Human Behavior*, 72, 577–588. <https://doi.org/10.1016/j.chb.2017.03.010>.
- Muttaqin, M. F., & Rizkiyah, H. (2022). Efektifitas Budaya Literasi dalam Meningkatkan Keterampilan 4C Siswa Sekolah Dasar. *Dawuh Guru: Jurnal Pendidikan MI/SD*, 2(1), 43–45. <https://doi.org/10.35878/guru/v2.il.342>.
- Nofziarni, A., Hadiyanto, H., Fitriya, Y., & Betri, A. (2019). Pengaruh Penggunaan Model Problem Based Learning (Pbl) Terhadap Hasil Belajar Siswa Di Sekolah Dasar. *Jurnal Basicedu*, 3(4), 2016–2024. <https://doi.org/10.31004/basicedu.v3i4.244>.
- Nurhamidah, S. (2022). *Problem Based Learning Kiat Jitu Melatih Berpikir Kritis Siswa*. Pusat Pengembangan Pendidikan dan Penelitian Bangsa.
- Nurul Fitri, S. F. (2021). Problematika Kualitas Pendidikan di Indonesia. *Jurnal Pendidikan Tambusai*, 5(1), 1617–1620. <https://www.jptam.org/index.php/jptam/article/view/1148>.
- Nuzulaeni, I., & Susanto, R. (2022). Dampak Kompetensi Pedagogik terhadap Kemampuan Berpikir Kritis pada Siswa Kelas V SD. *Jurnal Pedagogi Dan Pembelajaran*, 5(1), 20–26. <https://doi.org/https://doi.org/10.23887/jp2.v5i1.42481>.
- Perdana, R., Jumadi, J., Rosana, D., & Riwayani, R. (2020). The online laboratory simulation with concept mapping and problem based learning (OIs-cmpbl): Is it effective in improving students' digital literacy skills? *Cakrawala Pendidikan*, 39(2), 382–394. <https://doi.org/10.21831/cp.v39i2.31491>.
- Pramana, M. W. A., Jampel, I. N., & Pudjawan, K. (2020). Meningkatkan Hasil Belajar Biologi Melalui E-Modul Berbasis Problem Based Learning. *Jurnal Edutech Undiksha*, 8(2), 17. <https://doi.org/10.23887/jeu.v8i2.28921>.
- Primayanti, P. E., Suarjana, I. M., & Astawan, I. G. (2020). Pengaruh Model Pbl Bermuatan Kearifan Lokal terhadap Sikap Sosial dan Kemampuan Berpikir Kritis Matematika Siswa Kelas V di Gugus V Kecamatan Sukasada. *Thinking Skills and Creativity Journal*, 1(2), 86. <https://doi.org/10.23887/tscj.v1i2.20417>.
- Puring C, D. (2021). Effect of The Problem Based Learning Model on Students Critical Thinking Skills in Science Lessons. *Social, Humanities, and Educational Studies (SHES. Conference Series)*, 4(6), 409–413. <https://doi.org/10.20961/shes.v4i6.68476>.
- Rahmatia, F. (2020). Pengaruh Model Pembelajaran Problem Based Learning Terhadap Kemampuan Berpikir Kritis di Sekolah Dasar. *Jurnal Pendidikan Tambusai*, 4(3), 2685–2692. <https://doi.org/10.31004/jptam.v4i3.760>.
- Risnawati, A., Nisa, K., & Oktaviyanti, I. (2022). Pengaruh Model Pembelajaran Problem Based Learning terhadap Kemampuan Berpikir Kritis Siswa Kelas V Pada Tema Kerukunan dalam Bermasyarakat SDN Wora. *Jurnal Ilmiah Profesi Pendidikan*, 7(1), 109–115. <https://doi.org/10.29303/jipp.v7i1.426>.
- Seibert, S. A. (2020). Problem-based learning: A strategy to foster generation Z's critical thinking and perseverance. *Teaching and Learning in Nursing*, 000, 2–5. <https://doi.org/10.1016/j.teln.2020.09.002>.
- Sihotang, K. (2019). *Berpikir Kritis: Kecakapan hidup di era digital*. PT Kanisius.
- Syamsudin, S. (2020). Problem Based Learning dalam Mengembangkan Kemampuan Berpikir Kritis dan Keterampilan Sosial. *ELSE (Elementary School Education Journal): Jurnal Pendidikan Dan Pembelajaran Sekolah Dasar*, 4(2), 81–99. <https://doi.org/10.30651/else.v4i2.4610>.
- Ting, K. H., Cheng, C. T., & Ting, H. Y. (2021). Introducing the problem/project based learning as a learning strategy in University Social Responsibility Program - A study of local revitalization of Coastal Area, Yong-An District of Kaohsiung City. *Marine Policy*, 131(700), 104546.

- <https://doi.org/10.1016/j.marpol.2021.104546>.
- Wati, E. K., & Widiansyah, N. (2020). Design of learning media: Modeling & simulation of building thermal comfort optimization system in building physics course. *Jurnal Pendidikan IPA Indonesia*, 9(2), 257–266. <https://doi.org/10.15294/jpii.v9i2.23504>.
- Winarni, R., Slamet, S. Y., & Syawaludin, A. (2022). Development of Indonesian language text books with multiculturalism and character education to improve traditional poetry writing skills. *European Journal of Educational Research*, 10(1), 455–466. <https://doi.org/10.12973/EU-JER.10.1.455>.
- Zuryanty, Kenedi, A. K., Chandra, R., Hamimah, & Fitria, Y. (2019). Problem based learning: A way to improve critical thinking ability of elementary school students on science learning. *Journal of Physics: Conference Series*, 1424(1). <https://doi.org/10.1088/1742-6596/1424/1/012037>.