JPPIPA 8(1) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

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

Zulkarnaen[1], Suhirman[2*], Samsun Hidayat[3*], Saiful Prayogi[3], Fitria Sarnita[4], Widia[5], Fathurrahmaniah[5], Azra Fauzi[6], Lisda Ramdhani[6], Ni Nyoman Sri Putu Verawati[7]

[1] Physics Education Department, Universitas Mulawarman, Samarinda, Indonesia.
[2] Biology Education Department, Universitas Islam Negeri Mataram, Mataram, Indonesia.
[3] Physics Education Department, Universitas Pendidikan Mandalika, Mataram, Indonesia.
[4] Physics Education Department, STKIP Taman Siswa, Kota Bima, Indonesia.
[5] Science Education Department, STKIP Harapan Bima, Bima, Indonesia.
[6] Mathematic Education Department, STKIP Harapan Bima, Bima, Indonesia.
[7] Physics Education Department, Universitas Mataram, Mataram, Indonesia.

DOI: 10.29303/jppipa.v8i1.1307

Article Info
Received: December 20, 2021
Revised: January 18, 2022
Accepted: January 25, 2022
Published: January 31, 2022

Abstract: This study aimed to explore the effect of the PBL model on students' creative thinking ability. A quasi-experimental study with 70 samples divided into experimental group and control group was carried out in this study. Data on students' creative thinking ability were collected using 8 items of essay test instruments that accommodate the creative thinking ability indicators. Descriptive analysis using the n-gain equation and statistical analysis using the ANOVA test were carried out to determine the improvement and effect of the treatment implemented on students' creative thinking ability. The results showed that the students' creative thinking ability in the experimental group (n-gain: 0.72) was significantly different ($p<0.05$) in comparison with the control group (n-gain: 0.14). Based on the results of the study, it can be concluded that the PBL model has a significant effect on students' creative thinking ability.

Keywords: Problem-based learning; Learning model; Creative thinking ability.

Citation: Zulkarnaen, Z., Suhirman, S., Hidayat, S., Prayogi, S., Sarnita, F., Widia, W., Fathurrahmaniah, F., Fauzi, A., Ramdhani, L., & Verawati, N. N. S. P. (2022). The Effect of Problem Based Learning Model on Students' Creative Thinking Ability. *Jurnal Penelitian Pendidikan IPA*, *8*(1), 379–382. https://doi.org/10.29303/jppipa.v8i1.1307

Introduction

Indicators of the low quality of education can be seen from the strategies, methods, models and teaching methods implemented in learning activities. In general, the learning process at the secondary school level tends to use conventional learning such as lectures, assignments, using textbooks which are more dominated by teachers in the learning process. One of the innovative teaching models that can be implemented in science learning is problem-based learning (PBL) (Suhirman et al., 2021). Problem-based learning is a student-centred approach and requires prior general knowledge. Students are more active in obtaining information from various sources. Since it was first implemented until now, problem-based learning has become one of the methods that has received considerable attention in Indonesia, especially in the world of secondary and higher education (Suhirman, et al., 2020), and is a solution to improve the quality of learning in the fields of science, technology, engineering, and mathematics (STEM) (Hidayatulloh, et al., 2020).

Until now, to promote higher order thinking and problem solving for students in authentic learning situations, problem-based learning has been used, and it has been adopted in various educational and learning contexts (Yew & Goh, 2016). Along with the development of learning practices using PBL in various

*Email: suhirman@uinmataram.ac.id; samsunhidayat@ikipmataram.ac.id

learning settings there has been an increasing number of studies examining its effectiveness in developing students' thinking skills (Suhirman, et al., 2020). Previous studies have even investigated the effect of PBL in the learning curriculum (Dochy, et al., 2003), and the most popular is the implementation of PBL which leads to more optimal learning outcomes (Dolmans, et al., 2005). The result is that the application of PBL is able to improve and develop knowledge, competence, problem-solving and communication skills (Delaney, et al., 2017). In PBL, students work together in groups to find and solve problems. In this context, it prioritizes the suitability of learning with things found in everyday life (Nuswowati, et al., 2017). This is in line with the implementation of the 2013 Curriculum (K-13) in Indonesia which recommends learning to be carried out with a scientific approach through PBL.

PBL is a learning model designed in a learning procedure that begins with a specific problem (De Witte & Rogge, 2016). PBL requires students to develop knowledge independently or work together in study groups to find solutions to an authentic problem. Problems that are complex, contextual and ill-structured will provide opportunities for students to develop their thinking skills and develop their creativity in digging up various information, developing various possible solutions, and creating various sources to solve problems (Tsai & Chiang, 2013). Proponents of PBL claim to have been able to improve the quality of the learning process and are more effective at acquiring long-term knowledge when compared to conventional learning (Strobel & van Barneveld, 2009). This is further researched to develop creative thinking skills (Elizabeth & Sigahitong, 2018; Mirawati, et al., 2017).

Creative thinking is one of the 21st century thinking skills in addition to critical thinking, communication skills, collaboration, and problem solving (Prayogi, et al., 2018a, 2018b, 2019; Prayogi & Verawati, 2020; Verawati, Hikmawati, et al., 2019; Verawati, Prayogi, et al., 2019; Verawati & Hikmawati, 2019; Wahyudi, et al., 2018, 2019a, 2019b). An indication of educational progress in some developed countries is when students are able to think creatively (Wartono, et al., 2018). Creativity is shaped by a person's cognitive ability to solve problems and generate new ideas that is rarely thought of by others (Boltz, et al., 2015). Students' creative thinking abilities can develop with a stimulus, and this is usually facilitated by the teacher in the learning process with effective learning designs (Clinton & Hokanson, 2012). In this study we explored the effect of the PBL model on students' creative thinking ability.

Method

The type of research used is quasi-experimental. A quantitative approach in a quasi-experimental approach is used to determine the effect of the independent variable (treatment) on the dependent variable (outcome) under controlled conditions. The research sample consisted of 70 students (n = 70) from one of the secondary schools in the city of Mataram, West Nusa Tenggara, Indonesia. The sample was divided into two classes, each of 35 students as the experimental group and 35 students as the control group. The experimental group was given learning treatment using the PBL model, while the control group was given conventional learning (lectures and questions and answers).

Learning is carried out on physics material in the motion sub-material in four meetings (excluding pretest and posttest). The pretest-posttest was conducted in both groups (experimental and control) with a creative thinking ability test instrument consisting of 8 items that accommodate Torrance's creative thinking indicators on aspects of fluency, flexibility, originality, elaboration (Mullen Raymond, 2017). Each indicator consists of two question items. Scores of students' creative thinking ability were analyzed using a multilevel scale (five scales) adapted from the scoring technique of Verawati, et al (Verawati, et al., 2021) with the lowest score -1 (minus one) and the highest +3 (plus three). Furthermore, the creative thinking scores (CRs) of each student were interpreted into categories, as presented in Table 1.

Table 1. Interpretation CRs into categories

Score range	Categories
CRs > 17.6	Very creative
11.2 < CRs ≤ 17.6	Creative
4.8 < CRs ≤ 11.2	Quite creative
1.6 < CRs ≤ 4.8	Less creative
CRs ≤ -1.6	Not creative

Analysis of increasing creative thinking scores using the n-gain equation. Data on students' creative thinking abilities were analyzed descriptively by using SPSS v.23, where the normality test, homogeneity test, and analysis of variance were calculated for each group.

Result and Discussion

The results of the students' creative thinking ability test showed an increase in creative thinking ability after learning with the PBL model, as shown in Table 2 and Figure 1.

Table 2. Creative thinking test result

Sample group	N	Creative thinking score (CTs) & criteria				N-gain	Criteria
		Pretest	Criteria	Posttest	Criteria		
Experiment	35	0.41	Less creative	17.37	Creative	0.72	High
Control	35	0.46	Less creative	3.74	Less creative	0.14	Low

The results in Table 2 show that in the pretest the creative thinking ability score was 0.41 with less creative criteria, and this increased after learning treatment using PBL to 17.37 with creative criteria. It is different with the control group, where in the pretest and posttest students' creative thinking ability remain on the criteria of being less creative. The increase in the score of creative thinking ability in the experimental and control classes, respectively, was 0.72 (high criteria) and 0.14 (low criteria). The results in Table 1 also show explicitly that creative thinking ability can be improved with the PBL model, meanwhile with conventional learning (lectures and questions and answers) creative thinking ability cannot be improved.

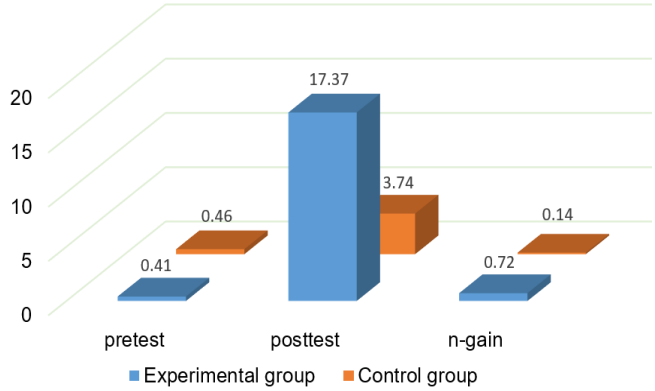

Figure 1. Creative thinking test result

Furthermore, the results of statistical tests (analysis of variance) were carried out to evaluate the differences in students' creative thinking abilities between the two groups (experimental and control), this was preceded by normality and homogeneity tests as presented in Table 3. While the results of the analysis of variance were presented in Table 4.

Table 3. The summary of the result of normality and homogeneity test

Group of data	Kolmogorov-Smirnov		Levene's Test	
	N	Sig.	Levene's test score	Sig.
Pretest of CR ability	70	0.200	0.000	0.981
Posttest of CR ability	70	0.200	0.960	0.320

Table 4. The results of one-way anova analysis

Group	Df	Mean square	F	Sig.
Between Groups	1	1836.413	608.187	0.000
Within Groups	68	3.134		
Total	69			

The results in Table 3. show that the sample groups from both classes (experimental and control) are normally distributed and homogeneous, this is because the significance value of both is greater than 0.05. The results of one-way ANOVA analysis (Table 4.) show a significance value (0.000) less than 0.05. It is interpreted that there are differences in students' creative thinking abilities between the two test classes (experimental and control) after the treatment of each group. When compared with the results in Table 2, it is very clear that the PBL model has a significant effect on increasing students' creative thinking abilities.

In line with the results, empirical studies show that PBL challenges students to be actively involved in problem solving with characteristics that are rich in information settings. On the other hand, a study that conducted a meta-analysis of 90 studies, 19 theses, and 6 articles found that PBL was proven to contribute more effectively than conventional learning to scientific attitudes (Veli, 2014), thinking skills, problem solving, and self-directed skills (Choi, et al., 2014) that allows students to be more active in learning (Kaldi et al., 2011) that allows students to be more active in learning (Putri, et al., 2019).

In contrast to the results of this study, Temel (Temel, 2014) found that PBL did not have a significant impact compared to direct learning, the results Temel's study only showed a significant difference in impact only on students' perceptions related to perceptions of problem solving abilities. In contrast to the results of this study, Ulger and Imer (Ulger & Imer, 2013) stated that PBL has a significant impact on students' creative thinking ability in visual art education learning.

Conclusion

The results of this study have achieved the objectives that have been formulated previously. Based on the results of the study, it can be concluded that the PBL model has a more significant impact on students' creative thinking ability than conventional learning ($p < 0.05$). Finally, based on the results of this study, we encourage the use of the PBL model in classroom-learning, especially for the purpose of training students' creative thinking ability.

Acknowledgments

We give our highest appreciation to those who have contributed to this study, especially the research team.

References

Boltz, L. O., Henriksen, D., & Mishra, P. (2015). Rethinking Technology & Creativity in the 21st Century: Empathy through Gaming - Perspective Taking in a Complex World. *TechTrends*, *59*(6), 3–8. https://doi.org/10.1007/s11528-015-0895-1

Choi, E., Lindquist, R., & Song, Y. (2014). Effects of problem-based learning vs. Traditional lecture on Korean nursing students' critical thinking, problem-solving, and self-directed learning. *Nurse Education Today*, *34*(1), 52–56. https://doi.org/10.1016/j.nedt.2013.02.012

Clinton, G., & Hokanson, B. (2012). Creativity in the training and practice of instructional designers: The Design/Creativity Loops model. *Educational Technology Research and Development*, *60*(1), 111–130. https://doi.org/10.1007/s11423-011-9216-3

De Witte, K., & Rogge, N. (2016). Problem-based learning in secondary education: Evaluation by an experiment. *Education Economics*, *24*(1), 58–82. https://doi.org/10.1080/09645292.2014.966061

Delaney, Y., Pattinson, B., Mccarthy, J., & Beecham, S. (2017). Transitioning from traditional to problem-based learning in management education: The case of a frontline manager skills development programme. *Innovations in Education and Teaching International*, *54*(3), 214–222.

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and Instruction*, *13*(5), 533–568. https://doi.org/10.1016/S0959-4752(02)00025-7

Dolmans, D. H. J. M., De Grave, W., Wolfhagen, I. H. A. P., & van der Vleuten, C. P. M. (2005). Problem-based learning: Future challenges for educational practice and research. *Medical Education*, *39*(7), 732–741. https://doi.org/10.1111/j.1365-2929.2005.02205.x

Elizabeth, A., & Sigahitong, M. M. (2018). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kreatif Peserta Didik SMA. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *6*(2), 66. https://doi.org/10.33394/j-ps.v6i2.1044

Hidayatulloh, R., Suyono, S., & Azizah, U. (2020). Development of STEM-Based Chemistry Textbooks to Improve Students' Problem Solving Skills. *Jurnal Penelitian Dan Pengkajian Ilmu Pendidikan: E-Saintika*, *4*(3), 308. https://doi.org/10.36312/e-saintika.v4i3.306

Kaldi, S., Filippatou, D., & Govaris, C. (2011). Project-based learning in primary schools: Effects on pupils' learning and attitudes. *Education 3-13*, *39*(1), 35–47. https://doi.org/10.1080/03004270903179538

Mirawati, B., Meilani, R., & Hunaepi, H. (2017). Pengaruh Model Pembelajaran Berbasis Masalah dengan Pendekatan Saintifik terhadap Keterampilan Berpikir Kritis Siswa. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*, *5*(1), 20. https://doi.org/10.33394/j-ps.v5i1.1153

Mullen Raymond, S. (2017). Neural foundations of creativity: A systematic review. *Revista Colombiana de Psiquiatría (English Ed.)*, *46*(3), 187–192. https://doi.org/10.1016/j.rcpeng.2016.06.001

Nuswowati, M., Susilaningsih, E., Ramlawati, R., & Kadarwati, S. (2017). Implementation of Problem-Based Learning with Green Chemistry Vision to Improve Creative Thinking Skill and Students' Creative Actions. *Jurnal Pendidikan IPA Indonesia*, *6*(2), 221. https://doi.org/10.15294/jpii.v6i2.9467

Prayogi, S., Muhali, M., Yuliyanti, S., Asy'ari, M., Azmi, I., & Verawati, N. N. S. P. (2019). The Effect of Presenting Anomalous Data on Improving Student's Critical Thinking Ability. *International Journal of Emerging Technologies in Learning (IJET)*, *14*(06), 133. https://doi.org/10.3991/ijet.v14i06.9717

Prayogi, S., & Verawati, N. N. S. P. (2020). The Effect of Conflict Cognitive Strategy in Inquiry-based Learning on Preservice Teachers' Critical Thinking Ability. *Journal of Educational, Cultural and Psychological Studies (ECPS Journal)*, *0*(21), 27–41. https://doi.org/10.7358/ecps-2020-021-pray

Prayogi, S., Yuanita, L., & Wasis. (2018a). Critical-Inquiry-Based-Learning: Model of Learning to Promote Critical Thinking Ability of Pre-service Teachers. *Journal of Physics: Conference Series*, *947*, 012013. https://doi.org/10.1088/1742-6596/947/1/012013

Prayogi, S., Yuanita, L., & Wasis. (2018b). Critical-Inquiry-Based-Learning: Model of Learning to Promote Critical Thinking Ability of Pre-service Teachers. *Journal of Physics: Conference Series*, *947*, 012013. https://doi.org/10.1088/1742-6596/947/1/012013

Putri, S. U., Sumiati, T., & Larasati, I. (2019). Improving creative thinking skill through project-based-learning in science for primary school. *Journal of Physics: Conference Series*, *1157*, 022052. https://doi.org/10.1088/1742-6596/1157/2/022052

Strobel, J., & van Barneveld, A. (2009). When is PBL More Effective? A Meta-synthesis of Meta-analyses Comparing PBL to Conventional Classrooms. *Interdisciplinary Journal of Problem-Based Learning*, *3*(1). https://doi.org/10.7771/1541-5015.1046

Suhirman, S., Prayogi, S., & Asy'ari, M. (2021). Problem-Based Learning with Character-Emphasis and Naturalist Intelligence: Examining Students Critical Thinking and Curiosity. *International Journal of Instruction*, *14*(2), 217–232. https://doi.org/10.29333/iji.2021.14213a

Suhirman, S., Yusuf, Y., Muliadi, A., & Prayogi, S. (2020). The Effect of Problem-Based Learning with Character Emphasis toward Students' Higher-Order Thinking Skills and Characters. *International Journal of Emerging Technologies in Learning (IJET)*, *15*(06), 183. https://doi.org/10.3991/ijet.v15i06.12061

Temel, S. (2014). The effects of problem-based learning on pre-service teachers' critical thinking dispositions and perceptions of problem-solving ability. *South African Journal of Education*, *34*(1), 1–20. https://doi.org/10.15700/201412120936

Tsai, C.-W., & Chiang, Y.-C. (2013). Research trends in problem-based learning (PBL) research in e-learning and online education environments: A review of publications in SSCI-indexed journals from 2004 to 2012: Colloquium. *British Journal of Educational Technology*, *44*(6), E185–E190. https://doi.org/10.1111/bjet.12038

Ulger, K., & Imer, Z. (2013). The effect of problem based learning approach on students' creative thinking ability. *Hacettepe University Journal of Education*, *28*(1), 382–392.

Veli, B. (2014). The effects of a problem based learning approach on students attitude levels: A meta-analysis. *Educational Research and Reviews*, *9*(9), 272–276. https://doi.org/10.5897/ERR2014.1771

Verawati, N. N. S. P., & Hikmawati, H. (2019). Validitas Model Inkuiri yang Diintervensi Proses Reflektif untuk Melatih Kemampuan Berpikir Kritis Mahasiswa Calon Guru. *Prisma Sains: Jurnal Pengkajian Ilmu Dan Pembelajaran Matematika Dan IPA IKIP Mataram*. https://doi.org/10.33394/j-ps.v0i0.1408

Verawati, N. N. S. P., Hikmawati, & Prayogi, S. (2019). Conceptual Framework of Reflective-Inquiry Learning Model to Promote Critical Thinking Ability of Preservice Physics Teachers. *Journal of Physics: Conference Series*, *1397*, 012009. https://doi.org/10.1088/1742-6596/1397/1/012009

Verawati, N. N. S. P., Hikmawati, & Prayogi, S. (2021). The Effectiveness of reflective-inquiry learning model to improve preservice-teachers' critical thinking ability viewed from cognitive style. *Journal of Physics: Conference Series*, *1747*(1), 012010. https://doi.org/10.1088/1742-6596/1747/1/012010

Verawati, N. N. S. P., Prayogi, S., Gummah, S., Muliadi, A., & Yusup, M. Y. (2019). The Effect of Conflict-Cognitive Strategy in Inquiry Learning towards Pre-Service Teachers' Critical Thinking Ability. *Jurnal Pendidikan IPA Indonesia*, *8*(4). https://doi.org/10.15294/jpii.v8i4.21002

Wahyudi, P Verawati, N. N. S., Ayub, S., & Prayogi, S. (2018). Development of Inquiry-Creative-Process Learning Model to Promote Critical Thinking Ability of Physics Prospective Teachers. *Journal of Physics: Conference Series*, *1108*, 012005. https://doi.org/10.1088/1742-6596/1108/1/012005

Wahyudi, Verawati, N. N. S. P., Ayub, S., & Prayogi, S. (2019a). Effectiveness of Inquiry-Creative-Process Learning Model to Promote Critical Thinking Ability of Prospective Physics Teachers. *Journal of Physics: Conference Series*, *1417*, 012071. https://doi.org/10.1088/1742-6596/1417/1/012071

Wahyudi, W., Verawati, N. N. S. P., Ayub, S., & Prayogi, S. (2019b). The Effect of Scientific Creativity in Inquiry Learning to Promote Critical Thinking Ability of Prospective Teachers. *International Journal of Emerging Technologies in Learning (IJET)*, *14*(14), 122. https://doi.org/10.3991/ijet.v14i14.9532

Wartono, W., Diantoro, M., & Bartlolona, J. R. (2018). Influence of Problem Based Learning Learning Model on Student Creative Thinking on Elasticity Topics A Material. *Jurnal Pendidikan Fisika Indonesia*, *14*(1), 32–39. https://doi.org/10.15294/jpfi.v14i1.10654

Yew, E. H. J., & Goh, K. (2016). Problem-Based Learning: An Overview of its Process and Impact on Learning. *Health Professions Education*, *2*(2), 75–79. https://doi.org/10.1016/j.hpe.2016.01.004