



PBL and PJBL Comparative Study on Critical Thinking Ability in Blended Learning

Nunung Lusiana^{1*}, Herwin², Laila Fatmawati³ 

^{1,2} Pendidikan Dasar, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

³ Pendidikan Dasar, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

ARTICLE INFO

Article history:

Received June 20, 2022

Accepted October 14, 2022

Available online November 25, 2022

Kata Kunci:

Problem based learning, Project Based Learning, Kemampuan berpikir kritis

Keywords:

Problem based learning, Project Based Learning, Critical Thinking Skills



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

Copyright © 2022 by Author. Published by Universitas Pendidikan Ganesha.

ABSTRAK

Pembelajaran IPS membosankan dan antusias mahasiswa kurang yang berakibat pada penurunan kemampuan berpikir kritis pada mahasiswa. Tujuan penelitian ini yaitu menganalisis penerapan model PBL dan PJBL terhadap kemampuan berpikir kritis dalam blended learning. Penelitian ini merupakan jenis penelitian kuantitatif dengan metode eksperimen. Desain penelitian yang digunakan adalah Matching Pretest Posttest Control Grub Design. Populasi penelitian ini berjumlah 320, dan sampel adalah 76. Teknik pengambilan sampel menggunakan teknik random sampling. Metode yang digunakan untuk mengumpulkan data yaitu dengan observasi dan tes. Instrumen yang digunakan untuk mengumpulkan data yaitu lembar soal. Teknik analisis data dilakukan dengan uji t-test dan test anova dengan menggunakan aplikasi SPSS 25. Hasil analisis yaitu model problem based learning memiliki kenaikan rerata sebelum dan sesudah diberi perlakuan. Penerapan project based learning memiliki kenaikan rerata sebelum dan sesudah diberi perlakuan. Komparasi antara model problem based learning dan project based learning terhadap kemampuan berpikir kritis menunjukkan bahwa penggunaan model problem based learning lebih unggul dibandingkan penggunaan model project based learning. Kesimpulan penelitian ini adalah kedua model memiliki pengaruh terhadap kemampuan berpikir kritis dan penggunaan model problem based learning lebih unggul dalam peningkatan kemampuan berpikir kritis dibandingkan dengan penggunaan model project based learning.

ABSTRACT

IPS learning is boring, and students lack enthusiasm which results in a decrease in students' critical thinking skills. This study aims to analyze the application of the PBL and PJBL models to necessary thinking skills in blended learning. This research is a type of quantitative research with experimental methods. The research design used was the Matching Pretest Posttest Control Grub Design. The population of this study was 320, and the sample was 76. The sampling technique used a random sampling technique. The method used to collect data is observation and tests. The instrument used to collect information is the question sheet. The data analysis technique was carried out using the t-test and ANOVA test using the SPSS 25 application. The result of the analysis showed that the problem-based learning model increased the mean before and after treatment. The application of project-based learning has an average rise before and after being given treatment. Comparing problem-based learning and project-based learning models on critical thinking skills shows that the use of problem-based learning models is superior to the use of project-based learning models. This study concludes that both models influence crucial thinking skills and that using problem-based learning models is superior in increasing necessary thinking skills compared to using project-based learning models.

1. INTRODUCTION

Education, which is planned as an effort to improve human resources, is hampered, especially in the ability to think critically due to the Covid-19 pandemic crisis (Sani et al., 2020; Seftiani et al., 2021; Yuliana, 2020). The ability to think critically is one of the skills of students in analysis-based learning. The transition from a pandemic to a new normal is expected to slowly restore the hampered learning process (Lim & Richardson, 2021; Selvaraj et al., 2021). The hope is that during the new normal era during the Covid-19 pandemic, critical thinking skills must still be integrated into learning (Bao, 2020; Dewi & Fatkhiyani, 2021; Siripongdee et al., 2020). Critical thinking ability is one of the 21st-century competencies that must be integrated into learning (Firmansyah & Rizal, 2019; Prafitasari et al., 2021). The purpose of integrating critical thinking skills into learning is for students to understand and maximize their learning activities with 21st-century skills. (Saputra, 2020; Yu & Wan Mohammad, 2019).

*Corresponding author.

E-mail addresses: nununglusiana.2021@student.uny.ac.id (Nunung Lusiana)

The use of learning models must be the focus of the teacher so that critical thinking skills can be achieved. The selection of learning methods that are suitable for Social Sciences material is by learning to analyze and direct involvement (Carroll & Conboy, 2020; Mustikaningrum et al., 2021). This learning is divided into two, namely analyzing problems and making projects to stimulate direct involvement. Learning by applying problem-solving is designed so that blended learning can include processes and investigations by observing, concluding, concocting hypotheses based on information, predicting, and communicating (Antika & Nawawi, 2017; Khromchenko & Shutilo, 2021). While learning by using a learning model by making a project will be more able to construct students' understanding independently (Antika & Nawawi, 2017; Azizah et al., 2018). Problem-based learning or project-based learning models are more efficient. The efficiency of selecting learning methods is one way to improve student's critical thinking skills (Dywan & Airlanda, 2020; Huang et al., 2020).

Efforts to improve critical thinking skills are by using problem-based learning models. Problem-based learning is a suitable learning model used for analyzing problems critically (Anastasiades, 2012; Thai et al., 2017). This is because in social studies learning problem-solving has a significant impact on honing students' critical thinking skills (Bervell & Arkorful, 2020; Napsawati, 2020). The use of problem-based learning methods can be taught explicitly to improve students' critical thinking skills (Belecina, 2018; Prafitasari et al., 2021). This is supported by research conducted by previous studies which stated that the use of problem-based learning methods can increase student learning activities in the form of students' critical thinking skills (Seftiani et al., 2021; Setiawan et al., 2020). The results of other studies show that students' thinking skills experience an increase when taught using problem-based learning methods (Munawwarah et al., 2020).

Efforts to improve critical thinking skills can also use the Project-based learning model. The learning model using project-based learning focuses on analysis by creating a project (Kanca et al., 2020; Mustikaningrum et al., 2021; Siripongdee et al., 2020). Project-based learning is learning that can hone students' critical thinking skills. This is because this model acts as a stimulus to construct students' understanding of the material being studied (Napsawati, 2020; Rimbarizki & Heryanto Susilo, 2017). As the results of research conducted by previous studies show that there are significant changes when students are taught material using the PjBL model characterized by a good category in critical thinking skills (Pujaningtyas et al., 2019). Research conducted by other studies shows the results that the PjBL learning model is more effective in improving students' critical thinking skills (Dywan & Airlanda, 2020). Learning by using project-based learning affects the level of student knowledge as evidenced by the results of other studies showing the results of the experimental class using this method are greater than the control class so it can be concluded that the use of the project-based learning method has a significant effect on the knowledge competence of students (Apsari & Wiarta, 2020).

Through the results of observations and interviews with lecturers in Elementary Social Studies subject matter, the use of the lecture model did not increase student activity. Student activeness influences critical analysis skills on the stimulus given by the lecturer. This can be seen from the document search, it can be seen that the learning outcomes of student HOTS questions have not increased. Learning outcomes in the form of repetition results and assignments given are done soberly without a critical analysis process. Another result is by interviewing, through the results of interviews with several students it was found that students often experience loss of concentration when answering the stimulus given so that the answers and questions are out of sync. The results of observations and interviews conducted in class show problems related to student interest in paying attention to lecturer explanations. Sometimes students tend to be silent when appointed to answer the stimulus from the lecturer. Learning that attracts students' attention is needed to improve student's critical thinking skills.

Based on the description of the things behind the ability to think critically, it appears that interesting learning with the right models and techniques can improve critical thinking skills (Evi & Indarini, 2021; Hodiyanto, 2017). Based on several previous studies, problem-based learning and project-based learning models are equally appropriate for increasing critical thinking skills in face-to-face learning because they were carried out before the pandemic hit (Hari Utomo et al., 2018; Seftiani et al., 2021). However, problem-based learning and project-based learning methods have not been proven to improve student's critical thinking skills in blended learning (Díaz, 2020; Thai et al., 2017). So the researcher is interested in carrying out research that is useful to find out the problem-based learning and project-based learning models in blended learning to see the effect of the different learning models on students' thinking skills with several objectives. The aims of this study were (1) to analyze the difference in significance between critical thinking skills before and after receiving the influence of the problem-based learning model, (2) to analyze the difference in significance between the ability to think critically between before and after receiving the influence of the project-based learning model, (3) to analyze the comparative effect of the use of problem-based learning models and project-based learning models.

2. METHOD

This research is a type of quantitative research with experimental methods. This method was chosen because this research is used to find the effect of certain treatments on research subjects under controlled conditions. The research design used was the Matching Pretest Posttest Control Grub Design, this was because two classes were selected directly, then they were given a pretest to find out their initial abilities and given a posttest after treatment, after which it was compared whether there was a difference between the experimental class and the control class in the pretest and posttest for each class (Sugiyono, 2016). This study uses two learning models, namely the Problem-based learning model and the Project-based learning model. In each treatment in each method, an investigation will be carried out regarding the level of critical thinking skills in students. Measurement of critical thinking skills was carried out using a test before (pretest) being given treatment for both types of learning models and after (posttest) being given treatment in each research class. The following is a research design chart with the Matching Pretest Posttest Control Group Design shown in Table 1.

Table 1. Matching Chart Pre-test Post-test Control Grub Design.

Group	Pretest	Treatment (X)	Posttest
Experiment Class	A1	X1	B1
Control Class	A2	X2	B2

This research was conducted at Ahmad Dahlan University which consisted of 320 students who were divided into 8 classes of elementary school teacher education students in the second semester of the 2021/2022 academic year as the population in this study. The sampling technique in this study was using a random sampling technique. This was done because of the wide range of samples available and heterogeneous. In selecting the research sample, the class was selected as it was formed at the outset without the intervention of the researcher. This is done to prevent the possibility of students who are research subjects knowing that they are involved in the research so that this research describes the effect of the treatment given. To determine the control class and experimental class used in research, previously tested the sample equivalence hypothesis. To find out the equality of the samples in this study, the researcher observed the students' activeness in answering logically and in-depth in the learning carried out by the relevant lecturers at the time the observations were made. The sample was determined into two classes, namely class G as the experimental class and class H as the control class. With the number of each being 38 students so the total sample is 76 samples.

The method used to collect data is observation and tests. The instrument used to collect data is the question sheet. The test technique used in this study aims to measure the level of students' critical thinking skills after being given treatment using the Problem-based learning model in the experimental class group and the PjBL learning model in the control class group. Regarding the ability to think critically about social studies learning materials for students using the Anderson Taxonomy cognition level at C4, C5, and C6 levels. Questions were made for each question by the researcher by the basic competencies in each material. The grid in determining questions on testing critical thinking skills in students before being validated is shown in Table 2.

Table 2. Problem Grid the Ability to Think Critically Before Being Validated by Experts

About	Cognitive Aspect	Question Number
Analyzing problems that arise related to the material presented (Science and Technology, Natural Appearance, Natural Resources)	C4	1,2,6,7
Identify problems that will arise related to the material presented (Science and Technology, Natural Appearance, Natural Resources)	C4	3,8,13
Assessing the solutions offered by the text on the material being studied (Science and Technology, Natural Appearance, Natural Resources)	C5	4,5,9,11
Considering the solutions that will be given to the material being studied (Science and Technology, Natural Appearance, Natural Resources)	C5	10,12
Construct solutions that will be given to the material being studied (Science and Technology, Natural Appearance, Natural Resources)	C6	14,15
Determine solutions according to the solutions offered in the material studied (Science and Technology, Natural Appearance, Natural Resources)	C4	16,17

About	Cognitive Aspect	Question Number
Formulate solutions to problems resulting from discussions on the material studied (Science and Technology, Natural Appearance, Natural Resources)	C6	18,19, 20
Total		20

Before the grid is used to determine the level of critical thinking skills, validation is carried out. Content validation was carried out by experts, namely lecturers in the Elementary Social Sciences course. Expert validation shows results, there are 2 invalid question numbers with measurements of critical thinking skills for students. Problem Grid The ability to think critically is demonstrated in [Table 3](#).

Table 3. Question Grid the Ability to Think Critically After Being Validated by Experts

About	Cognitive Aspect	Question Number	Validation
Analyzing problems that arise related to the material presented (Science and Technology, Natural Appearance, Natural Resources)	C4	1,2,6,7	Valid
Identify problems that will arise related to the material presented (Science and Technology, Natural Appearance, Natural Resources)	C4	3,8,13	Valid
Assessing the solutions offered by the text on the material being studied (Science and Technology, Natural Appearance, Natural Resources)	C5	4,5,9,11	Valid
Considering the solutions that will be given to the material being studied (Science and Technology, Natural Appearance, Natural Resources)	C5	10,12	Valid
Construct solutions that will be given to the material being studied (Science and Technology, Natural Appearance, Natural Resources)	C6	14,15	Valid
Determine solutions according to the solutions offered in the material studied (Science and Technology, Natural Appearance, Natural Resources)	C4	16,17	Invalid
Formulate solutions to problems resulting from discussions on the material studied (Science and Technology, Natural Appearance, Natural Resources)	C6	18,19, 20	Valid
Total		20	18

The data analysis method was carried out using the t-test and ANOVA test using the SPSS 25 application. The t-test was used to test the hypothesis. The use of T-test is used to compare or differentiate whether the means of the two groups tested are significantly different or not. The use of T-test uses a paired sample T-test analysis which is useful for comparing the means of two variables in one group. That is, the use of paired sample T-test analysis is useful for testing one sample that gets a treatment which will then compare the mean of the sample between using or not using the treatment. The ANOVA test is a form of statistical hypothesis testing where researchers can draw conclusions based on inferential statistical data or groups.

3. RESULT AND DISCUSSION

Result

This research was conducted using a parametric comparison test using dependent comparisons and independent comparisons between the two models, namely problem-based learning and project-based learning models. Before deciding to use parametric or non-parametric techniques, a prerequisite test is carried out, namely by using the normality test and homogeneity test as prerequisite tests in the t-test. Normality and homogeneity tests were carried out using the SPSS 25 program.

The results of the normality test on the data were divided into two, namely the normality between the results of the pretest of the two models and the results of the post-test of the two models. In the Kolmogorov-Smirnov normality test on the pre-test score, it appears that the Asymp. Sig. (2-tailed) of 0.101 is greater than the alpha value of 0.05 so that the data is said to be normal. Furthermore, the normality test on the posttest score of the normality value of 0.101 is greater than the alpha value of 0.05,

so it can be said that the post-test scores of both models have a normal value. The results of the homogeneity test were divided into two tests, namely the pretest homogeneity test and the posttest homogeneity test. In the pretest homogeneity test, it appears in the table of homogeneity of variance that it has a significance exceeding the value of 0.05 of 0.872. This provides information that the pre-test of both models has a homogeneous score.

The dependent comparison test was carried out to find out whether the model used had shown significant results between before and after being given treatment. Comparative tests were carried out in the experimental class using the problem-based learning model and in the control, class using the project-based learning model, the average student test results increased. The Paired Samples Test shows Sig. (2-tailed) of 0.000 is smaller than the alpha value of 0.05. So it can be concluded that the results of the pre-test and post-test scores have a significant difference. Social studies material learning uses a problem-based learning model and uses project-based learning as informed in the paired samples table shown in Table 4.

Table 4. Paired Samples Problem-Based Learning and Project-Based Learning

Model	Pretest	Posttest	Ascension	Sig.	N
<i>Problem-based learning</i>	70.63	83.84	13.21	0.000	38
<i>Project-based learning</i>	70.94	78.89	7.94	0.001	38
Total					

The improvements that occurred to both models in Table 4 show that by using problem-based learning and project-based learning models. Both have a level of influence on scores before and after being given treatment. However, it turns out that the problem-based learning model has a more significant influence on students' critical thinking skills. This is based on the SPSS output on the independent t-test, it can be seen that the mean posttest critical thinking ability score using the problem-based learning model is greater than using the project-based learning model.

Simultaneously using the two learning models there is a significant difference in average. But it is necessary to do an independent test. The independent test is a parametric test used to find out whether there is a mean difference between the two groups in the experimental class and the control class. The differences appear in the table below. In Table 5 It appears that the two models in each class have different means.

Table 5. Independent Samples Test

Independent Samples Test	Means	N	Sig (2-tailed)
<i>Problem-based learning</i>	83.84	38	-
<i>Project-based learning</i>	78.89	38	-
<i>Equal variances assumed</i>		38	0.001
Total	4.95		0.001

Based on Table 5 the sample test shows that the results of the post-test test for both models show that the use of problem-based learning is proven to be better because it has an average post-test score of 83.84 compared to using the project-based learning model which only has an average score of 78.89 which is less than the average problem-based learning model. This is to the hypothesis that the use of problem-based learning models is appropriate for students to use in social studies learning material. Compared to using project-based learning, problem-based learning aims to improve students' critical thinking skills in social studies courses based on problem analysis. Even so, the use of project-based learning models also has a positive influence on students' critical thinking skills. Students do experience an increase in scores. However, the increase in score is not as high as using the problem-based learning model.

Discussion

The learning process in the learning process is carried out in blended learning using both models, it turns out that in fact, blended learning does not affect the level of thinking skills in students. Because it turns out that blended learning techniques can be combined with the use of appropriate learning models. So that using both models, learning is still carried out well. This is because students can still discuss and conclude the problems given for analysis. Blended learning that is applied to students makes students more enthusiastic about learning (Bervell & Arkorful, 2020; Siripongdee et al., 2020). Using blended learning when combined with the right learning model will help students learn optimally. This is because

by doing problem-based learning, students are given the freedom to analyze a problem to find the right solution (Murti, 2018; Nurhasanah et al., 2017; Rahmawati, 2013). Finding the right solution will have a positive impact on students' social life. It can be seen in the picture below, online students are still following the lesson carefully. Online students also answer every stimulus given by the teacher.

The use of problem-based learning models teaches students to analyze a problem through discussion (Azizah et al., 2018; Erick, 2017; Wahyu Ariyani & Prasetyo, 2021). In solving problems, students can use strategies such as understanding a problem, seeing clearly what is required, understanding how several things can be related, seeing how things can be related, getting solutions to solving problems, implementing plans and the last is solving problems and discuss what to do (Happy & Widjajanti, 2016; Simamora, 2019). Learning by using the problem-based learning method is one of the most appropriate methods of learning to see the cognitive level of students (Prafitasari et al., 2021; Setiawan et al., 2020).

In line with the research that has been done, the success of using the problem-based learning model can be seen from the results of the study that the average score of students' critical thinking skills has increased in score compared to using the project-based learning model. The average increase in the score of critical thinking skills shows that the use of problem-based learning models is appropriate for use in Elementary Social Studies courses (Rahayu et al., 2019; Rokhmah Wati et al., 2017). Critical thinking skills have a significant impact when using the right learning model (Saminan et al., 2016; Saputra, 2020). The problem-based learning model can activate prior knowledge. This can have a good impact on cognitive development in students. The use of problem-based learning models is suitable for problem-based learning. The problem-based learning process is carried out together with the group to exchange opinions regarding the solutions offered to be agreed upon by the group.

Based on the results that have been described, the use of problem-based learning models can improve critical thinking skills by research that has been done previously which states that problem-based learning is effective on student learning outcomes. This can be seen from the learning outcomes obtained from students with an increasing average (Siako, 2020). Other research also shows that the class average results using the problem-based learning model are better than the problem-based learning model (Sani et al., 2020). Research related to the accuracy of problem-based learning was also found in group research using problem-based learning models that have more critical thinking skills (Latifa, 2019). The use of problem-based learning models has provided evidence that these models can improve students' critical thinking skills (Barutchu, 2017; Simanjuntak et al., 2021). Research on the use of problem-based learning models is widely believed and maintained as a relevant and appropriate pedagogical approach (Miner-Romanoff et al., 2019; Savery, 2019). Research related to problem-based learning explains that students can improve learning through the development and implementation of instructional design theories and processes. Problem-based learning provides such innovation in education through problem-based learning from complexity to simplicity. The purpose of problem-based learning is to develop critical thinking and complex problem solving which can significantly contribute to future education (Miner-Romanoff et al., 2019; Saleh et al., 2017).

The problem-based learning model provides students with learning abilities, especially by increasing students' critical thinking skills. Similar to previous research which stated that problem-based learning applied to students was able to improve student's critical thinking skills in management information systems courses. (Kardoyo et al., 2020). Students are more enthusiastic about attending lectures because they are faced with real problems and are involved in finding the right solution. This thinking process trains the ability to think critically in students (Qondias et al., 2022; Yusri, 2018). Supported by other research that compares the use of combined problem-based learning models and the use of conventional models has a different impact on the results of critical thinking skills. For accounting students, it can be seen that the average result is higher using the problem-based learning model compared to the conventional model (Mardi et al., 2021). In line with the results of this study, the results of increasing the mean in the problem-based learning model are superior to the project-based learning model.

Research on the model of problem-based learning and project-based learning is done a lot, but a little even difficult to find research that compares these two learning models. This study has the benefit to find out what models are suitable for students in social studies courses in Elementary School. The right Model will affect the resulting impact. This study provides benefits so that teachers can use the learning model of problem-based learning in social studies learning based on problem analysis. However, on a certain basis, especially in teaching projects, it is also necessary to use the project-based learning model in elementary school social studies courses. Although this study has been able to compare the use of both models, but due to the limitations of researchers, the study was only conducted in the scope of one

university. It will be maximized if the research is conducted throughout the campus with the Elementary School Teacher Education Study program

4. CONCLUSION

There is a significant difference in the form of increased scores between before and after using problem-based learning. Significant differences in the form of increased scores before and after using project-based learning. Problem-Based Learning models based on Problem-Based Learning based on score assessment are superior to the use of Problem-Based Learning Models.

5. REFERENCES

- Anastasiades, P. (2012). Blended learning environments for adults: Evaluations and frameworks. *Blended Learning Environments for Adults: Evaluations and Frameworks*, 1, 1–326. <https://doi.org/10.4018/978-1-4666-0939-6>.
- Antika, R. N., & Nawawi, S. (2017). The effect of project based learning model in seminar course to student's creative thinking skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 3(1), 72–79. <https://doi.org/10.22219/jpbi.v3i1.3905>.
- Apsari, N. L. S., & Wiarta, I. W. (2020). Pengaruh Model Pembelajaran Project Based Learning Melalui Percobaan Sederhana Terhadap Kompetensi Pengetahuan IPA. *International Journal of Elementary Education*, 4(1), 54. <https://doi.org/10.23887/ijee.v4i1.24333>.
- Azizah, M., Sulianto, J., & Cintang, N. (2018). Analisis Keterampilan Berpikir Kritis Siswa Sekolah Dasar pada Pembelajaran Matematika Kurikulum 2013. *Jurnal Penelitian PendidikanA & A (Semarang)*, 35(1), 61–70. <https://doi.org/10.15294/jpp.v35i1.13529>.
- Bao, W. (2020). COVID-19 and online teaching in higher education: A case study of Peking University. *Human Behavior and Emerging Technologies*, 2(2), 113–115. <https://doi.org/10.1002/hbe2.191>.
- Barutcu, C. D. (2017). The Relationship Between Problem Solving and Creative Thinking Skills among Nursing Students. *International Journal of Psychology and Educational Studies*, 4(2), 34–41. <https://doi.org/http://dx.doi.org/10.17220/ijpes.2017.02.004>.
- Belecina, R. R. (2018). Effecting Change on Students?? Critical Thinking in Problem Solving. *Educare*, 10(2), 109–118. <https://doi.org/10.2121/edu-ijes.v10i2.949>.
- Bervell, B., & Arkorful, V. (2020). LMS-enabled blended learning utilization in distance tertiary education: establishing the relationships among facilitating conditions, voluntariness of use and use behaviour. *International Journal of Educational Technology in Higher Education*, 17(1), 6. <https://doi.org/10.1186/s41239-020-0183-9>.
- Carroll, N., & Conboy, K. (2020). Normalising the “new normal”: Changing tech-driven work practices under pandemic time pressure. *International Journal of Information Management*, 55. <https://doi.org/10.1016/j.ijinfomgt.2020.102186>.
- Dewi, R. A. K., & Fatkhiyani, K. (2021). Blended Learning: Can It Be a Solution to Improve Digital Literacy and HOTS for PGSD Students in a Pandemic Situation? *International Journal of Elementary Education*, 5(4), 601. <https://doi.org/10.23887/ijee.v5i4.39411>.
- Díaz, J. E. M. (2020). Virtual World as a Complement to Hybrid and Mobile Learning. *International Journal of Emerging Technologies in Learning (IJET)*, 15(22), 267. <https://doi.org/10.3991/ijet.v15i22.14393>.
- Dywan, A. A., & Airlanda, G. S. (2020). Efektivitas Model Pembelajaran Project Based Learning Berbasis STEM dan Tidak Berbasis STEM terhadap Kemampuan Berpikir Kritis Siswa. *Jurnal Basicedu*, 4(2), 344–354. <https://doi.org/10.31004/basicedu.v4i2.353>.
- Erick, B. (2017). Aktivitas Fisik Olahraga untuk Pertumbuhan dan Perkembangan Siswa SD. *Indonesian Journal of Primary Education*, 1(1), 51–58. <https://doi.org/https://doi.org/10.17509/ijpe.v1i1.7497>.
- Evi, T., & Indarini, E. (2021). Meta Analisis Efektivitas Model Problem Based Learning dan Problem Solving Terhadap Kemampuan Berpikir Kritis Mata Pelajaran Matematika Siswa Sekolah Dasar. *Edukatif: Jurnal Ilmu Pendidikan*, 3(2), 385–395. <https://doi.org/10.31004/edukatif.v3i2.314>.
- Firmansyah, A., & Rizal, R. (2019). Potret Keterampilan Berpikir Kritis dan Motivasi Berprestasi Mahasiswa PGSD Universitas Tadulako. *Jurnal Inspirasi Pendidikan*, 9(2), 103–109. <https://doi.org/10.21067/jip.v9i2.3323>.
- Happy, N., & Widjajanti, D. B. (2016). Keefektifan Pbl Ditinjau Dari Kemampuan Berpikir Kritis Dan Kreatif

- Matematis, Serta Self-Esteem Siswa Smp. *Jurnal Riset Pendidikan Matematika*, 1(1), 48. <https://doi.org/10.21831/jrpm.v1i1.2663>.
- Hari Utomo, D., Nyoman Ruja, I., Artikel Abstrak, I., & Pendidikan Geografi, S. (2018). Pengaruh Project-Based Learning terhadap Kemampuan Berpikir Kritis. *Jurnal Pendidikan*, 3(4), 475-479. <https://doi.org/http://dx.doi.org/10.17977/jptpp.v3i4.10748>.
- Hodiyanto, H. (2017). Pengaruh model pembelajaran problem solving terhadap kemampuan komunikasi matematis ditinjau dari gender. *Jurnal Riset Pendidikan Matematika*, 4(2), 219. <https://doi.org/10.21831/jrpm.v4i2.15770>.
- Huang, S. Y., Kuo, Y. H., & Chen, H. C. (2020). Applying digital escape rooms infused with science teaching in elementary school: Learning performance, learning motivation, and problem-solving ability. *Thinking Skills and Creativity*, 37(129), 100681. <https://doi.org/10.1016/j.tsc.2020.100681>.
- Kanca, I. N., Ginaya, G., & Sri Astuti, N. N. (2020). effectiveness of the problem solving method on learning outcomes of the English course for room division operation during the COVID-19 pandemic. *International Journal of Linguistics, Literature and Culture*, 7(1), 12-22. <https://doi.org/10.21744/ijllc.v7n1.1102>.
- Kardoyo, Nurkhin, A., Muhsin, & Pramusinto, H. (2020). Problem-Based Learning Strategy: Its Impact on Students' Critical and Creative Thinking Skills. *European Journal of Educational Research*, 9(3), 1141-1150. <https://doi.org/https://doi.org/10.12973/eu-jer.9.3.1141>.
- Khromchenko, O., & Shutilo, I. (2021). *Approaches and Methods in Language Teaching*. Cambridge university press. <https://doi.org/10.36074/logos-28.05.2021.v2.05>.
- Latifa, N. A. (2019). Pengaruh Penerapan Model Problem Solving terhadap Kemampuan Berpikir Kritis. *Bioeducation Journal*, 3(2), 113-120. <https://doi.org/10.24036/bioedu.v3i2.240>.
- Lim, J., & Richardson, J. C. (2021). Predictive effects of undergraduate students' perceptions of social, cognitive, and teaching presence on affective learning outcomes according to disciplines. *Computers and Education*, 161(May 2020), 104063. <https://doi.org/10.1016/j.compedu.2020.104063>.
- Mardi, Fauzi, A., & Respati, D. K. (2021). Development of Students' Critical Thinking Skills Through Guided Discovery Learning (GDL) and Problem-Based Learning Models (PBL) in Accountancy Education. *Eurasian Journal of Educational Research*, 95, 2010-2226. <https://ejer.info/index.php/journal/article/view/454>.
- Miner-Romanoff, K., Rae, A., & Zakrzewski, C. E. (2019). A Holistic and Multifaceted Model for Ill-Structured Experiential Problem-Based Learning: Enhancing Student Critical Thinking and Communication Skills. *Journal Problem Based Learning in Higher Education*, 7(1), 70-96. <https://doi.org/10.5278/ojs.jpblhe.v7i1.3341>.
- Munawwarah, M., Laili, N., & Tohir, M. (2020). Keterampilan Berpikir Kritis Mahasiswa Dalam Memecahkan Masalah Matematika Berdasarkan Keterampilan Abad 21. *Alifmatika: Jurnal Pendidikan Dan Pembelajaran Matematika*, 2(1), 37-58. <https://doi.org/10.35316/alifmatika.2020.v2i1.37-58>.
- Murti, T. (2018). Perkembangan Fisik Motorik dan Perseptual serta Implikasinya pada Pembelajaran di Sekolah Dasar. *Wahana Sekolah Dasar*, 26(1), 21-28. <https://doi.org/10.17977/um035v26i12018p021>.
- Mustikaningrum, G., Widiyanto, W., & Mediatati, N. (2021). Application of The Discovery Learning Model Assisted by Google Meet to Improve Students' Critical Thinking Skills and Science Learning Outcomes. *International Journal of Elementary Education*, 5(1), 30. <https://doi.org/10.23887/ijee.v5i1.34344>.
- Napsawati, N. (2020). Analisis Situasi Pembelajaran Ipa Fisika Dengan Metode Daring Di Tengah Wabah Covid-19. *Karst: Jurnal Pendidikan Fisika Dan Terapannya*, 3(1), 96-102. <https://doi.org/10.46918/karst.v3i1.546>.
- Nurhasanah, S., Malik, A., & Mulhayatiah, D. (2017). Penerapan Model Experiential Learning Untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *WaPFI (Wahana Pendidikan Fisika)*, 2(2), 58. <https://doi.org/10.17509/wapfi.v2i2.8280>.
- Prafitasari, F., Sukarno, S., & Muzzazinah, M. (2021). Integration of Critical Thinking Skills in Science Learning Using Blended Learning System. *International Journal of Elementary Education*, 5(2), 434. <https://doi.org/10.23887/ijee.v5i2.35788>.
- Pujaningtyas, S. W., Kartakusumah, B., & Lathifah, Z. K. (2019). Penerapan Model Experiential Learning Pada Sekolah Alam Untuk Menciptakan Pembelajaran Yang Menyenangkan. *Tadbir Muwahhid*, 3(1), 40. <https://doi.org/10.30997/jtm.v3i1.1653>.
- Qondias, D., Lasmawan, W., Dantes, N., & Aryana, I. B. P. (2022). Effectiveness of Multicultural Problem-Based Learning Models in Improving Social Attitudes and Critical Thinking Skills of Elementary

- School Students in Thematic Instruction. *Journal of Education and E-Learning Research*, 9(2), 62–70. <https://doi.org/10.20448/jeelr.v9i2.3812>.
- Rahayu, R., Nuryani, P., & Hermawan, R. (2019). Penerapan Model PBL untuk Meningkatkan Keterampilan Berpikir Kritis pada Pelajaran IPS SD. *Jurnal Pendidikan Guru Sekolah Dasar*, 4(2), 93–101. <https://doi.org/10.17509/jpgsd.v4i2.20488>.
- Rahmawati, B. F. (2013). Meningkatkan Motivasi Belajar Dan Kemampuan Berpikir Kritis Mahasiswa Melalui Model Pembelajaran Berbasis Masalah. *Educatio*, 8(2), 17–27. <https://doi.org/10.29408/edc.v8i2.5>.
- Rimbarizki, R., & Heryanto Susilo, M. P. (2017). Penerapan Pembelajaran Daring Kombinasi dalam Meningkatkan Motivasi Belajar Peserta Didik Paket C Vokasi di Pusat Kegiatan Belajar Masyarakat (PKBM) Pioneer KarangAnyar. *E-Journal Unesa*, 6(2), 1–12. <https://jurnalmahasiswa.unesa.ac.id/index.php/36/article/view/19586>.
- Rokhmah Wati, D. A., Tukiran, T., & Ibrahim, M. (2017). Penerapan Magang Kognitif (Cognitive Apprenticeship) Untuk Mengajarkan Keterampilan Metakognitif Dan Hasil Belajar Kognitif Siswa. *JPPS (Jurnal Penelitian Pendidikan Sains)*, 2(2), 212. <https://doi.org/10.26740/jpps.v2n2.p212-217>.
- Saleh, M., Al barghuthi, N., & Beker, S. (2017). Innovation in Education via Problem Based Learning from Complexity to Simplicity. *International Conference on New Trends in Computing Sciences (ICTCS)*, 283–288. <https://doi.org/http://dx.doi.org/10.1109/ICTCS.2017.51>.
- Samiran, N. F., Gani, A., & Rini, S. (2016). Peningkatan Keterampilan Berpikir Kritis Dan Ilmiah Siswa Dengan Menggunakan Model Cooperative Inquiry Labs (Cil) Pada Materi Suhu Dan Kalor. *Pendidikan Sains Indonesia*, 04(02), 171–179. <http://202.4.186.66/JPSI/article/view/6595>.
- Sani, I. N., Bahar, A., & Elvinawati, E. (2020). Perbandingan Model Pembelajaran Problem Solving Dan Problem Based Learning Terhadap Kemampuan Berpikir Kritis Siswa Kelas Xi Mia Man 2 Kota Bengkulu. *Alotrop*, 4(2), 107–116. <https://doi.org/10.33369/atp.v4i2.13834>.
- Saputra, H. (2020). Kemampuan Berfikir Kritis Matematis. *Perpustakaan IAI Agus Salim*, April, 1–7.
- Savery, J. R. (2019). *Comparative Pedagogical Models of Problem-Based Learning* (M. Moallem, W. Hung, & N. Dabbagi (eds.)). John Wiley. <https://doi.org/https://doi.org/10.1002/9781119173243.ch4>.
- Seftiani, S., Zulyusri, Arsih, F., & Lufri. (2021). Meta-analisis Pengaruh Model Pembelajaran Project Based Learning terhadap Kemampuan Berpikir Kritis Peserta Didik SMA. *Bioilmi: Jurnal Pendidikan*, 7(2), 110–119. <https://doi.org/http://dx.doi.org/10.24036/7912171074>.
- Selvaraj, A., Radhin, V., KA, N., Benson, N., & Mathew, A. J. (2021). Effect of pandemic based online education on teaching and learning system. *International Journal of Educational Development*, 85(May), 102444. <https://doi.org/10.1016/j.ijedudev.2021.102444>.
- Setiawan, B., Rachmadtullah, R., & Iasha, V. (2020). Problem-Solving Method: The Effectiveness of The Pre-service Elementary Education Teacher Activeness in The Concept of Physics Content. *JURNAL BASICEDU Research & Learning in Elementary Education*, 4(4), 1074–1083. <https://doi.org/10.31004/basicedu.v4i4.484>.
- Siako, yulianti. (2020). Effectiveness of Problem Solving Learning Model towards Student Learning Outcomes on Acid-Base Solution in SMA Negeri 1 Buko on Academic Year 2018-2019. *Jurnal Akademik Kimia*, 9(3), 162–168. <https://doi.org/10.22487/j24775185.2020.v9.i3.pp162-167>.
- Simamora, R. E. (2019). Improving Students' Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. *International Electronic Journal Of Mathematics Education*, 14(1), 61–72. <https://doi.org/https://doi.org/10.12973/iejme/3966>.
- Simanjuntak, M. P., Hutahaean, J., Marpaung, N., & Ramadhani, D. (2021). Effectiveness of Problem-Based Learning Combined with Computer Simulation on Students' Problem-Solving and Creative Thinking Skills. *International Journal of Instruction*, 14(3), 519–534. <https://eric.ed.gov/?id=EJ1304603>.
- Siripongdee, K., Pimdee, P. & Tuntiwongwanich, S. (2020). A Blended Learning Model with IoT-based Technology: Effectively used when the COVID-19 pandemic? *Journal for the Education of Gifted Young Scientist*, 8(1), 905–917. <https://doi.org/http://dx.doi.org/10.17478/jegys.698869>.
- Sugiyono. (2016). *Metode Penelitian Kuantitatif, Kualitatif dan R&D*. Alfabeta.
- Thai, N. T. T., De Wever, B., & Valcke, M. (2017). The impact of a flipped classroom design on learning performance in higher education: Looking for the best “blend” of lectures and guiding questions with feedback. *Computers & Education*, 107, 113–126. <https://doi.org/https://doi.org/10.1016/j.compedu.2017.01.003>.
- Wahyu Ariyani, O., & Prasetyo, T. (2021). Efektivitas Model Pembelajaran Problem Based Learning dan Problem Solving terhadap Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Basicedu*, 5(3), 1149–1160. <https://doi.org/10.31004/basicedu.v5i3.892>.

- Yu, T. X., & Wan Mohammad, W. M. R. (2019). Integration of 21st Century Learning Skills (4C Elements) in Interventions to Improve English Writing Skill Among 3K Class Students. *International Journal of Contemporary Education*, 2(2), 100. <https://doi.org/10.11114/ijce.v2i2.4498>.
- Yuliana, Y. (2020). Corona virus diseases (Covid-19): Sebuah tinjauan literatur. *Wellness And Healthy Magazine*, 2(1), 187–192. <https://doi.org/10.30604/well.95212020>.
- Yusri. (2018). The Effects of Problem Solving, Project-Based Learning, Linguistic Intelligence and Critical Thinking on the Students' Report Writing. *Advances in Language and Literary Studies*, 9(6), 21–26. <https://doi.org/http://dx.doi.org/10.7575/aiac.all.v.9n.6p.21>.