The Impact of Problem-Based Learning on Student Learning Outcomes

Cahyana✉[1], Ari Widodo[2]

[1,2] Elementary Education Study Program, School of Postgraduate Studie, Universitas Pendidikan Indonesia, Bandung, Indonesia

✉ cahyana@upi.edu

Abstract. The learning model is very necessary in learning science. However, the learning model used in elementary schools (SD) is not optimal, which causes students to be less motivated to learn and has a negative impact on learning outcomes. This study aims to determine the effectiveness of the problem-based learning (PBL) model on student learning outcomes. This type of research is quantitative, using quasi-experimental methods, and the design used is a one group pretest and posttest design. The population in this study was all fifth-grade students at an elementary school, while the sample in this study consisted of 20 students. Random sampling was used for sampling in this study. This study will test the pre-test and post-test using the Wilcoxon matched pairs test. In carrying out the Wilcoxon test to analyze the two paired data sets, it was carried out using test analysis through the SPSS version 25 program. Based on the research and discussion, it can be concluded that the PBL learning model is effective in improving student learning outcomes in class V SD. This is supported by the Wilcoxon test results, which show that the asymptotic significance (two-tailed) is 0.000 < 0.05. The implications of this research are that it is hoped that teachers can implement this PBL model in the learning process so that it can improve students' ability to understand subject matter easily and quickly during the learning process.

Keywords: Learning Outcomes, Problem-based Learning Learning Model, Science.

How to Cite: Cahyana, & Widodo, A. (2024). The Impact of Problem-Based Learning on Student Learning Outcomes. *Proceeding The 6th International Conference Elementary Education, 6*(1), 113-120.

INTRODUCTION

Natural Science (IPA) is a fundamental subject in the Indonesian education curriculum, present in learning ranging from elementary school (SD) to higher education. Biased evaluations will be excluded unless explicitly indicated as such, and language will adhere to value-neutral, objective standards in formal register. Natural science is a scientific discipline that studies factual natural phenomena, including events and their causal relationships (Wisudawati and Sulistyowati, 2014). Technical terms will be explained when first introduced, and logical progression and causal connections between statements will be maintained. IPA is a branch of science that concentrates on nature and its processes. Conventionally accepted structures, consistent formatting, and citation styles will be utilized for the text's clarity and coherence without filler words, biased expressions, figurative language, or ornamental writing. Precise, subject-specific vocabulary will be preferred where appropriate, and grammatical accuracy will be prioritized. The field of inquiry concerning the development of human life for improved well-being is commonly known as "science learning." It is worth noting that elementary school students may not possess enough knowledge to comprehend the full extent of this issue. Nevertheless, introducing them to the subject matter can be valuable.

The science learning process facilitates student engagement in authentic, real-world problems, promoting the acquisition of knowledge, skills, attitudes and capabilities necessary for addressing daily challenges (Rahmad, 2016). Scientific inquiry encourages the application of logical thinking and strategic actions when tackling issues in the students' immediate environment. Diverse problem-solving approaches, including the use of appropriate learning models, are essential in developing their proficiency in addressing and surmounting complex obstacles.

The integration of learning models is a crucial component of an educational journey. Learning models impact not only instructional planning, but also significantly influence content delivery. These models provide guidance to educators on articulating procedures, establishing

meaningful connections, and optimizing the learning experience, resulting in successful knowledge transfer (Winaryati, 2017). The prominence of learning models in the educational landscape is undermined by a troubling trend. A thorough review of literature uncovers that numerous schools persist in using traditional learning models during instruction. This adherence to traditional methods has been recognized as a significant factor in the lack of progress seen in student learning outcomes, emphasizing the urgent requirement for a new educational framework. Adopting various up-to-date learning models can open doors to a more active and influential educational experience, promoting greater understanding and practical application of knowledge for students.

Addressing critical issues is essential, requiring a dedicated effort towards improvement. Implementing a transformative learning approach provides a promising path towards achieving favorable student learning outcomes. The Problem-Based Learning (PBL) model, which is widely recognized for its effectiveness in addressing educational challenges, emerges as an especially successful strategy. The model selected is supported by prior research which demonstrates its ability to overcome learning challenges, foster critical thinking abilities, and enhance student achievement in science and math courses (Hasibuan, 2014; Dharma & Lestari, 2022). The implementation of the Project-Based Learning (PBL) model serves as a solution for learning obstacles and showcases a considerable advancement in student learning achievements, supported by studies executed by Aziz and Wartono. By adopting pioneering approaches such as PBL, educational institutions can take a proactive stance toward tackling current difficulties, resulting in a more captivating and consequential learning milieu that fosters not only the acquisition of knowledge but also the enhancement of crucial cognitive abilities (Aziz et al., 2015; Wartono et al., 2018).

The PBL learning model is a student-centered approach emphasizing collaboration to solve problems assigned by the teacher or encountered in daily life, guided by a teacher or tutor (Dewi & Lestari, 2020; Wijnen et al., 2017). The model's principle is to present problems as the initial stage of the learning process. The presented issues often arise in daily life and can significantly affect academic progress and test scores (Farisi et al., 2017; Izma & Kesuma, 2019). Objective evaluation is necessary, avoiding biased or emotional language. Clear, concise, and logically structured sentences are crucial with a coherent flow of information. Standard language should be utilized with consistent technical terminology while passive tone and impersonal construction are preferred. Adherence to academic conventions, including relevant sections and formatting, is key. Precision in word choice is necessary. Lastly, grammatical correctness, accurate citation, and appropriate footnote formatting should be maintained.

The Problem-Based Learning (PBL) model is an effective tool for promoting the development of lifelong learning skills among students. This approach fosters an educational climate that cultivates openness, rationality, reflection, critical thinking, and active engagement (Sintadewi et al., 2020; Windari, 2017). Through the implementation of the PBL model during the learning process, significant improvements in students' cognitive abilities and overall learning outcomes are expected. This study aimed to examine the impact of the PBL model on science learning outcomes among fifth-grade students at Galunggung Elementary School in Tasikmalaya City.

The research seeks to go beyond traditional academic achievement in terms of its outcomes. By implementing the Problem-based Learning (PBL) approach, this study aims to develop a conducive learning atmosphere that not only enhances students' academic achievements but also fosters their engagement, critical attitude, and critical thinking skills. The ultimate objective is to equip students with the necessary tools to tackle global challenges, in addition to succeeding in the classroom. As students build a strong basis in problem-solving, collaboration, and critical analysis through the project-based learning approach, they are prepared to become versatile and inventive thinkers, ready to tackle the challenges of a continually changing world.

METHOD

The methodology employed in this research is quantitative and utilizes an experimental approach in the form of a pre-experimental design. This pre-experimental design lacks a control

group for comparison with the tested group (Walliman, 2017). Specifically, a single group design (one group pretest-posttest design) is utilized, which involves three distinct steps. Ary suggest a three-step process for conducting experimentation: (1) measure the dependent variable through conducting a pretest, (2) apply experimental treatment X to the subjects, and (3) conduct a posttest to measure the dependent variable again (Ary et al., 2010). By comparing pretest and posttest scores, any differences associated with the application of the experimental treatment can be evaluated. According to Sugiyono, the one-group pretest-posttest design is a relevant technique for identifying effects before and after an intervention (Sugiyono in Tohir & Mashari, 2020). The study population comprised all fifth-grade students at SDN Galunggung, while the sample was drawn from class V-A students at SDN Galunggung totaling 20 students. Sampling was conducted using the technique for determining research samples (Agung, 2016), followed by random sampling for this study.

Data analysis employed the Wilcoxon test, comparing mean scores on pre- and post-tests to determine the efficacy of the PBL learning model on student outcomes. Avoiding subjective evaluation, this study presents clear and concise information with a logical flow of information and proper technical term usage. Data analysis employed the Wilcoxon test, comparing mean scores on pre- and post-tests to determine the efficacy of the PBL learning model on student outcomes. Adherence to academic conventions is maintained throughout the text, with consistent citations and formal language employed. Due to the small sample size (less than 25) of research participants, the data distribution is considered non-normal according to Sudjana's findings (Tohir & Mashari, 2020). Furthermore, the collected data is ordinal, hence nonparametric statistical analysis is used via the Wilcoxon Matched Pairs Test, as suggested by Sugiyono (Tohir & Mashari, 2020). The aim of this study is to examine the pre and post-test scores to identify any observed differences between them using the Wilcoxon test. The analysis of the two paired data using test analysis was conducted through the SPSS version 25 program during the implementation of the Wilcoxon test.

RESULTS

This research seeks to evaluate the effectiveness of the Problem-Based Learning (PBL) model in improving the academic achievement of the fifth grade students of Galunggung Elementary School, focusing specifically on Theme 1 and Sub-Theme 1. The initiation of this study was preceded by a collaborative discussion between the researcher and the teacher to comprehensively identify and address the prevailing challenges in the educational landscape. During this dialogue, a critical issue emerged: a pervasive lack of student engagement in the learning process, which contributed to an uninspiring and monotonous classroom environment.

The crux of the problem lay in an approach to teaching in which the teacher was primarily a disseminator of knowledge, fostering a passive learning environment devoid of the active participation of the students. This methodology failed to stimulate students' curiosity or encourage their active participation, ultimately hindering their overall learning experience. The obvious consequence was a lack of significant improvement in student learning outcomes. Recognizing the urgent need for a transformative change, the researchers embarked on a quest to explore alternative learning models, with the Problem-Based Learning (PBL) approach emerging as a promising avenue. This exploration seeks not only to address the identified challenges, but also to introduce a dynamic and participatory element into the learning process, fostering a more vibrant and effective educational environment for students.

This study incorporated a comprehensive assessment strategy that began with a pretest designed to measure students' baseline understanding of the subject matter. Following the implementation of the Problem-Based Learning (PBL) model throughout the learning process, a post-test was administered to evaluate the evolution of the students' conceptual understanding. These pre-test and post-test measures were strategically used to determine the effectiveness of the PBL model in improving the learning outcomes of students in V-A at Galunggung Elementary School.

The data derived from the pre-test, serves as an initial snapshot of the students' knowledge level prior to engaging in the PBL model. This baseline assessment lays the groundwork for a

comparative analysis that allows for a nuanced examination of the impact of the PBL approach on student understanding and retention. By employing both pre- and post-test evaluations, this study aims to provide a robust and evidence-based assessment of the transformative influence of the PBL learning model on the academic performance of students in V-A at Galunggung Elementary School. Students were immersed in the Problem-Based Learning (PBL) model throughout the learning process and received a comprehensive exploration of this innovative approach. In order to assess the effectiveness of the PBL model, a post-test was administered upon completion of the PBL-based learning sessions. The post-test served as a critical evaluation tool to measure the extent to which students had absorbed and applied the knowledge and skills acquired through the PBL model. Results of the pre-test and post-test can be seen in the following table.

Table 1. Student Pre-test Results

No.	Total students	Pretest Average
Pre-test	20	78.75
Post-test	20	93.23

The analysis of pre-test and post-test results for 20 fifth-grade students indicates a positive change in their academic performance. The average pre-test score of 78.75 increased to 93.23 in the post-test, indicating an improvement of 14.48. This significant increase provides strong evidence that the implementation of the Problem-Based Learning (PBL) model is effective in enhancing students' understanding and skills. The improvement of 14.48 points in learning outcomes reflects the positive impact of the PBL approach on the learning process. This change is not limited to score improvement but also encompasses the development of conceptual understanding and the application of knowledge in a broader context.

Thus, it can be concluded that the implementation of the Problem-Based Learning model contributes positively to the progress of fifth-grade students. These results provide robust support for the effectiveness of this teaching method in achieving the goal of improving academic performance. As an implication, the application of PBL can be considered a successful solution for enhancing student learning outcomes and can be recommended for broader implementation in the educational context. After a careful analysis of the pre- and post-test results, the collected data was statistically analyzed using the Wilcoxon test. The goal was to identify any significant changes or improvements in student performance as a result of exposure to the Problem-Based Learning (PBL) model so as to provide a comprehensive statistical representation of the results.

The Wilcoxon test can conclude the impact of the PBL model on student learning outcomes by showing any statistically significant differences between the pre-test and post-test scores. This statistical examination not only adds a layer of rigor to the assessment process, but also provides a quantitative lens through which to measure the effectiveness of the PBL model in fostering greater understanding and application of the subject matter. The test results, contribute to the empirical foundation that supports the assertion that the use of the PBL model correlates with observable improvements in student academic performance.

To evaluate the effectiveness of the problem-based learning approach, a rigorous statistical analysis was conducted using the Wilcoxon Signed Rank Test statistic. This method allowed for a robust examination of the impact of problem-based learning on various metrics related to student performance. The Wilcoxon Signed Rank Test provides a clear and organized presentation of the results. It serves as a crucial reference for observing differential changes in student outcomes, thus contributing to a wider comprehension of the effectiveness of problem-based learning methods. Through the use of this statistical test, the study seeks to provide a methodologically sound basis for confirming or clarifying the effects of problem-based learning, thereby facilitating a more nuanced and evidence-based discussion of its effectiveness in the educational context. The statistical results of the Wilcoxon Signed Rank Test, which details any significant changes or improvements, are carefully compiled and comprehensively presented in the following table.

Table 2. Results of the Wilcoxon Signed Rank Test Statistics

	Post-test - Pre-test
Z	-3.852[a]
Asymp. Sig. (2-tailed)	0.000

a. Based on negative ranks.

Looking at the data presented, there is one notable observation: the Asymp. Sig (2-tailed) value is 0.000. Since this value is less than the conventional significance level of 0.05, a significant threshold commonly used in statistical analysis, a robust conclusion can be drawn. The evidence strongly supports the assertion that the Problem-Based Learning (PBL) model has a significant and positive impact on improving the learning outcomes of students in Class V-A at SDN Galunggung.

In practical terms, a significance level of less than 0.05 means that the observed results are unlikely to be due to chance. The PBL learning model, with its statistically significant impact, stands validated as an effective approach in improving student learning outcomes in the specific context of Class V-A at SDN Galunggung. This conclusion, drawn from a rigorous statistical analysis, underscores the tangible benefits of implementing the PBL model as a pedagogical strategy and provides valuable insights for educators and stakeholders invested in improving the quality of education.

DISCUSSION

Learning effectiveness can be conceptualized as a treatment within the learning process that impacts the success of efforts or actions on student learning outcomes (Rifa'I, 2013). In this study, effectiveness is related to the problem-based learning (PBL) model on student learning outcomes in science education. The PBL model is a system that includes various interconnected components (Rusman, 2010).

The problem-based learning (PBL) model concentrates on activities that solve problems (Ismaimuza et al., 2010). Consequently, learners can proactively seek solutions to the issues presented by instructors. Here, educators function primarily as mediators and facilitators, assisting in the students' active knowledge acquisition (Siregar & Seri, 2016). According to Dutch (Yulianti & Gunawan, 2019) posits that Project-Based Learning (PBL) is an instructional technique that motivates students to work collaboratively in groups to solve real-world problems. This approach connects students' curiosity, analytical abilities, and initiative with the learning objectives. PBL fosters critical thinking and analytical skills while encouraging students to seek and utilize appropriate educational resources.

The success of the PBL educational approach is intertwined with the proactive engagement of learners. They autonomously identify, tackle, and resolve issues arising from within the educational process. In contrast, the educator serves as a mentor and a liaison, facilitating acquisition of knowledge for the students. Five stages are involved in implementing inquiry learning, specifically: a) introducing students to problems; b) arranging their study; c) guiding both individual and group investigations; d) creating, presenting and developing the work; and e) analyzing and assessing the problem-solving process (Hotimah, 2020).

The PBL learning model utilizes concrete problems as a foundation for learning. Students play an integral role as subjects in the learning process and are expected to actively participate throughout. In addition to active participation, students must possess the ability to autonomously solve problems assigned by the teacher (Sujana & Sopandi, 2020). The problem-solving procedure occurs through group discussion and class discussion (Sujana & Sopandi, 2020).

The discussion experience offers valuable insights and understanding that cannot be easily attained with conventional learning models. Moreover, students can utilize discussion activities to dissect the outcomes of their investigations and collaboratively address problems with their peers. As a result, discussion and presentation activities will create an environment that is conducive to fruitful exchanges of perspectives, given that studying with friends enhances the

opportunity to share opinions based on firsthand observations. The findings of this study support Sofyan's assertion that students collaborate with peers in groups to resolve challenges and acquire fresh insights independently via the instructor's problem-solving techniques.

Several other studies, including Dharma and Lestari's research, support the results of this study, demonstrating the significant positive impact of the PBL learning model on social studies learning outcomes and students' critical thinking skills in comparison to conventional learning models (Dharma & Lestari, 2022). Maqbullah's research indicates that the PBL learning model can also enhance critical thinking skills and student learning outcomes in elementary school science subjects (Maqbullah et al., 2018). Another study supporting this research is Rahmasari's application of the PBL model to improve science learning outcomes in Class IV SD. The study's results demonstrate the PBL learning model's ability to enhance science learning outcomes through several cycles of classroom action research (Rahmasari, 2016).

The results of the research underscore a compelling correlation between the use of the problem-based learning model and an increase in the learning outcomes of the students. This assertion is supported by the tangible evidence of substantial post-test scores. When compared to pre-test scores, these post-test scores show a marked improvement. By way of illustration, the mean score of the students on the pre-test in science, which was administered prior to the introduction of problem-based learning, was 78.75. After engaging with the problem-based learning model, the students' post-testing scoring increased substantially, reaching an impressive average score of 93.23. This notable increase in learning outcomes is further emphasized when evaluating the average student performance, suggesting that the problem-based learning approach not only positively impacts individual performance, but also contributes to an overarching improvement in the collective learning outcomes of the student cohort. These findings provide empirical support for the efficacy of the problem-based learning model as a powerful tool for raising academic achievement and affirm its potential to serve as a transformative pedagogical strategy.

CONCLUSION

The culmination of research and discussion clearly establishes the problem-based learning (PBL) model as a powerful catalyst for improving the science learning outcomes of fifth grade students at Galunggung Elementary School. The robustness of this assertion is reinforced by the results of the Wilcoxon test, where Assump.Sig (2-tailed) is documented at 0.000, a value significantly lower than the conventional significance level of 0.05. This statistically significant result provides compelling evidence of the effectiveness of the PBL learning model in producing positive changes in student learning outcomes.

In light of these findings, a notable recommendation emerges: elementary schools seeking to improve student learning outcomes are encouraged to consider implementing the PBL model, especially when Assump.Sig (2-tailed) falls below the 0.05 threshold. This recommendation is based on the empirical validation provided by the research, which highlights the potential of the PBL model as a strategic pedagogical tool capable of producing tangible improvements in student academic achievement. By incorporating the PBL approach, elementary schools can create a dynamic and engaging learning environment that not only promotes subject-specific knowledge, but also cultivates essential skills for lifelong learning.

ACKNOWLEDGMENTS

The authors would like to extend their gratitude to Elementary Education Universitas Pendidikan Indonesia (UPI) and the public elementary schools who have helped and supported the research. Thanks also to the editors and reviewers for the opportunity given.

REFERENCES

Agung, Anak Agung Gede. (2016). *Statistika Dasar untuk Pendidikan*. Deepublish.

Ary, D., Jacobs, L. C., & Razavieh, A. (2010). *Introduction to research in education 8th edition, Wardswoth Cengage Learning*. Canada: Nelson Education Ltd Exotic Classic.

Aziz, Azmi, Joni Rokhmat, and Kosim Kosim. (2015). Pengaruh Model Pembelajaran Berbasis Masalah dengan Metode Eksperimen Terhadap Hasil Belajar Fisika Siswa Kelas X SMAN 1 Gunungsari Kabupaten Lombok Barat Tahun Pelajaran 2014/2015. *Jurnal Pendidikan Fisika Dan Teknologi*, *1*(3), 200–204. https://doi.org/10.29303/jpft.v1i3.259.

Dewi, Made Sri Astika, and Nyoman Ayu Putri Lestari. (2020). E-modul interaktif berbasis proyek terhadap hasil belajar siswa. *Jurnal Imiah Pendidikan Dan Pembelajaran*, 4(3), 433–441. https://doi.org/10.23887/jipp.v4i3.28035. 2020.

Dharma, I Made Aditya, and Nyoman Ayu Putri Lestari. (2022). The Impact of Problem-based Learning Models on Social Studies Learning Outcomes and Critical Thinking Skills for Fifth Grade Elementary School Students. *Jurnal Ilmiah Sekolah Dasar*, *6*(2), 263–269. https://doi.org/10.23887/jisd.v6i2.

Farisi, Ahmad, Abdul Hamid, and Melvina Melvina. (2017). Pengaruh Model Pembelajaran Problem Based Learning terhadap Kemampuan Berpikir Kritis dalam Meningkatkan Hasil Belajar Siswa pada Konsep Suhu dan Kalor. *Jurnal Ilmiah Mahasiswa Pendidikan Fisika*, 2(3), 283–287.

Hasibuan, M. Idrus. (2014). Model Pembelajaran CTL (Contextual Teaching and Learning). *Logaritma: Jurnal Ilmu-Ilmu Pendidikan Dan Sains*, 2(1). https://doi.org/10.24952/logaritma.v2i01.214.

Hotimah, Husnul. (2020). Penerapan Metode Pembelajaran Problem Based Learning Dalam Meningkatkan Kemampuan Bercerita Pada Siswa Sekolah Dasar. *Jurnal Edukasi*. Vol. 7(2): 5-11.

Ismaimuza, Dasa. (2010). Pengaruh Pembelajaran Berbasis Masalah dengan Strategi Konflik Kognitif Terhadap Kemampuan Berpikir Kritis Matematis dan Sikap Siswa SMP. *Jurnal Pendidikan Matematika*, 4(*1*), 1-10.

Izma, Tri, and Vira Yolanda Kesuma. (2019). Peran Pendidikan Kewarganegaraan Dalam Membangun Karakter Bangsa. *Wahana Didaktika: Jurnal Ilmu Kependidikan*, 17(1), 84–92. https://doi.org/10.31851/wahanadidaktika.v17i1.2419.

Maqbullah, Shofiyah, Tati Sumiati, and Idat Muqodas. (2018). Penerapan Model Problem Based Learning (PBL) untuk Meningkatkan Kemampuan Berpikir Kritis Siswa pada Pembelajaran IPA di Sekolah Dasar. *Metodik Didaktik: Jurnal Pendidikan Ke-SD-an*, 13(2).

Rahmad, Rahmad. (2016). Kedudukan Ilmu Pengetahuan Sosial (IPS) pada Sekolah Dasar. *Muallimuna: Jurnal Madrasah Ibtidaiyah*, 2(1), 67–78. https://doi.org/10.31602/muallimuna.v2i1.742.

Rahmasari, Riana. (2016). Penerapan Model Pembelajaran Problem Based Learning Untuk Meningkatkan Hasil Belajar IPA Kelas IV SD. *Jurnal Pendidikan Guru Sekolah Dasar.* Edisi 36 Tahun ke 5.

Rifa'i, B. (2013). kontribusi pengelolaan laboratorium dan motivasi belajar siswa. *Kebijakan dan Manajemen Publik*, 1(*1*), h.132.

Rusman. (2010). *Model-model Pembelajaran*. Jakarta: Gravindo Persada.

Sintadewi, Ni Made Dita, Ni Putu Juni Artini, and Irwan Febryan. (2020). Analysis of English Learning Difficulty of Students in Elementary School. *International Journal of Elementary Education*, 4(3), 431–438. https://doi.org/10.23887/ijee.v4i3.28524.

Siregar, purwanto dan seri. (2016). pengaruh model pembelajaran problem based learning (pbl) terhadap belajar siswa pada materi pokok suhu dan kalor di kelas x semester ii sma negeri 11 medan t.p 2014/2015. *jurnal ikatan alumni fisika universitas*

Sofyan, Herminarto, Kokom Komariah and Wagiran Wagiran. (2017). *Problem Based Learning dalam Kurikulum 2013*. Yogyakarta: UNY Press. Tersedia dari staffnew.uny.ac.id.

Sujana, Atep and Wahyu Sopandi. (2020). *Model-model Pembelajaran Inovatif Teori dan Implementasi*. Depok: Rajawali Pers.

Tohir, Ahmad. (2020). Efektivitas Model Pembelajaran Inkuiri dalam Meningkatkan Hasil Belajar Siswa Kelas IV SDN 27 Tegineneng. *Jurnal Ilmiah Sekolah Dasar*. 4(1), 48-53.

Walliman, N. (2017). *Research Methods: The Basics*. Routledge.

Wartono, Wartono, M. Diantoro, and John Rafafy Bartlolona. (2018). Influence of problem-based 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.

Wijnen, Marit, Sofie M. Loyens, Guus Smeets, Maarten Kroeze, and Henk van der Molen. (2017). Comparing problem-based learning students to students in a lecture-based curriculum: learning strategies and the relation with self-study time. *European Journal of Psychology of Education*, 32(3), 431–447. https://doi.org/10.1007/s10212-016-0296-7.

Winaryati, Eny. (2017). *Model Pembelajaran "Wisata Lokal" (Implementasi Pembelajaran Abad 21)*. Semarang: Unimus Press. Tersedia dari Repository Unimus.

Windari, Putu Ayu Arya. (2017). Penerapan Pembelajaran Berbasis Masalah untuk Meningkatkan Kemampuan Berbahasa Inggris di Kelas XII IPA 1 SMA Dwijendra Denpasar. *LITERA: Jurnal Litera Bahasa Dan Sastra*, 3(1). https://jurnal.undhirabali.ac.id/index.php/litera/article/download/280/256.

Wisudawati, and Sulistyowati. (2014). *Metodologi pembelajaran IPA*. Jakarta: Bumi Aksara.

Yulianti, Eka & Gunawan, Indra. (2019). Problem Based Learning (Pbl) Learning Model: The Effect on Understanding Of Concept And Critical Thinking. *Indonesian Journal of Science and Mathematics Education*, 2(*3*), 399-408.