Mimbar PGSD Undiksha
Volume 12, Number 1, Tahun 2024, pp. 101-107
P-ISSN : 2614-4727, E-ISSN : 2614-4735
Open Access: https://doi.org/10.23887/jjpgsd.v12i1.62280

The Effect of Problem Based Learning Model on Students' Critical Thinking Ability

Nur Putri Awaliyah[1]*, Woro Sri Hastuti[2] , Setiawan Edi Wibowo[3], Panji Hidayat[4]
[1,2,3,4] Fakultas Ilmu Pendidikan dan Psikologi, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia

ARTICLE INFO

Article history:
Received May 29, 2023
Accepted October 22, 2023
Available Online April 25, 2024

Kata Kunci:
Kemampuan Berpikir Kritis:
Problem Based Learning

Keywords:
Critical Thinking Skills: Problem Based Learning

ABSTRAK

Mahasiswa masih mengalami kesulitan dalam mengembangkan kemampuan kritis, sehingga mahasiswa masih mengalami kesulitan bekerja dalam kelompok, berkomunikasi, memecahkan masalah, dan membuat keputusan sebagai solusi yang tepat untuk suatu permasalahan. Tujuan penelitian ini untuk menganalisis ada tidaknya pengaruh model pembelajaran problem based learning (PBL) melalui pembelajaran IPA terhadap kemampuan berpikir kritis mahasiswa. Penelitian ini menggunakan desain quasi eksperimen dengan pretest-posttest control design. Metode pengumpulan data menggunakan metode observasi dan dokumentasi dengan menggunakan instumen penelitian. Teknik analisis data yang digunakan adalah analisis deskriptif kuantitatif. Sampel penelitian ini berjumlah 25 mahasiswa. Berdasarkan pengujian hipotesis yang diperoleh yaitu melalui perhitungan uji-t dengan taraf signifikan (a) 0.05 dan dk = 25-2 = 23 didapatkan nilai thitung = 27,98. Dengan demikian dapat disimpulkan bahwa $t\text{-}_{hitung} > t\text{-}_{tabel}$ atau 27,98 > 2,069 maka H_0 ditolak dan Ha diterima berarti hipotesis yang menyatakan metode problem-based learning memiliki pengaruh terhadap kemampuan berpikir kritis mahasiswa kelas 4H Universitas Ahmad Dahlan diterima kebenarannya. Disimpulkan bahwa bahwa metode problem-based learning memiliki pengaruh terhadap kemampuan berpikir kritis mahasiswa.

ABSTRACT

Students still experience difficulties developing critical abilities, so students still experience difficulties working in groups, communicating, solving problems, and making decisions as the right solution to a problem. This study aimed to analyze whether the problem-based learning (PBL) learning model, through science learning, affected students' critical thinking skills. This study used a quasi-experimental design with a pretest-posttest control design. Methods of data collection using observation and documentation methods using research instruments. The data analysis technique used is quantitative descriptive analysis. The sample of this research is 25 students. Based on the hypothesis testing obtained through the t-test calculation with a significant level (a) 0.05 and dk = 25-2 = 23, the value of tcount = 27.98 is obtained. Thus, it can be concluded that $t\text{-}_{count} > t\text{-}_{table}$ or 27.98 > 2.069, then H_0 is rejected and H_a is accepted, meaning that the hypothesis stating that the problem-based learning method influences the critical thinking skills of class 4H students at Ahmad Dahlan University is accepted as true. It was concluded that the problem-based learning method influenced the critical thinking skills of class 4H students.

1. INTRODUCTION

Individual quality and potential need to be improved to adapt to current developments. One of the human resources that can compete in the era of digitalization is individuals who can solve problems scientifically. The quality of a country's human resources is a reflection of its progress (Munawwarah et al., 2020; Zanthy, 2016). Universities have an important role in these skills. However, lectures often only focus more on the theoretical level. Critical thinking and problem-solving skills are also very necessary. Each individual's critical thinking ability depends on how often they practice developing this ability. Critical thinking skills are needed for students, especially elementary school teacher education students so that when they enter the world of work, they can overcome and resolve the problems they face (Anugraheni, 2020; Luritawaty et al., 2022). Based on the results of observations made on students in classes F and H in the fourth semester of UAD Elementary School Teacher Education, it was found that students in classes F

Corresponding author
*E-mail addresses: putriawaliyahn@gmail.com (Nur Putri Awaliyah)

and H in the fourth semester of UAD Elementary School Teacher Education still experienced difficulties in developing critical thinking skills during elementary science learning material courses. Students only follow theory and have yet to show development according to their potential and abilities. Apart from that, some students still need help with working in groups, communicating, solving problems, and deciding the right solution.

Critical thinking skills, or the ability to think critically, are needed by everyone to respond to various problems in the realities of life. By thinking critically, people can regulate, adjust, or change their thinking patterns to decide on the right action. Critical thinking gives unmemorized answers (Halimah et al., 2023; Vieira et al., 2019). Critical thinking is the ability and tendency to make and assess conclusions based on evidence (Egok, 2016; Halpern, 2013). A person who thinks critically is skilled at reasoning and tends to believe and act according to his reasoning. Critical thinking includes reflective, productive, and evaluative thinking about an event to find a concept (Rahayu et al., 2019; Syafitri et al., 2021). A person has critical thinking if he can analyze and prove based on reasons that have been considered rationally, make generalizations from existing data, and assess the adequacy of arguments, data, and conclusions. "Critical thinking is the ability to conduct analysis, create and use criteria objectively, and systematically evaluate data" (Fristadi & Bharata, 2015; Kusumah, 2019; et al., 2013).

Elementary School Teacher Education students, as prospective teachers or elementary school educators, need to have critical thinking skills because this ability will help them appropriately solve various problems in the school environment. Students often only rely on lecturers' explanations and need to learn the actual conditions in the field, even though they will later face situations in the real world of work. Therefore, universities focus on understanding material suitable for application in the work environment that students will face in the future. The PBL learning model, also known as the problem-based learning model, is a learning model that uses the discovery of real problems in the surrounding environment as a basis for gaining knowledge and developing critical thinking and problem-solving skills (Oktaviana & Haryadi, 2020; Yustianingsih et al., 2017). PBL is based on a collaborative process where students will build knowledge through interactions with other people and build reasoning from the knowledge they have (Amin et al., 2020; Laksmiwati & Khoirunnisa, 2018). Through PBL, students are expected to be able to solve problems with various alternative solutions and identify the causes of existing problems. Applying the PBL model can change learning conditions from transferring information from lecturers to students into a knowledge construction process based on individual and group understanding and experience. The problems given in PBL are based on real problems in the field. Problems in PBL do not have a single answer, so students must explore several solutions (Balan et al., 2019; Fakhriyah, 2014). Through full involvement in problem-solving, students can develop critical thinking skills. In problem-solving activities, students must use critical thinking skills to solve problems and draw conclusions based on their understanding.

Problem-based learning (PBL) is a learning model that uses a student-centered approach. The student center approach is an approach that makes students the subjects of learning activities. Thus, in the problem-based learning (PBL) model, students must be more active and independent in searching for information because educators are only facilitators. The PBL process is not merely a procedure but is part of learning to manage oneself as a life skill focusing on students (Dwijananti & Yulianti, 2010; Halabi, 2020). The problem-based learning (PBL) model is often known as one that uses real problems in the surrounding environment to acquire knowledge and concepts through critical thinking and problem-solving skills. PBL is an instructional learning model that encourages students to learn through authentic problems (Noprianda et al., 2019; Shofwani & Rochmah, 2021). In PBL or problem-based learning, students become more active, independent, and creative and can develop critical, analytical, and collaborative thinking skills (Graff, 2003; Lailaturrahmah et al., 2020). Problem-based learning is an innovation in learning because, in the teaching and learning process, students' learning abilities are optimized through systematic group or teamwork so that students can empower, hone, test, and develop their thinking abilities continuously (Charlton-Perez, 2013; Dudu & Vhurumuku, 2012; Riyanto, 2024).

Then, the researchers tried to find solutions to students' critical thinking problems by looking for supporting theories for overcoming these problems, such as the problem-based learning (PBL) learning model, often known as a learning model that uses real problems in the surrounding environment as a basis for gaining knowledge and concepts through critical thinking and problem-solving skills. So that students do not only follow theory but can show development according to their potential and abilities. Apart from that, students can work in groups, communicate, solve problems, and make decisions about the right solution to a problem. This is confirmed by previous research conducted by previous research which obtained analysis results that there were significant differences in critical thinking abilities between groups of students taught with the Problem-Based Learning model based on performance assessment and those taught with conventional learning in fifth-semester students of the School Teacher Education Department. Basics of the Faculty of Education, Ganesha Education University (Saputra, 2019; Sholikah & Dwi, 2021).

Based on this, this research aims to analyze whether the problem-based learning (PBL) learning model, through science learning, influences students' critical thinking abilities.

2. METHOD

This research uses a quasi-experimental quantitative method with a pretest-posttest control design. Quasi-experiments aim to observe cause-and-effect relationships involving control and experimental groups (Creswell, 2014). The following is an overview of the pretest-posttest control design. The stages that will be carried out in this research are: Initial Test Stage (Pretest), the pretest is carried out to prove that the control class and experimental class have the same ability in critical thinking skills. If the pretest results show insignificant results, then the research can proceed to the next stage, namely the stage of providing treatment. Stages of Providing Treatment: Treatment is carried out so that students are involved in the problem-based learning (PBL) learning model, which improves students' critical thinking skills. Stages of giving a final test (post-test): Give a final test (post-test) to find out whether the results of using the problem-based learning (PBL) learning model have an influence on students' critical thinking abilities after being given treatment.

The research population is closely related to the data taken in research related to the objects and subjects studied. The research population of UAD Elementary School, Teacher Education students, was taken based on the same semester and course. "Population is the entire subject to be researched." So, the population relates to data or objects and subjects for data collection (Arikunto, 2012). The population in this study were all fourth-semester class F and H students. The sample is a part or representative of the population to be studied. The sampling technique used in this research is purposive sampling because the samples are adjusted to research needs. Purposive sampling is a technique for determining samples with certain considerations (Sugiyono., 2014). The sample in this study was class H students in the fourth semester of UAD Primary School Teacher Education, with 25 students. This research uses a simple regression analysis technique because there are 2 (two) variables involved in this research, namely the problem-based learning (PBL) learning model as the independent variable and critical thinking ability as the dependent variable. According to other researchers, the conditions that must be met in a simple regression test are: the sample is taken randomly, the Y value has a normal distribution, and the variable.

Table 1. Critical Thinking Ability Research Instrument

No	Statement Items	Score			
		4 (Very good)	3 (Good)	2 (Enough)	1 (Less)
1.	Be open minded				
2.	Take a stand when evidence and reasons are sufficient.				
3.	Consider the whole situation.				
4.	Equip yourself with information.				
5.	Seek as much truth/accuracy as possible.				
6.	Solve problems systematically and thoroughly.				
7.	Look for alternatives				
8.	Look for reasons/reasons.				
9.	Look for a clear statement of a problem.				
10.	Remember the main/basic things.				
11.	Use credible sources and mention them.				
12.	Try to be relevant to the main idea.				
13.	Sensitive to other people's feelings, level of knowledge, and level of ability				

3. RESULT AND DISCUSSION

Result

Research results on the problem-based learning model's influence on students' critical thinking abilities. First, test the normality of the data. The normality test is one of the requirements that must be carried out before analyzing the data. The data that will be tested includes the pretest and post-test results of critical thinking skills through the problem-based learning method for critical 4H class students at Ahmad Dahlan University Elementary School Teacher Education using the slope of the curve formula. The pretest KM value is calculated as 0.0117. This value lies between (-1) and (1), so the data from the pretest results of critical thinking skills through the problem-based learning method for students in class 4H PGSD at Ahmad Dahlan University is normally distributed. Meanwhile, in the post-test calculation, the KM value is 0.0008. This value lies between (-1) and (1), so the data from the post-test results of critical thinking skills through the problem-based learning method for students in class 4H of Elementary School Teacher Education at Ahmad Dahlan University is normally distributed.

Second, the homogeneity test. The homogeneity test was used to see whether or not both pretest and post-test data on critical thinking skills through the problem-based learning method for students in class 4H of Elementary School Teacher Education at Ahmad Dahlan University had homogeneous variance. The homogeneity test tests the similarity of average values that are normally distributed and use the same sample. To carry out the homogeneity test, researchers used the F test with the following formula:

The results are $F_{count} \leq F_{table}$ or $1.05 \leq 4.28$, so the variance is declared homogeneous. Data from the pretest and post-test results of children's critical thinking abilities through the problem-based learning method will be used to test research hypotheses. Third, hypothesis testing was carried out to find out and prove whether the problem-based learning method influenced students' critical thinking abilities, so the statistical analysis used was the t-test with a significance level of (a) 0.05. The calculation results show that the average value of the pretest class learning outcomes is 84.67, and the average value of the post-test class is 87.70. This means that the average value of the post-test class is greater than the average value of the pretest class. So, it can be concluded that the problem-based learning method positively influences students' critical thinking abilities. Based on the results of t-test calculations with a significance level of (a) 0.05 and dk = 25-2 = 23, the value of t = 27.98 was obtained. Thus, it can be concluded that $t_{count} > t_{table}$ or $27.98 > 2.069$, so H_0 is rejected and Ha is accepted, meaning that the hypothesis which states that the problem-based learning method influences the critical thinking abilities of class 4H PGSD students at Ahmad Dahlan University is accepted as true. Data from the pretest and post-test results of students' critical thinking abilities are shown in Table 2.

Table 2. Pretest and Post-test Results Data on Students' Critical Thinking Ability

Class	The influence of the inquiry model on the logical thinking abilities of grade 4 B elementary school students	
	Pretest	Posttest
Experiment	34.42	81.86
Control	40.53	50.52

Based on Table 2, the average score for the experimental class on the pretest was 34.42, and the average post-test was 81.86. Meanwhile, in the control class, the pretest result was 40.53, and the post-test result was 50.52. This shows that the pretest and post-test results for the experimental class experienced significant changes, while the control class did not experience significant changes. This means that the problem-based learning method influences children's critical thinking abilities more than the question-and-answer method used for the pretest. The data obtained is based on the calculations obtained for the pretest normality test. The data obtained was 0.0117, and the post-test obtained 0.0008. This value lies between (-1) and (1), so it can be said that the two data sets are normally distributed. Then, the normality test data for $F_{count} \leq F_{table}$ or $1.05 \leq 4.28$, and the variances are declared homogeneous. Next, a hypothesis test was carried out. It was found that $t_{count} > t_{table}$ or $27.98 > 2.069$, so H_0 was rejected and H_a was accepted, meaning that the hypothesis which stated that the problem-based learning method had a significant influence on the critical thinking abilities of class 4H students at Ahmad Dahlan University was accepted as true.

Discussion

Critical thinking ability is one aspect of cognitive development. Critical thinking is students' ability to provide answers based on evidence that is reflective, productive, and evaluative of an event. This can be seen from students' ability to think openly, take a stand when evidence and reasons are sufficient, consider the whole situation, equip themselves with information, seek as much truth/accuracy as possible, solve

problems systematically and thoroughly, look for alternatives, look for reasons/causes, looking for a clear statement of a problem, remembering the main/basic things, using credible sources and mentioning them, trying to be relevant to the main idea, and being sensitive to the feelings, level of knowledge and level of ability of other people.

In optimizing students' critical thinking skills, lecturers should be able to provide opportunities for students to search and find information without assistance or with assistance that places students as learning subjects so that this can direct students to think systematically and critically (Aziz et al., 2016; Choate et al., 2021). Meanwhile, lecturers only act as facilitators who can support students in developing the critical thinking skills they must have. Then, the researchers tried to find solutions to students' critical thinking problems by looking for supporting theories for overcoming these problems, such as the problem-based learning (PBL) learning model, often known as a learning model that uses real problems in the surrounding environment as a basis for gaining knowledge and concepts through critical thinking and problem-solving skills. This is reinforced by the research opinion that PBL is an instructional learning model that encourages students to learn through authentic problems (Affandi & Sukyadi, 2016; Ferrero et al., 2021).

Furthermore, other research states that problem-based learning is an innovation in learning because, in the teaching and learning process, students' learning abilities are optimized through systematic group or teamwork so that students can empower, hone, test, and continuously develop their thinking abilities (Rahmadani, 2019). In PBL or problem-based learning, students become more active, independent, and creative in learning and can develop critical, analytical, and collaborative thinking skills.

In line with the two theories above in the research conducted, other research found significant differences in critical thinking abilities between groups of students taught with the Problem-Based Learning model based on performance assessment and those taught with conventional learning in fifth-semester students of the Department of Elementary School Teacher Education, Faculty of Education, Ganesha University of Education (Imam et al., 2018; Saputra, 2019). This can be seen from the average score obtained for the experimental group $\bar{X}$= 72.08 >$\bar{X}$= 62.92 for the control group and from the test criteria t_{count} = 2.11 > t_{table}(α= 0.05, 58) = 2,000. Therefore, it can be concluded that applying the problem-based learning model based on performance assessment positively affects the critical thinking abilities of fifth-semester students of the PGSD FIP Department, Ganesha Education University.

Looking at relevant previous theories and studies, it can be seen that the problem-based learning method is one of the ways that lecturers can overcome critical thinking problems in students because, through the problem-based learning method, students are allowed to find information that can improve their understanding of science and critical thinking. , and skilled in obtaining and analyzing information. Apart from that, this research is proven through instruments taken from the conclusions of several expert opinions in the form of observation and assessment sheets to obtain data on student's critical thinking abilities by comparing pretest and post-test results. The average score for the experimental class on the pretest was 34.42, and the average post-test was 81.86. Meanwhile, in the control class, the pretest result was 40.53, and the post-test result was 50.52. This shows that the pretest and post-test results for the experimental class experienced significant changes, while the control class did not experience significant changes. This means that the problem-based learning method influences children's critical thinking abilities more than the question-and-answer method used for the pretest.

This research is also strengthened by data from observation sheets and documentation in the form of photos and videos of the research process. After obtaining the data, data management is then carried out. The data obtained is based on the calculations obtained for the pretest normality test. The data obtained was 0.0117, and the post-test obtained 0.0008. This value lies between (-1) and (1), so it can be said that the two data sets are normally distributed. Then, the normality test data for $F_{count} \leq F_{table}$ or 1.05 ≤ 4.28, and the variances are declared homogeneous. Next, a hypothesis test was carried out. It was found that $t_{count} > t_{table}$ or 27.98 > 2.069, so H_0 was rejected and Ha was accepted, meaning that the hypothesis which stated that the problem-based learning method had a significant influence on the critical thinking abilities of class 4H students at Ahmad Dahlan University was accepted as true.

4. CONCLUSION

Based on the results of hypothesis testing and discussion, it can be proven through research instruments that the problem-based learning model can improve students' ability to think openly, take a stand when evidence and reasons are sufficient, consider the whole situation, equip themselves with information, seek as much truth/accuracy as possible. , solve problems systematically and thoroughly, look for alternatives, look for reasons/causes, look for a clear statement of a problem, remember the main/basic things, use credible sources and mention them, try to be relevant to the main idea, sensitive to feelings, level

of knowledge and level of ability of others. Based on these indicators, overall, the problem-based learning model influences the critical thinking abilities of class 4H students at Ahmad Dahlan University and can overcome the problems of students who have difficulty working in groups, communicating, solving problems, and making decisions as the right solution for a problem. It can be seen from the increase in pretest to post-test results in the critical thinking abilities of class 4H students at Ahmad Dahlan University in the experimental class.

5. REFERENCES

Affandi, A., & Sukyadi, D. (2016). Project-Based Learning and Problem-Based Learning for EFL Students' Writing Achievement at the Tertiary Level. *Rangsit Journal of Educational Studies*, *3*(1), 23–40. https://doi.org/10.14456/rjes.2016.2.

Amin, S., Utaya, S., Bachri, S., Sumarmi, & Susilo, S. (2020). Effect of problem-based learning on critical thinking skills and environmental attitude. *Journal for the Education of Gifted Young Scientists*, *8*(2), 743–755. https://doi.org/10.17478/jegys.650344.

Anugraheni, I. (2020). Analisis Kesulitan Mahasiswa dalam Menumbuhkan Berpikir Kritis Melalui Pemecahan Masalah. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *4*(1), 261–267. https://doi.org/10.31004/cendekia.v4i1.197.

Arikunto. (2012). *Prosedur Penelitian Suatu Pendekatan Praktik*. Remaja Rosdakarya.

Aziz, A., Ahyan, S., & Fauzi, L. M. (2016). Implementasi Model Problem Based Learning (PBL) dalam Meningkatkan Kemampuan Berpikir Kritis Mahasiswa melalui Lesson Study. *Jurnal Elemen*, *2*(1), 83. https://doi.org/10.29408/jel.v2i1.179.

Balan, L., Yuen, T., & Mehrtash, M. (2019). Problem-based Learning Strategy for Cad Software Using Free-Choice and Open-Ended Group Projects. *12th International Conference Interdisciplinarity in Engineering, INTER-ENG 2018, 4–5 October 2018, Tirgu Mures, Romania*, *32*, 339–347. https://doi.org/10.1016/j.promfg.2019.02.223.

Charlton-Perez, A. J. (2013). Problem-Based Learning Approaches in Meteorology. *Journal of Geoscience Education*, *61*(1), 12–19. https://doi.org/10.5408/11-281.1.

Choate, K., Goldhaber, D., & Theobald, R. (2021). The effects of COVID-19 on teacher preparation. *Phi Delta Kappan*, *102*(7), 52–57. https://doi.org/10.1177/00317217211007340.

Creswell, J. W. (2014). *Research design: qualitative, quantitative, and mixed methods approaches* (4th ed). SAGE Publications.

Dudu, W. ., & Vhurumuku, E. (2012). Teacher practices of inquiry when teaching investigations: A case study. *Journal of Science Teacher Education*, *23*(6), 579–600. https://doi.org/10.1007/s10972-012-9287-y.

Dwijananti, P., & Yulianti, D. (2010). Pembelajaran Problem Based Instruction Pada Mata Kuliah. *Jurnal Pendidikan Fisika Indonesia*, *6*, 108–114. https://journal.unnes.ac.id/nju/JPFI/article/download/1122/1039.

Egok, A. . (2016). Kemampuan Berpikir Kritis dan Kemandirian Belajar dengan Hasil Belajar Matematika. *Jurnal Pendidikan Dasar*, *7*(2), 185–198. https://core.ac.uk/download/pdf/297684592.pdf.

Facione, P. A., & Facione, N. C. (2013). Critical Thinking for Life. *Inquiry: Critical Thinking Across the Disciplines*, *28*(1), 5–25. https://doi.org/10.5840/inquiryct20132812.

Fakhriyah, F. (2014). Penerapan problem based learning dalam upaya mengembangkan kemampuan berpikir kritis mahasiswa. *Jurnal Pendidikan IPA Indonesia*, *3*(1), 95–101. https://doi.org/10.15294/jpii.v3i1.2906.

Ferrero, M., Vadillo, M. A., & León, S. P. (2021). Is project-based learning effective among kindergarten and elementary students? A systematic review. *PLoS ONE*, *16*(4 April), 1–14. https://doi.org/10.1371/journal.pone.0249627.

Fristadi, R., & Bharata, H. (2015). Meningkatkan Kemampuan Berpikir Kritis Siswa Dengan Problem Based Learning. *Seminar Nasional Matematika Dan Pendidikan Matematika UNY 2015*, 597–602. http://seminar.uny.ac.id/semnasmatematika/sites/seminar.uny.ac.id.semnasmatematika/files/banner/PM-86.pdf.

Graff, erik de. (2003). Characteristics of Problem-Based Learning. *Proceedings of the International Conference on Education and Research in Computer Aided Architectural Design in Europe*, *19*(5), 182–189. https://doi.org/10.52842/conf.ecaade.2006.182.

Halabi, O. (2020). Immersive virtual reality to enforce teaching in engineering education. *Multimedia Tools and Applications*, *79*(3–4), 2987–3004. https://doi.org/10.1007/s11042-019-08214-8.

Halimah, S., Usman, H., & Maryam, S. (2023). Peningkatkan Kemampuan Berpikir Kritis Dalam Pembelajaran IPA Melalui Penerapan Model Pembelajaran Problem-based learning (PBL) di Sekolah Dasar.

Jurnal Ilmu Sosial Dan Pendidikan, *3*(6), 403–413. https://doi.org/http://dx.doi.org/10.36418/syntax-imperatif.v3i6.207.

Halpern, D. F. (2013). Thought and knowledge: An introduction to critical thinking, Fifth Edition. In *Thought and Knowledge: An Introduction to Critical Thinking, Fifth Edition* (Issue 2013). https://doi.org/10.4324/9781315885278.

Imam, I., Ayubi, A., & Bernard, M. (2018). Pengaruh Pembelajaran Berbasis Masalah Terhadap Kemampuan Pemecahan Masalah Matematis Siswa SMA. *JPMI:Jurnal Pembelajaran Matematika Inovatif*, *1*(3), 355–360. https://doi.org/10.22460/jpmi.v1i3.355-360.

Kusumah, R. G. T. (2019). Peningkatan Kemampuan Berfikir Kritis Mahasiswa Tadris IPA Melalui Pendekatan Saintifik Pada Mata kuliah IPA Terpadu. *IJIS Edu : Indonesian Journal of Integrated Science Education*, *1*(1), 71. https://doi.org/10.29300/ijisedu.v1i1.1762.

Lailaturrahmah, E., Tahir, M., & Rosyidah, A. N. K. (2020). Pengaruh Model Problem Based Learning (Pbl) Terhadap Retensi Dan Kemampuan Berpikir Kritis Ipa Peserta Didik SD. *Jurnal Ilmiah Pendas: Primary Education Journal*, *1*(1), 1–11. https://doi.org/10.29303/pendas.v1i1.49.

Laksmiwati, Y. W. S. H. laksmiwati, & Khoirunnisa, R. N. (2018). Penerapan Model Problem Based Learning untuk Meningkatkan Kemampuan Berfikir Kritis Mahasiswa. *Jurnal Pendidikan (Teori Dan Praktik)*, *3*, 7–12. https://doi.org/10.26740/jp.v3n1.p7-12.

Luritawaty, I. P., Herman, T., & Prabawanto, S. (2022). Analisis Cara Berpikir Kritis Mahasiswa pada Materi Bangun Ruang Sisi Datar. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(2), 191–202. https://doi.org/10.31980/mosharafa.v11i2.1536.

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.

Noprianda, M., Noor, M. F., & Zulfiani, Z. (2019). Keterampilan Berpikir Kritis Siswa Model Pembelajaran Problem Based Learning Dan Sains Teknologi Masyarakat Pada Konsep Virus. *Edusains*, *8*(2), 182–191. https://doi.org/10.15408/es.v8i2.3892.

Oktaviana, D., & Haryadi, R. (2020). Pengaruh Model Pembelajaran Problem Based Learning (Pbl) Terhadap Kemampuan Pemecahan Masalah Mahasiswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *9*(4), 1076. https://doi.org/10.24127/ajpm.v9i4.3069.

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.

Rahmadani. (2019). Metode Penerapan Model Pembelajaran Problem Based Learning (PBL). *Lantanida Journal*, *7*, 1–100. https://www.jurnal.ar-raniry.ac.id/index.php/lantanida/article/download/4440/pdf.

Riyanto, M. (2024). Efektivitas Problem Based Learning terhadap Kemampuan Berpikir Kritis Mahasiswa Muhamad. *Journal Of Information Systems And Management V*, *03*(01), 1–5. https://doi.org/10.52005/belaindika.v1i2.14.

Saputra, H. (2019). *Pembelajaran Bangun Ruang , Model Problem Based Learning (PBL*. Dan Kemampuan Berpikir Kritis Matematis.

Shofwani, S. A., & Rochmah, S. (2021). Penerapan Problem Based Learning untuk Meningkatkan Minat dan Hasil Belajar Managemen Operasional di Masa Pandemi Covid-19. *Jurnal Educatio FKIP UNMA*, *7*(2), 439–445. https://doi.org/10.31949/educatio.v7i2.1074.

Sholikah, M., & Dwi, H. (2021). "Enhancing Student Involvement Based on Adoption Mobile Learning Innovation as Interactive Multimedia." *International Journal of Interactive Mobile Technologies*, *15*(8), 101–18,. https://doi.org/10.3991/ijim.v15i08.19777.

Sugiyono. (2014). *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Syafitri, E., Armanto, D., & Rahmadani, E. (2021). Aksiologi Kemampuan Berpikir Kritis. *Journal of Science and Social Research*, *4307*(3), 320–325. https://doi.org/10.54314/jssr.v4i3.682.

Vieira, E. A. O., Silveira, A. C. D., & Martins, R. X. (2019). Heuristic evaluation on usability of educational games: A systematic review. *Informatics in Education*, *18*(2), 427–442. https://doi.org/10.15388/infedu.2019.20.

Yustianingsih, R., Syarifuddin, H., & Yerizon, Y. (2017). Pengembangan Perangkat Pembelajaran Matematika Berbasis Problem Based Learning (PBL) untuk Meningkatkan Kemampuan Pemecahan Masalah Peserta Didik Kelas VIII. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *1*(2), 258. https://doi.org/10.33603/jnpm.v1i2.563.

Zanthy, L. S. (2016). Pengaruh Motivasi Belajar Ditinjau Dari Latar Belakang Pilihan Jurusan Terhadap Kemampuan Berpikir Kritis Mahasiswa Di Stkip Siliwangi Bandung. *Teorema*, *1*(1), 47. https://doi.org/10.25157/.v1i1.540.