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Effectiveness of problem-based learning models to improve learning outcomes of geography in the new normal learning era

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Article Info

ABSTRACT

Online learning causes teachers to be considered more active than students, so students' higher-order thinking skills decrease. Limited face-to-face learning is a new normal policy in the field of education. Learning models can be one way to recreate active learning to improve student's learning outcomes. This study determines the effectiveness of the problem-based learning (PBL) model in enhancing student learning outcomes of geography in new normal learning. This research is a nonequivalent pretest-posttest control group design. The population is all class XI social study (IPS) at Senior High School 13 Banjarmasin, Indonesia. The sample is used as the experimental group, namely XI IPS 3 totaling 17 students, and the sample is used as the control group, namely XI IPS 2 totaling 14 students. Data collection techniques use tests, non-test, interviews, and documentation. The results are the independent t-test in the experimental and control groups showed that the PBL model effectively improved student learning outcomes in geography in the new normal learning era. The implication is the PBL model can be applied to new normal learning by teachers by elaborating with learning technology which is still adapted to the characteristics of students so that learning objectives are achieved.

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1. INTRODUCTION

Online learning is a learning method in which material and tests in learning activities are disseminated online with media such as computers, laptops, and cellphones and with the help of applications such as Google Classroom, Google Meet, Zoom, and other applications so that this learning is different from face-to-face learning methods [1]–[3]. Constraints faced during the online learning process include the lack of knowledge of information technology and online learning support facilities, the availability of quotas and networks, internet access, learning becomes boring, and many students are found to be less active and find it difficult to express their aspirations, the capacity of teaching digital, and opinions compared to face-to-face learning [4]–[8]. Obstacles to online learning can slowly decrease along with the control of COVID-19 cases and face-to-face learning (PTM) policies in the new normal learning era [9], [10]. In line with the central government's approach, the city of Banjarmasin will 100% implement face-to-face learning in the new normal learning era in 2022 while still implementing strict health protocols.

The results of observations at Senior High School or SMA Negeri 13 Banjarmasin, Indonesia found that the problem in learning geography, one of the subjects in the social studies department of SMA during

the new normal learning, was the learning process's weakness. Learning in the new normal era is still teacher-centered, where the teacher does not encourage student activity, does not develop students' thinking skills, and only directs students to the ability to memorize information or material. Teacher-centered learning means that the teacher dominates the activity in the learning process by delivering subject matter through lectures and assignments. This learning is called conventional learning or direct learning [11], which is dominated by the view that knowledge is a fact that must be memorized, which causes students to become passive. Students' ways of thinking need to develop more critically of the problems around them [12], [13]. This is supported by the results of interviews conducted with several students who showed that learning geography seemed monotonous, memorizing, and dull. This causes geography to be one of the less attractive subjects to students, so student learning outcomes in geography still need to be below the minimum completeness criteria value of 70. Teachers often find that most of the students' answers could be more optimal because they are indicated to be copying from online articles, which causes their ability to analyze in problem-solving still needs to improve.

Problems in learning in the new normal era are also felt by teachers, where teachers still need help choosing and implementing a suitable learning model. Other information obtained from several schools, teachers need to learn more about learning models that optimize student activities and learning outcomes, so teachers still use conventional methods. This condition causes learning problems in the new normal era to be more complex, including student learning outcomes that still need to be improved, low interest in learning geography, and typical students' critical thinking skills. For this reason, the learning paradigm must be changed from teacher-centered to student-centered to solve the problem. Students are guided and facilitated in building their knowledge base and are given real learning experiences. Thus, the selection and application of learning models play an important role in achieving learning objectives.

The learning model plays an important role in education related to internal representation. The problem-based learning (PBL) model has used pedagogical philosophy for the last 50 years [14]. PBL model in the 2013 curriculum can be the leading choice as a learning model because this model refers to complex learning and uses open problems so that teachers can encourage students to take more active roles [15], [16]. The problems used in this model are problems that are closely related to the real world. The closer to the real world, the better the effect on improving students' skills [17]. The use of student-centered PBL models is expected to help students construct existing problems and logical thought, so they can then understand and apply them [18]–[20] so students can think critically, collaborate in small groups, problem-solving ability, improve their ability to communicate effectively, and lifelong-learning [21], [22]. Implementing the PBL model requires a series of cognitive and metacognitive strategies to practice problem-solving skills. To solve problems, contextual understanding and various literacy are needed as a reference source through the steps of reading, learning, planning, drawing (if required), verifying, and answering questions so that they can find solutions to problems [23].

Various studies in education admit that learning success can be achieved by applying this PBL model. This model makes learning more active and not boring so that it can improve student learning outcomes followed by increasing scientific process skills [24] and has a significant influence on students' problem-solving abilities [25], [26]. The research was conducted to improve the quality of learning by stimulating students' interest and critical thinking skills. Previous studies specifically for the PBL model have shown the effectiveness of the PBL model in improving skills, including oral skills [27]–[29] and high school geography student learning outcomes and knowledge [30]–[32], chemical [24], [33], and math [34]. These various studies show that the PBL model can improve students' other abilities, such as problem-solving, critical thinking, and scientific process skills, and student learning outcomes. This study rarely uses the PBL model in geography learning, especially in the new normal era. Therefore, it is necessary to research to test the effectiveness of the PBL model in improving geography learning outcomes in high school during the new normal learning period so that it can fill the gaps related to learning models in the field of education.

2. RESEARCH METHOD

This research uses quantitative research with quasi-experiments. The effectiveness of PBL was tested using a nonequivalent pretest-posttest control group design as seen in Table 1. This design uses two groups (experimental and control) as research samples which are randomly distributed. Both groups were observed and analyzed in this design before and after being treated [35].

Table 1. Nonequivalent pretest-posttest control group design [36]

Group	Pretest	Treatment	Posttest
A	O_{A1}	X_1	O_{A1}
B	O_{B1}	X_2	O_{B2}

This research was conducted at SMA Negeri 13 Banjarmasin, South Kalimantan. The total number of students involved in this study was in class XI social studies or IPS, which consisted of XI IPS 1 and XI IPS 2. The two classes were grouped into the experimental group (XI IPS 1) and the control class (XI IPS 2). The choice of these two class groups was due to homogeneous students, less active learning, and low higher-order thinking skill (HOTs) for geography subjects. Both groups (experimental class and control class) were given a pretest before treatment. This aims to determine the homogeneity and understanding of the material being taught. The two groups were given separate instructions; the experimental group was treated with the PBL model, and the control group used the conventional method. After the treatment, both groups were given a posttest to measure their effectiveness. The teaching material used in this study is population dynamics in the even semester of the 2021/2022 academic year.

The instrument used is in the form of multiple-choice tests to encourage students' high order thinking skills. The multiple-choice questions of 20 questions were taken from several geography textbooks for class XI SMA recommended by geography teachers. Students of XI IPS 1 carried out the validation test of multiple-choice questions at SMA Negeri 13 Banjarmasin, which was different from the research sample. Validation test using product moment correlation. A reliability test is also used to determine the consistency of multiple-choice questions to be used repeatedly, and analysis in the form of Cronbach's negligent test is used. The analysis of research data using the N-Gain score test is known from the comparison of pretest and posttest values, which are interpreted according to the gain score criteria in Table 2 [37].

Table 2. Gain score criteria

Score (%)	Remark
<40	Not effective
40–55	Less effective
56–75	Enough effective
>76	Effective

To determine the effectiveness of the PBL model on the high-order thinking skills of class XI IPS students, an independent sample t-test was used, which previously went through the normality and homogeneity tests. The Kolmogorov-Smirnov test determines if the data is normally distributed, which is said to be normally distributed if the value of Sig. >0.05. The homogeneity test of the data used the Levene test, in which the data was said to be homogeneous if the value of Sig. >0.05. All data were tested using SPSS version 26. The results of the independent sample t-test were used as hypothesis testing, namely the use of a PBL model that effectively improved the learning outcomes of class XI IPS students at SMA 13 Banjarmasin.

3. RESULTS
3.1. Validity test and reliability test
The test of the validity of the questions shows that the items used in this instrument are valid so that they can be distributed to both experimental and control groups. The results showed that the items used as pretest and posttest were declared valid, Sig. (2-tailed)<0.05. This means that the question instrument is suitable for use by the experimental group and the control group. A reliability test is used to determine the consistency of the questions repeatedly. The reliability test results showed the Cronbach Alpha value of 0.867>0.6. This means that 20 multiple-choice items are declared reliable and can be used as data collection instruments.

3.2. N-Gain score test
This N-gain score test showed an increase and the effectiveness of the PBL model in the experimental group compared to conventional methods in the control class. Table 3 shows the N-gain score in the experimental group and control class. Thus, it can be concluded that the use of the PBL model is quite effective in improving students' learning outcomes in the new normal learning era.

Table 3. Result of N-Gain score test

No	Group	N-Gain score (%)	Remark
1	Experiment class	69.26	Enough effective
2	Control class	41.43	Less effective

3.3. Different test

The difference in the learning outcomes of the students of class XI IPS who were treated with the PBL model compared to the conventional method. It was based on the data of the students' pretest and posttest scores with the independent sample t-test. However, before the independent sample t-test, the normality and homogeneity tests were carried out as prerequisite tests.

3.3.1. Normality test

The results of this normality test are used to determine whether the data distribution is normally distributed. Table 4 shows the normality test results of the pretest and posttest scores in the experimental and control classes. Interpretation of normality test data, if the value of Sig. >0.05, then the data is said to be normally distributed. Based on Table 4, it shows that the pretest and posttest data, both in the experimental class and the control class, are normally distributed.

Table 4. Result of N-Gain score test

No	Category of question	Sig. Score	
		Experiment class	Control class
1	Pretetst	0.054	0.750
2	Posttest	0.254	0.250

3.3.2. Homogeneity test

The homogeneity test is used to provide confidence that the population of this study has a homogeneous character (not much different). Homogeneity test using the Levene test found that the data is homogeneous with the value of Sig. (0.794)>0.05. The independent sample t-prerequisite test results concluded that the data were normal and homogeneous. Then both groups were given independent sample t-tests for the pretest and posttest. The independent sample t-test statistics for the pretest scores are shown in Table 5. Based on the table, the independent sample t-test statistic used a significance level of 5% in comparing the pretest scores of both the experimental group (mean=61.47, standard deviation=11.959) and the control group (mean=65.36 and standard deviation=13.511) with an average difference 1552. The p-value (0.403)>0.05, then the pretest values in the experimental and control groups had no significant difference.

Table 5. Independent sample t-test in the experimental group and control in the pretest

No	Group	Mean	Standard deviation	Standard error deviation	t-value	p-value	Remark
1	Experiment class	61.47	11.959	2.900	0.849	0.403	Not Sig.
2	Control class	65.36	13.511	3.611			

After being given treatment, both groups were given a posttest to see the treatment's effect. The independent sample t-test statistic was used to compare the post-test scores in the experimental group with PBL treatment and the control group with the conventional method, as shown in Table 6. The table shows the results of the independent sample t-test using a significance level of 5% by comparing the post-test scores of both the experimental group (mean=87.35 and standard deviation=7.097) and the control group (mean=81.43 and standard deviation=7.949) with an average difference 0.852. The p-value (0.037)<0.05. Then the hypothesis test using the independent sample t-test concluded that there was a significant difference in the improvement of student learning outcomes in class XI IPS with the PBL model compared to the lecture model (conventional method).

Table 6. Independent sample t-test in the experimental group and control in the posttest

No	Group	Mean	Standard deviation	Standard error deviation	t-value	p-value	Remark
1	Experiment class	87.35	7.097	1.721	2.191	0.037	Sig.
2	Control class	81.43	7.949	2.124			

4. DISCUSSION

New normal learning after the COVID-19 pandemic is carried out. Face-to-face learning is limited to all levels of education in Indonesia. This new normal learning is seen as a change in people's way of life and behavior to remain productive by following strict health protocols during activities in public spaces [38],

[39]. Then the teacher began to adapt to follow the new normal learning rules. One is applying a learning model with a scientific approach, namely the PBL model. This PBL model is principled in utilizing problems that occur in the surrounding environment, which are studied comprehensively so that it can improve students' cognitive abilities [40]–[42]. The advantages of this model include that students are encouraged to have the ability to solve problems in real conditions, the ability builds knowledge independently, use relevant knowledge reference sources, communicate skills, construct a situational, and reduce student learning difficulties both individually and in groups in peer teaching [43]–[46].

The use of the PBL model during the new normal learning period is assisted by online learning media such as google meet and Google Forms in implementing the PBL learning syntax. In this study, the learning syntax in the PBL model in the new normal era is passed through stages including: i) Problem orientation, namely giving pretests to students before students observe the problem that becomes the object of learning in the form of population dynamics; ii) Organization of learning activities, namely by submitting various questions to the problem being studied; iii) Problem investigation, namely investigation activities carried out by individuals or groups to solve the problem being studied; iv) Presentation of results, through presentations based on data analysis, discussion results, and relevance of literature; and v) Process evaluation [47].

At the beginning of the meeting, the teacher gave less material delivery in general by the teacher to students compared to conventional methods. Submission of material is an important factor in student learning, even though students must be more active in building knowledge from other reference sources. The teacher also provides an orientation related to the contextual problems of population dynamics. This can happen because contextual and meaningful issues for students will have a stronger impact [48], [49]. At this initial meeting, students still needed help understanding the population problems that occurred in the surrounding community. However, at the next meeting, students began to understand formulating problems based on initial observation activities during the beginning of learning and using relevant literature. Using relevant literature can build students' knowledge [50], [51]. Student responses are also quite good in answering questions from the teacher.

Presenting problems at the beginning of learning can attract students' attention to think critically about problems that exist in everyday life through learning media. The teacher also gives questions containing population dynamics problems that students in groups must analyze. Group learning will build a knowledge base based on mutual interaction and understanding [52]. At this stage, the teacher provides problem instructions as a problem-solving guide to make it easier for students to analyze and solve problems. Students trained to analyze empirical data will find it easier to form a master of concepts [53]–[55]. So this stage is the problem orientation stage which involves students' thinking and analyzing components related to certain problems [51], [52]. Through discussion activities, students can learn to give ideas or opinions in solving problems and learn to collaborate and work together. Through discussion, students can analyze problems from various perspectives [56]–[58]. In addition, students need knowledge in collaborating, making the right decisions, and good teamwork in solving problems. There is a relationship between teamwork skills and existing academic experience [59], [60]. This is supported by the fundamental theory underlying social constructivism learning which emphasizes learning through social interaction [61]. In addition, students present their work and continue with the teacher evaluation. The teacher evaluates the provision of post-test questions to students. This PBL model creates a conducive learning atmosphere and supports the learning process to grow students' abilities, such as improving learning outcomes, thinking independently, respecting the ongoing learning process, and forming students' self-confidence [43], [62].

The learning process of this new normal era with the adaptation of learning carried out by teachers in the classroom. In the experimental class that applies the PBL model, almost all students in the study group help each other solve the problems compared to the control class that uses the control class with the conventional method (lecture method). Students' enthusiasm in teaching and learning activities makes the learning atmosphere active to improve the mindset and increase each student's knowledge. Besides that, PBL can also help students to be active and independent in developing problem-solving thinking skills through searching data so that rational and authentic solutions are obtained [68]. This is in line with previous research that the PBL model helps to create an active learning atmosphere that involves students so that it is useful for fostering their self-confidence, increasing their thinking patterns, building their continuous knowledge of real-world problems, and using access tools to improve their problem-solving competences [62], [63]. The PBL model, in its implementation, provides opportunities for students to understand learning by solving problems given by the teacher by forming groups. The involvement of students in groups provides an advantage in solving real problems in defining the knowledge and investigations needed to solve problems. PBL facilitates students in solving problems and determining new ways so that they can solve existing problems [64]. This embodies student success in learning through improving cognitive and affective aspects of geography, especially population dynamics. So, problem-solving skills need to be improved because they are one of the needs of this century. This ability makes students capable of dealing with various problems and

improves the way students think to be more active and creative [65], [66] and can adapt quickly to the 4.0 education era [67], [68].

The selection of an effective model in the new normal era is a challenge for teachers in improving the learning outcomes of geography students during the COVID-19 pandemic. Generally, a good learning model has systematic characteristics and procedures, learning outcomes determined according to the criteria, and functions such as guidelines, curriculum development, teaching materials, and revisions in the learning [69]. The effectiveness of this model can be designed so that students can have good learning outcomes, including building their knowledge abilities, skills, and skills in problem-solving and social skills. The effectiveness of the application of the PBL model can improve student learning outcomes in geography by adjusting the new normal learning [70], [12], so this is certainly very influential on the mindset of students and allows students to think more critically, logically, and creatively in solving problems at a high-level [71] so, as to get satisfactory learning outcomes. The effectiveness of this model, in general, can be influenced by several factors, such as the presence of internal factors (in students) such as physical, psychological, and fatigue factors [72], external factors (from outside the students themselves) and learning approach factors [73], [74].

To improve learning outcomes by applying the PBL model, the teacher usually acts as a facilitator and mediator to assist students in constructing student knowledge effectively through problems given by the teacher so that students collect appropriate information and get problem-solving, as well as the final result where the teacher helps students. Prepare work as a result of problem-solving in the form of a reported [54], [75]. However, in this PBL model research, the teacher as a facilitator provides a problem-solving guide to students so that students are more focused on analyzing and finding solutions to existing problems. It means that the role of the facilitator and student is part of the feedback for decision-making involving students in the learning [76]. Student learning outcomes were also measured through the provision of post-tests with the type of questions of high-order thinking skills via a Google Form. It was found that students met the minimum completeness criteria and maximum learning objectives. This is supported by previous research, which states that the PBL model can effectively improve student learning outcomes in geography during the new normal learning period. So, the PBL model can fill the gaps related to the development of learning models in each teacher's world of education. The findings have implications that PBL is a learning model that can improve students' learning outcomes and high-order thinking skills with the help of learning technology adapted to each student's characteristics in the era of education 4.0.

5. CONCLUSION

The PBL model effectively improves student learning outcomes in geography during the new normal learning period compared to conventional methods (lecture method). In the PBL model in this study, in the learning process, the teacher acts as a facilitator and mediator for students in solving problems using a problem-solve guide so students can solve problems more focused. The increase in student geography learning outcomes is seen from the posttest results using HOTS questions through online media such as Google Forms; it is found that the students' minimum completeness criteria have been met. This research implies that new normal learning makes teachers implement this PBL model elaborate with learning technology adapted to students' characteristics to achieve learning objectives. However, this research still has limitations, so further research is recommended so that the scope of this research is expanded and carried out on other subjects besides geography for class XI IPS.

REFERENCES

[1]   Z. Ling, J. Na, S. Yan-Li, and J. Sriyanto, "School culture and professional development of school teachers from urban and rural areas in China," *Cakrawala Pendidikan*, vol. 39, no. 3, pp. 609–619, Oct. 2020, doi: 10.21831/cp.v39i3.31580.

[2]   L. D. Prasojo *et al.*, "Managing digital learning environments: Student teachers' perception on the social networking services use in writing courses in teacher education," *Turkish Online Journal of Educational Technology*, vol. 16, no. 4, pp. 42–55, 2017.

[3]   Z. Solomon, N. Ajayi, R. Raghavjee, and P. Ndayizigamiye, "Lecturers' perceptions of virtual reality as a teaching and learning platform," in *Communications in Computer and Information Science*, vol. 963, 2019, pp. 299–312. doi: 10.1007/978-3-030-05813-5_20.

[4]   M. Mispandi, A. Riswanto, and I. Ilfa, "The effect of online learning on student learning interest and motivation," *Edueksos Jurnal Pendidikan Sosial & Ekonomi*, vol. 11, no. 2, pp. 200–209, 2022, doi: 10.24235/edueksos.v11i2.12132.

[5]   M. Adnan, "Online learning amid the COVID-19 pandemic: Students perspectives," *Journal of Pedagogical Sociology and Psychology*, vol. 1, no. 2, pp. 45–51, 2020, doi: 10.33902/jpsp.2020261309.

[6]   Mailizar, A. Almanthari, S. Maulina, and S. Bruce, "Secondary school mathematics teachers' views on e-learning implementation barriers during the COVID-19 pandemic: The case of Indonesia," *Eurasia Journal of Mathematics, Science and Technology Education*, vol. 16, no. 7, 2020, doi: 10.29333/EJMSTE/8240.

[7]   E. Liguori and C. Winkler, "From Offline to Online: Challenges and Opportunities for Entrepreneurship Education Following the COVID-19 Pandemic," *Entrepreneurship Education and Pedagogy*, vol. 3, no. 4, pp. 346–351, 2020, doi:

10.1177/2515127420916738.

[8]   F. Delita, "The Challenges of E-Learning Implementation During the Covid-19 Pandemic in Senior High School," *Journal of Digital Learning and Education*, vol. 1, no. 3, pp. 150–157, Dec. 2021, doi: 10.52562/jdle.v1i3.257.

[9]   Y. B. Hermanto and V. A. Srimulyani, "The Challenges of Online Learning During the Covid-19 Pandemic," *Jurnal Pendidikan dan Pengajaran*, vol. 54, no. 1, p. 46, Mar. 2021, doi: 10.23887/jpp.v54i1.29703.

[10] G. Kaur, "Digital Life: Boon or Bone In Teaching Sector on COVID-19," *CLIO an Annual Interdisciplinary Journal of History*, vol. 6, no. 6, pp. 416–427, 2020.

[11] P. Freire, "Pedagogy of the Oppressed: 50th Anniversary Edition," *International Journal of Christianity & Education*, p. 205699711983792, 2019.

[12] B. D. Permatasari, G. Gunarhadi, and R. Riyadi, "The influence of problem based learning towards social science learning outcomes viewed from learning interest," *International Journal of Evaluation and Research in Education (IJERE)*, vol. 8, no. 1, p. 39, Mar. 2019, doi: 10.11591/ijere.v8i1.15594.

[13] R. K. Shah, "Similarities and Difference between LCT and TCT," *International Journal of Creative Research Thoughts*, vol. 8, no. 7, pp. 5694–5719, 2020.

[14] D. Kilińska and T. Ryberg, "Connecting Learning Analytics and Problem-Based Learning – Potentials and Challenges," *Journal of Problem Based Learning in Higher Education*, vol. 7, no. 1, pp. 1–24, 2019, doi: 10.5278/ojs.jpblhe.v7i1.2545.

[15] W. Y. Silviariza, S. Sumarmi, and B. Handoyo, "Improving Critical Thinking Skills of Geography Students with Spatial-Problem Based Learning (SPBL)," *International Journal of Instruction*, vol. 14, no. 3, pp. 133–152, Jul. 2021, doi: 10.29333/iji.2021.1438a.

[16] M. A. Almulla, "The Effectiveness of the Project-Based Learning (PBL) Approach as a Way to Engage Students in Learning," *SAGE Open*, vol. 10, no. 3, p. 215824402093870, Jul. 2020, doi: 10.1177/2158244020938702.

[17] M. . Amir, *Educational Innovation through Problem Based Learning: How Educators Empower Students in the Knowledge Age*. Jakarta: Prenada Media Group, 2009.

[18] X. Xu, Y. Wang, S. Zhang, and F. Liu, "Performance of Problem-Based Learning Based Image Teaching in Clinical Emergency Teaching," *Frontiers in Genetics*, vol. 13, no. June, pp. 1–11, 2022, doi: 10.3389/fgene.2022.931640.

[19] A. S. Manurung, A. Halim, and A. Rosyid, "The Role of Problem Based Learning Learning in Improving Student Character Education," *Jurnal Basicedu*, vol. 7, no. 1, pp. 169–170, Jan. 2023, doi: 10.31004/basicedu.v7i1.4279.

[20] A. A. Rafiq, M. B. Triyono, and I. W. Djatmiko, "The Integration of Inquiry and Problem-Based Learning and Its Impact on Increasing the Vocational Student Involvement," *International Journal of Instruction*, vol. 16, no. 1, pp. 659–684, Jan. 2023, doi: 10.29333/iji.2023.16137a.

[21] C. S. Farias, R. A. Dantas de Oliveira, and M. R. M. P. Luz, "A problem-based learning course to teach Brazilian biology students about the viral hepatitis from a health geography perspective," *Journal of Geography in Higher Education*, vol. 47, no. 3, pp. 432–450, May 2023, doi: 10.1080/03098265.2022.2087213.

[22] S. S. Ali, "Problem Based Learning: A Student-Centered Approach," *English Language Teaching*, vol. 12, no. 5, p. 73, Apr. 2019, doi: 10.5539/elt.v12n5p73.

[23] A. S. Nur, K. Kartono, Z. Zaenuri, and R. Rochmad, "Solving mathematical word problems using dynamic assessment for scaffolding construction," *International Journal of Evaluation and Research in Education*, vol. 11, no. 2, pp. 649–657, 2022, doi: 10.11591/ijere.v11i2.22535.

[24] A. Gurses, C. Dogar, and E. Geyik, "Teaching of the Concept of Enthalpy Using Problem Based Learning Approach," *Procedia - Social and Behavioral Sciences*, vol. 197, pp. 2390–2394, Jul. 2015, doi: 10.1016/j.sbspro.2015.07.298.

[25] Sutarto, I. Dwi Hastuti, D. Fuster-Guillén, J. P. Palacios Garay, R. M. Hernández, and E. Namaziandost, "The Effect of Problem-Based Learning on Metacognitive Ability in the Conjecturing Process of Junior High School Students," *Education Research International*, vol. 2022, pp. 1–10, Jan. 2022, doi: 10.1155/2022/2313448.

[26] J.-S. Choi, S.-M. Bae, S.-J. Shin, B.-M. Shin, and H.-J. Lee, "Effects of Problem-Based Learning on the Problem-Solving Ability and Self-Efficacy of Students Majoring in Dental Hygiene," *International Journal of Environmental Research and Public Health*, vol. 19, no. 12, p. 7491, Jun. 2022, doi: 10.3390/ijerph19127491.

[27] C. N. Wuntu, Y. Singal, and O. A. Rorintulus, "The Implementation of Project Based Learning (PBL) in Improving Students' Speaking Skill at SMA Yadika Kopandakan II," *International Journal of English and Applied Linguistics (IJEAL)*, vol. 2, no. 3, pp. 387–398, Dec. 2022, doi: 10.47709/ijeal.v2i3.1882.

[28] T. Gomez-del Rio and J. Rodriguez, "Design and assessment of a project-based learning in a laboratory for integrating knowledge and improving engineering design skills," *Education for Chemical Engineers*, vol. 40, pp. 17–28, Jul. 2022, doi: 10.1016/j.ece.2022.04.002.

[29] D. Qondias, W. Lasmawan, N. Dantes, and I. B. P. Arnyana, "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*, vol. 9, no. 2, pp. 62–70, Mar. 2022, doi: 10.20448/jeelr.v9i2.3812.

[30] L. M. Drăghicescu, A.-M. Petrescu, G. C. Cristea, L. M. Gorghiu, and G. Gorghiu, "Application of Problem-based Learning Strategy in Science Lessons – Examples of Good Practice," *Procedia - Social and Behavioral Sciences*, vol. 149, pp. 297–301, Sep. 2014, doi: 10.1016/j.sbspro.2014.08.245.

[31] E. Ersoy and N. Başer, "The Effects of Problem-based Learning Method in Higher Education on Creative Thinking," *Procedia - Social and Behavioral Sciences*, vol. 116, pp. 3494–3498, Feb. 2014, doi: 10.1016/j.sbspro.2014.01.790.

[32] G. Gorghiu, L. M. Drăghicescu, S. Cristea, A.-M. Petrescu, and L. M. Gorghiu, "Problem-based Learning - An Efficient Learning Strategy in the Science Lessons Context," *Procedia - Social and Behavioral Sciences*, vol. 191, pp. 1865–1870, 2015, doi: 10.1016/j.sbspro.2015.04.570.

[33] S. Temel, "The effects of problem-based learning on pre-service teachers' critical thinking dispositions and perceptions of problem-solving ability," *South African Journal of Education*, vol. 34, no. 1, pp. 1–20, 2014, doi: 10.15700/201412120936.

[34] R. P. Djunaedy, "Implementation of online learning with problem based learning model to increase students' activeness in learning mathematics class XI MM 3 SMKN 5 Malang (in Indonesian)," *Laplace : Jurnal Pendidikan Matematika*, vol. 3, no. 2, pp. 95–108, Oct. 2020, doi: 10.31537/laplace.v3i2.376.

[35] M. S. Abdurrahman, *Introduction to research methodology & statistics: a guide for students and supervisors*, no. October. Zaria: Ahmadu Bello University Press, 2017.

[36] A. Ibrahim, A. Alang, B. Madi, M. A. Ahmad, and Dawanti, *Research Methodology (in Indonesian)*. Makassar: Gunadarma Ilmu, 2018.

[37] P. K. Nashiroh, F. Ekarini, and R. D. Ristanto, "The effectiveness of the application of jigsaw type cooperative learning model with mind map on pedagogical ability of students of training program development course (in Indonesian)," *Jurnal Pendidikan Teknologi dan Kejuruan*, vol. 17, no. 1, p. 43, Jan. 2020, doi: 10.23887/jptk-undiksha.v17i1.22906.

[38]   E. Diana, N. Rahmah, and M. Rofiki, "Blended Learning Management: The Efforts to Develop Students' Soft Skills in the New Normal Era," *Jurnal Basicedu*, vol. 6, no. 3, pp. 4272–4281, Apr. 2022, doi: 10.31004/basicedu.v6i3.2835.

[39]   E. Birer, E. Hasgül, and E. Can, "Transformation of home environments in pandemic: the concept of 'life fits into room' in the new normal," *Open House International*, vol. 47, no. 1, pp. 87–106, Feb. 2022, doi: 10.1108/OHI-02-2021-0046.

[40]   M. J. Jacobson, J. A. Levin, and M. Kapur, "Education as a complex system: conceptual and methodological implications," *Educational Researcher*, vol. 48, no. 2, pp. 112–119, 2019, doi: 10.3102/0013189X19826958.

[41]   S. Mennin, "Small-group problem-based learning as a complex adaptive system," *Teaching and Teacher Education*, vol. 23, no. 3, pp. 303–313, Apr. 2007, doi: 10.1016/j.tate.2006.12.016.

[42]   Y. Pantiwati, F. H. Permana, and T. Kusniarti, "The relationship between capability dimension and cognitive dimension ability of grade VII middle school students," in *AIP Conference Proceedings*, 2020, vol. 2215, p. 40010. doi: 10.1063/5.0000556.

[43]   D. Rhonda and J. Gabriel, "Motivation heightens and independent thinking deepens: Undergraduate students share their experiences of PBL while learning Microeconomics," *Educational Research and Reviews*, vol. 17, no. 8, pp. 227–233, Aug. 2022, doi: 10.5897/ERR2022.4258.

[44]   A. Wirantaka and H. S. R. Sukarno, "Investigating the Implementation of Problem-Based Learning (PBL) in English Teaching and Learning," in *Proceedings of the International Conference on Sustainable Innovation on Humanities, Education, and Social Sciences (ICOSI-HESS 2022)*, Paris: Atlantis Press SARL, 2022, pp. 260–273. doi: 10.2991/978-2-494069-65-7_24.

[45]   H. Li, Z. Lu, H. Wu, and X. Zhang, "Effective Strategies of PBL Teaching Mode in China's Higher Education," in *Proceedings of the 2nd International Conference on Education, Language and Art (ICELA 2022)*, Paris: Atlantis Press SARL, 2023, pp. 207–216. doi: 10.2991/978-2-38476-004-6_27.

[46]   X. Liu, Y. Yang, and J. W. Ho, "Students Sense of Belonging and Academic Performance via Online PBL: A Case Study of a University in Hong Kong during Quarantine," *International Journal of Environmental Research and Public Health*, vol. 19, no. 3, p. 1495, Jan. 2022, doi: 10.3390/ijerph19031495.

[47]   D. Atminingsih, A. Wijayanti, and A. Ardiyanto, "The effectiveness of audio visual media Pbl learning model on learning outcomes of class III SDN Baturagung (in Indonesian)," *Mimbar PGSD Universitas Pendidikan Ganesha*, vol. 7, 2019, doi: 10.23887/jjpgsd.v7i2.17560.

[48]   R. Rahmadani, "Method of application of problem based learning model (PBL) (in Indonesian)," *Lantanida Journal*, vol. 7, no. 1, p. 75, Jul. 2019, doi: 10.22373/lj.v7i1.4440.

[49]   A. García de la Vega, "The GeoScenario: A Methodological Resource From Problem-Based Learning (PBL) in Landscape Teaching," in *Didactic Strategies and Resources for Innovative Geography Teaching*, 2022, pp. 51–78. doi: 10.4018/978-1-7998-9598-5.ch003.

[50]   H. E. Vidergor, "Effects of Innovative Project Based Learning Model on Students' Knowledge Acquisition, Cognitive Abilities, and Personal Competences," *Interdisciplinary Journal of Problem-Based Learning*, vol. 16, no. 1, Aug. 2022, doi: 10.14434/ijpbl.v16i1.31183.

[51]   H. Li, H. Deng, and Y. Zhang, "Application of the PBL Model Based on Deep Learning in Physical Education Classroom Integrating Production and Education," *Computational Intelligence and Neuroscience*, vol. 2022, pp. 1–12, Feb. 2022, doi: 10.1155/2022/4806763.

[52]   E. Barkley, C. Howell Major, and K. Cross, *Collaborative learning techniques: a handbook for college faculty*. New Jearsey: John Wiley & Sons, 2014.

[53]   J. R. Batlolona and H. F. Souisa, "Problem based learning: Students' mental models on water conductivity concept," *International Journal of Evaluation and Research in Education*, vol. 9, no. 2, pp. 269–277, 2020, doi: 10.11591/ijere.v9i2.20468.

[54]   F. I. Farhan, "Modified Project-Based Learning in Geography : A Better Approach," *Foundasia*, vol. 13, no. 2, pp. 71–76, 2022.

[55]   C. E. Hmelo-Silver, "Problem-based learning: what and how do students learn?," *Educational Psychology Review*, vol. 16, no. 3. pp. 235–266, Sep. 2004. doi: 10.1023/B:EDPR.0000034022.16470.f3.

[56]   Z. Abuduo and B. Yang, "Research on Blended Teaching Practice of Literature Theory Under the Concepts of PBL and OBE," in *Proceedings of the 2nd International Conference on Education: Current Issues and Digital Technologies (ICECIDT 2022)*, Paris: Atlantis Press SARL, 2023, pp. 619–631. doi: 10.2991/978-2-494069-02-2_68.

[57]   K. Smith *et al.*, "Principles of Problem-Based Learning (PBL) in STEM Education: Using Expert Wisdom and Research to Frame Educational Practice," *Education Sciences*, vol. 12, no. 10, p. 728, Oct. 2022, doi: 10.3390/educsci12100728.

[58]   B. L. Song, K. L. Lee, C. Y. Liew, R. C. Ho, and W. L. Lin, "Business students' perspectives on case method coaching for problem-based learning: impacts on student engagement and learning performance in higher education," *Education + Training*, vol. 64, no. 3, pp. 416–432, Jan. 2022, doi: 10.1108/ET-03-2021-0106.

[59]   A. Lozano-Rodríguez, F. I. García-Vázquez, C. Zubieta-Ramírez, and C. S. Lopez-Cruz, "Competencies associated with Semestre i and its relationship to academic performance," *Higher Education, Skills and Work-Based Learning*, vol. 10, no. 2, pp. 387–399, Dec. 2019, doi: 10.1108/HESWBL-07-2019-0092.

[60]   M. J. Martínez-Romero, A. M. Priego de la Cruz, C. Ferrer-García, and M. P. Casado-Belmonte, "The effect of previous experience with working in groups on students' academic performance in the accounting discipline," *Revista de Contabilidad*, vol. 24, no. 2, pp. 153–167, Jul. 2021, doi: 10.6018/rcsar.359561.

[61]   N. S. Mohamad and T. R. Muhamad Romli, "Application of Theory of Social Constructivism in Teaching Arabic Teachers to Apply Higher Order Thinking Skill," *International Journal of Academic Research in Progressive Education and Development*, vol. 10, no. 2, Jun. 2021, doi: 10.6007/IJARPED/v10-i2/10130.

[62]   I. Yunitasari and A. T. A. Hardini, "Application of the Pbl model to increase learners' activeness in online learning at elementary school (in Indonesian)," *Jurnal Basicedu*, vol. 5, no. 4, pp. 1700–1708, Jun. 2021, doi: 10.31004/basicedu.v5i4.983.

[63]   S. Ludwig and A. Rausch, "The relationship between problem-solving behaviour and performance – Analysing tool use and information retrieval in a computer-based office simulation," *Journal of Computer Assisted Learning*, vol. 39, no. 2, pp. 617–643, Apr. 2023, doi: 10.1111/jcal.12770.

[64]   N. S. Ismail, J. Harun, M. A. Z. M. Zakaria, and S. M. Salleh, "The effect of Mobile problem-based learning application DicScience PBL on students' critical thinking," *Thinking Skills and Creativity*, vol. 28, pp. 177–195, Jun. 2018, doi: 10.1016/j.tsc.2018.04.002.

[65]   L. Bao and K. Koenig, "Physics education research for 21st century learning," *Disciplinary and Interdisciplinary Science Education Research*, vol. 1, no. 1, p. 2, Dec. 2019, doi: 10.1186/s43031-019-0007-8.

[66]   R. B. Rudibyani, R. Perdana, and E. Elisanti, "Development of Problem-Solving-Based Knowledge Assessment Instrument in Electrochemistry," *International Journal of Instruction*, vol. 13, no. 4, pp. 957–974, Oct. 2020, doi: 10.29333/iji.2020.13458a.

[67]   D. A. Setyarini, Z. A. Imam Supardi, and Elok Sudibyo, "Improving Senior High School Students' Physics Problem-solving Skills Through Investigated Based Multiple Representation (IBMR) Learning Model," *IJORER : International Journal of Recent*

Educational Research, vol. 2, no. 1, pp. 42–53, Jan. 2021, doi: 10.46245/ijorer.v2i1.74.

[68] J. Maknun, "Physics problem solving skills of civil engineering students by implementing problem-based learning," *Review of International Geographical Education Online*, vol. 11, no. 3, pp. 594–603, 2021, doi: 10.33403/rigeo.800525.

[69] C. Cioc, N. Haughton, S. Cioc, and J. Napp, "A Model for incorporating information literacy and collaboration in a project-based learning pedagogical exercise with application to a fluid mechanics course," *International Journal of Mechanical Engineering Education*, vol. 50, no. 4, pp. 955–977, Oct. 2022, doi: 10.1177/03064190221081450.

[70] M. Khusna, Sudaryanto, and D. Dian, "Implementation of problem based learning (PBL) model based on blended learning to improving motivation and learning outcomes in 6th grade students of SD Muhammadiyah Banjaran (in Indonesian)," in *Teacher Professional Education Proceedings ((n Indonesia)*, pp. 1313–1323.

[71] S. Wardani, "The Effectiveness of Problem Based Learning Model (Pbl) on the Material of Whole Numbers and Fractions in Improving Higher Order Thinking Skills (Hots) of Class Vii Students of Smpn 6 Salatiga in the 2019/2020 Academic Year," Institut Agama Islam Negeri (IAIN) Salatiga, 2019.

[72] Slameto, *Learning and Affecting Factors (in Indonesian)*. Jakarta: Rineka Cipta, 2013.

[73] A. Asrori, *Educational psychology a multidisciplinary approach (in Indonesian)*. Banyumas: CV. Pena Persada, 2020.

[74] F. F. Amanda, S. B. Sumitro, S. R. Lestari, and I. Ibrohim, "Developing Complexity Science-Problem Based Learning Model to Enhance Conceptual Mastery," *Journal of Education and Learning (EduLearn)*, vol. 16, no. 1. pp. 65–75.

[75] M. Khusna, Sudaryanto, and D. Dian, "Application of problem based learning (PBL) model based on blended learning to increase motivation and learning outcomes in class vi students of SD Muhammadiyah Banjaran," *Proseiding Pendidikan Profesi Guru Fakultas Keguruan dan Ilmu Pendidikan Universitas Ahmad Dahlan*, vol. 21, no. 1, pp. 1–9, 2020.

[76] T. Jivram, S. Kavia, E. Poulton, A. S. Hernandez, L. A. Woodham, and T. Poulton, "The Development of a Virtual World Problem-Based Learning Tutorial and Comparison With Interactive Text-Based Tutorials," *Frontiers in Digital Health*, vol. 3, Apr. 2021, doi: 10.3389/fdgth.2021.611813.

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