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Analysis of Science Learning Outcomes of Grade V Students on the Material of Changes in the Form of Objects Through the Learning Based Learning Model

Yolanda Yunita Sari [1*], Nailah Mufidah [1], Novianah Zahra [1], Sabrina Nabilah [1], Indri Eltha Supriyati [1], Fadli Nur Ilmi [1], Afna Mufidah Salsabila [2]

[1] Universitas Muhammadiyah Prof. Dr. Hamka, Indonesia
[2] Kastamonu University, Turkey
* Author Correspondence

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Abstrack

This study aimed to improve the comprehension and learning outcomes of fifth-grade students at Ciracas 13 Public Elementary School, East Jakarta regarding the change of state of objects within science-related learning activities. Initial observations revealed low student engagement, limited question-asking behavior, and low confidence in expressing opinions factors contributing to poor academic performance. To address this issue, the Problem Based Learning model was implemented to emphasize active participation in solving contextual problems. This Classroom Action Research followed four stages: planning, implementation, observation, and reflection. The pre-test and post-test results showed significant improvement in students' understanding, with average scores increasing from 54.48 to 72.07. Statistical analysis using a paired t-test confirmed the effectiveness of Problem Based Learning in improving outcomes (p-value = 0.003 < 0.05). Students became more active, confident, and engaged in discussions. The findings support the idea that Problem Based Learning not only enhances cognitive achievements but also promotes positive behavioral changes during science learning. The model fosters critical thinking and collaborative learning in real-world scenarios, making the learning process more meaningful and enjoyable. This study concludes that Problem Based Learning is an effective approach to science instruction in primary schools, particularly for material involving tangible phenomena.

Contact : Corresponding author e-mail: yolandayunitasari1@gmail.com

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Introduction

Education is a conscious effort by students to understand and shape themselves through a learning process and guidance that is useful for the future. Education aims to increase the intelligence of the nation and build individuals who understand the principles of life. Learning is part of the educational process and is a way to gain new knowledge. In this situation, learning can be defined as an effort to gain knowledge and understanding(Aulia et al., 2024; Febianti et al., 2024; Hartomo et al., 2024; Sukmawati, 2021).

According to Tadjab, learning is a process of changing students' abilities in seeing, thinking, feeling, and doing something through various experiences they have. Meanwhile, according to Lefudin, learning is a process and activity that involves all the senses that can change a person's behavior towards themselves, others, and their environment. Learning is also a process of exploring an object that can be combined to become perfect. Thus, learning is a process of change regarding understanding of something, from not knowing to knowing. Not only changes regarding understanding, but learning is also a process of changing new behavior as a result of experience or practice(Fitria et al., 2024; Sukmawati, 2020; Sulistiani et al., 2024; Wahjusaputri et al., 2022).

Natural Sciences (IPA) is defined as a discipline that systematically and scientifically investigates natural phenomena, with its core characteristics focusing on observation, experimentation, and the application of logical and analytical thinking to comprehend natural concepts (Prawirohartono, 1989). Within the elementary school Science Education. curriculum, the material on changes in the state of matter is an essential component. This content is crucial for understanding the processes of phase transitions including melting, freezing, sublimation, crystallization, condensation, and evaporation and it maintains a strong connection to daily life.

Despite its high relevance, many students continue to face difficulties in fully internalizing this material.Before conducting this classroom action research, the researcher performed interviews and observations with teachers and students of Class V at Ciracas 13 Public Elementary School, East Jakarta, which was chosen as a core school with an average class size of 30 students. Interview findings indicated that some students exhibited passive behavior during material Q&A sessions, struggled to comprehend what they were learning, and lacked the confidence to articulate their ideas.

Statistical data from the first semester PAS further substantiated these findings, revealing that only 13 out of 30 students (41%) achieved the Minimum Completeness Criteria (KKM), while a significant 59% did not meet the required learning standards.This identified constraint underscores the imperative for implementing a learning model capable of fostering active student participation, enhancing conceptual understanding, and making the learning process more meaningful.

Based on teacher interviews and researcher-conducted literature reviews, Problem Based Learning is identified as a suitable model to actively involve students in learning(Izzati et al., 2024; Muthi'ah et al., 2023; Putri et al., 2024; Saputri et al., 2024). Arends (2008:41) explains that Problem Based Learning fundamentally involves presenting students with diverse authentic and meaningful problem situations.

In its implementation, educators serve as facilitators, introducing genuine problems that students are tasked with solving through discussion, problem formulation, and information

exchange(Ifdaniyah et al., 2024; Kusnadi et al., 2023; Sukmawati et al., 2024; Wahjusaputri et al., 2024).This process not only elevates students' cognitive engagement but also fortifies their critical thinking and collaborative proficiencies. Therefore, this study aims to: 1) Outline the procedures for implementing Problem Based Learning to enhance science learning outcomes concerning changes in the state of matter in Class V students. 2) Enhance science learning outcomes concerning changes in the state of matter in Class V students.

Method

This study, framed as a Classroom Action Research, took place in Class V at Ciracas 13 Public Elementary School, East Jakarta. With 30 students serving as research subjects, its primary objective was to optimize the science learning process and outcomes, particularly concerning changes in the state of matter(M. N. Fitria et al., 2022; Istiqomah et al., 2023; Ramadhani et al., 2022; Wati Sukmawati et al., 2023). The research adhered to the Kurt Lewin model, structured into four distinct stages: planning, implementation, observation, and reflection. A quantitative methodology was applied through a one-group pre-test-post-test design. The findings demonstrated a significant improvement: the average pre-test score for 29 students was 54.48, which subsequently rose to 72.07 in the post-test. A paired t-test analysis confirmed a statistically significant difference between the scores obtained before and after the intervention. The t Stat value of -3.22598, coupled with a p-value of 0.003188 (which is less than 0.05) and a Critical t value of 2.048407, robustly supports the effectiveness of the applied procedure. Consequently, this study concludes that the implementation of the Problem Based Learning model effectively enhances students' science learning outcomes.

Results and Discussion

Result

The purpose of this study was to improve the understanding and learning outcomes of fifth grade students of Ciracas 13 Public Elementary School, East Jakarta related to the material of changes in the state of objects through the application of the Problem Based Learning learning model(Fauziah et al., 2023; Novianti et al., 2023; Nurliana et al., 2023). Various problems identified, such as low student participation, lack of self-confidence, and achievement of learning outcomes that do not reach learning targets, indicate the need for a learning approach that can encourage active participation and critical thinking of students.

The use of the Problem Based Learning model is very relevant because it puts students at the center of the learning process who are directly involved in solving real problems. This is in accordance with the formulation of the problem in this study, namely: Can the application of the Problem Based Learning learning model improve science learning outcomes on the material of changes in the state of objects for grade V students of Ciracas 13 Public Elementary School, East Jakarta ?

The purpose of this study is in line with the formulation of the problem, namely to measure the effectiveness of the Problem Based Learning model in improving student learning outcomes in the material of changes in the state of matter. Numerous earlier research have demonstrated that Problem Based Learning can enhance learning motivation, deeper conceptual knowledge, and high-level thinking skills (HOTS). Students are more likely to feel

content and driven to learn on their own when they can solve the challenges they encounter(Sukmawati, 2023).

In addition, the implementation of Problem Based Learning also trains students to build their own knowledge and apply it in everyday life(Sukmawati et al., 2021a). This will create a more meaningful and applicable understanding. Problem Based Learning has also been proven to have a positive impact on student learning behavior, especially thanks to its approach that focuses on active learning syntax, namely problem orientation, learning organization, research, presentation of results, and evaluation.

Thus, the relationship between background, objectives, and problem formulation is not only based on local needs in grade V of Ciracas 13 Public Elementary School, East Jakarta, but also supported by previous findings showing that the Problem Based Learning model is effective in improving learning outcomes in various subjects, including science, mathematics, and the solar system. It is anticipated that this study will bolster the data supporting Problem Based Learning efficacy in raising student learning outcomes and promoting constructive modifications in learning behavior(Sukmawati et al., 2021b).

This study aimed to improve the understanding and learning outcomes of fifth-grade students at Ciracas 13 Public Elementary School, East Jakarta regarding changes in the state of matter by applying the Problem Based Learning model. Several identified issues, such as low student participation, a lack of self-confidence, and learning outcomes falling short of targets, highlighted the need for an instructional approach that could foster active engagement and critical thinking.The Problem Based Learning model is highly relevant because it places students at the center of the learning process, directly involving them in solving real-world problems.

This aligns with the study's research question: "Can the application of the Problem Based Learning model improve science learning outcomes on changes in the state of matter for fifth-grade students at Ciracas 13 Public Elementary School, East Jakarta?"The purpose of this study directly corresponds to its problem formulation, which is to measure the effectiveness of the Problem Based Learning model in improving student learning outcomes related to changes in the state of matter. Numerous prior studies have demonstrated that Problem Based Learning can enhance learning motivation, lead to a deeper conceptual understanding, and develop higher-order thinking skills (HOTS).

When students successfully resolve challenges, they tend to feel satisfied and motivated to learn independently.Furthermore, implementing Problem Based Learning also trains students to construct their own knowledge and apply it in everyday life, fostering a more meaningful and practical understanding. Problem Based Learning has also proven to positively impact student learning behavior, particularly through its active learning syntax, which includes problem orientation, learning organization, investigation, results presentation, and evaluation(Sukmawati et al., 2022).

Thus, the connection between the background, objectives, and problem formulation is not only rooted in local needs observed in Class V at Ciracas 13 Public Elementary School, East Jakarta, but also supported by previous findings demonstrating the effectiveness of the Problem Based Learning model in improving learning outcomes across various subjects, including science, mathematics, and the solar system. This study is expected to strengthen the evidence

supporting Problem Based Learning efficacy in boosting student learning outcomes and promoting constructive shifts in learning behavior.

Figure 1 The picture shows the atmosphere of an elementary school class that is carrying out teaching and learning activities. All students are wearing Scout uniforms, and several students are seen standing in front of the class, possibly to present assignments or have group discussions. The teacher stands near the blackboard watching the students who are performing.

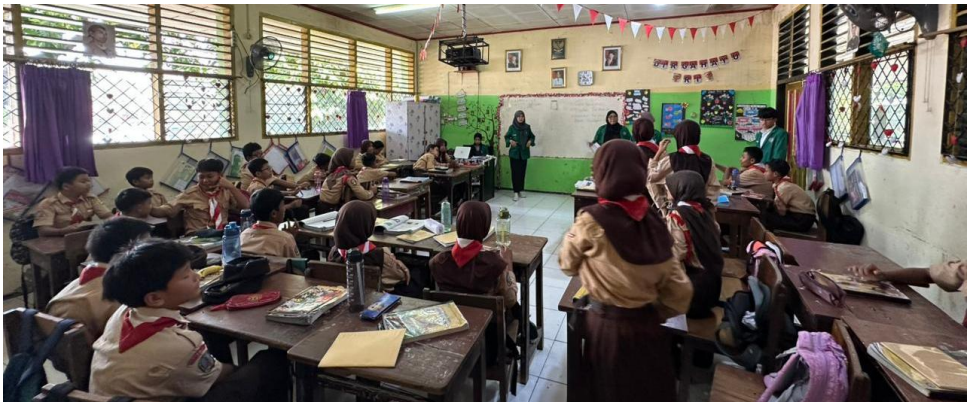

Figure 1. Science learning changes in the states of matter

Various educational methods and interventions continue to be developed and implemented to improve student learning and learning outcomes. These include new learning models, the use of interesting media, and more active and participatory learning strategies. To find out how much of an impact these interventions can have on students' learning accomplishment, it is crucial to assess how effective they are. In order to ascertain whether learning outcomes had changed or improved, assessments were conducted both before and after the treatment (pre-test and post-test). Here is an analysis of the findings from the paired t-test computation applied to the pre-test and post-test data from 29 students.

Table 1. *Pre-test and Post-test Research Results Data*

	Pretest	**Postest**
Mean	54,48276	72,06897
Variance	239,9015	438,4236
Observations	29	29
Pearson Correlation	-0,2829	
Hypothesized Mean Difference	0	
df	28	
T Stat	-3,22598	
P(T<= *t*) one-tail	0,001594	
T Critical one-tail	1,701131	
P(T<= *t*) two-tail	0,003188	
T Critical two-tail	2,048407	

Based on the calculation results*t - test*paired, it was found that the average post-test score (72.07) was higher than the average pre-test score (54.48) of 29 students. This shows an increase in learning outcomes after being given certain treatments (for example certain learning models, media, or strategies used in the research).

The average difference of 17.59 points indicates that the treatment or intervention given to students is effective in improving their understanding of the material. In addition, although the post-test variance (438.42) is greater than the pre-test variance (239.90), indicating that the distribution of post-learning scores is slightly more spread out, this is reasonable and does not reduce the meaning of the increase in scores in general.

Discussion

The study's findings suggest that applying the problem-based learning paradigm can enhance the learning outcomes of fifth grade students at Ciracas 13 Public Elementary School, East Jakarta on the subject of changes in object states. The study's findings are consistent with earlier research that highlights the Problem Based Learning model's efficacy in raising students' conceptual knowledge and learning outcomes, particularly in the context of science instruction in elementary schools.

The use of the Problem Based Learning model in conjunction with the demonstrative technique with fourth grade students at Karanglo 02 Public Elementary School enhanced learning activities and learning outcomes about changes in the condition of objects, according to research by Mubarokah (2023) published in the JGURUKU journal. According to this study, a contextual and student-centered approach can overcome passive student participation and improve their learning outcomes.

Furthermore, Fatimah (2023) reported that the implementation of Problem Based Learning in the Independent Curriculum at Kawunglarang 5 Public Elementary School, Ciamis improved student learning outcomes and motivation. This shows that Problem Based Learning not only makes students smarter, but also helps them become more critical, collaborative, and active during learning.

The results of this study are also supported by additional research conducted by Pujiastuti (2023) on fourth grade students of Sekardoja Elementary School. In the JGURUKU journal, she found that the Problem Based Learning model helps improve science learning outcomes, especially material that experiences changes in the state of matter. This study shows that problem-based learning methods increase student engagement and understanding. Research shows that classroom conditions, teacher readiness, and implementation time can affect the effectiveness of Problem Based Learning. For example, Efendi and Wardani (2021) in the Basicedu Journal compared Problem Based Learning and question learning and found that, although Problem Based Learning was effective, the question method did not always produce better results. This is an important note that Problem Based Learning must still be adjusted to the specific learning context.

The low comprehension of science content among fifth grade students at Ciracas 13 Public Elementary School, East Jakarta, particularly with relation to changes in object states, served as the impetus for this study. Initial observations revealed that students tended to be passive throughout class, rarely asked questions, and appeared less comfortable voicing their ideas. This condition has an impact on learning outcomes that have not met learning targets, where more than half of students received grades below the set standards. This problem encourages researchers to look for alternative learning models that are more effective. One of the approaches chosen is the learning model. Problem Based Learning. This model is considered capable of encouraging students to think critically, actively discuss, and solve problems related to real life.

In the process, teachers are no longer the main center of information, but act as facilitators who guide students in finding knowledge independently and collaboratively.

Classroom Action Research, which has four stages planning, execution, observation, and reflection was used to carry out the study. Thirty fifth-graders served as the research subjects. A quantitative strategy with a design was employed in the data collection process. pre-test and post-test for one group. There was a 17.59-point difference between the average student score on the pre-test, which was 54.48, and the post-test, which was 72.07. The findings of the paired t-test statistical test revealed a p value = 0.003 (< 0.05), indicating a statistically significant difference between the learning outcomes before and after therapy. In addition to the cognitive aspect, positive changes are also seen in student behavior during learning. They appear more active, confident, and enthusiastic when discussing or completing group assignments. Learning feels more fun and meaningful because it involves students in real situations that are relevant to their daily lives.

This study has several limitations. First, the number of research subjects consisting of only one class cannot represent a wider population. Second, the test instrument used only measures the cognitive aspects of students, not reaching the affective or psychomotor domains. Third, the research implementation time is relatively short, so it is not yet known whether the improvements that occur are sustainable.The results of this study indicate that the application of the Problem Based Learning model is worthy of being an alternative in science learning in elementary schools. Problem Based Learning not only improves learning outcomes significantly, but also forms students' learning characters who are more active, collaborative, and critical of the problems around them.

This study offers a number of benefits that can serve as a foundation for the advancement of scientific education in elementary schools, particularly in relation to the content on object state transitions. The focus and applicability of the subject matter, which is examining the learning outcomes of grade V children in relation to the idea of changes in the state of objects one of the primary subjects covered in the elementary school science curriculum are among the study's benefits. Applying the Problem Based Learning model has been shown to enhance student learning outcomes for the material on changes in the state of objects, according to the findings of the research that has been done. The comparison of pupils' pre-test and post-test results demonstrates this. The average pre-test score for cycle I was 54.48, indicating that most students are still getting used to active learning patterns and do not fully comprehend the idea of changes in the status of objects. They are used to getting information straight from professors and have a tendency to be passive. After the implementation of the Problem Based Learning model and reflection to improve the learning process, the average post-test score in cycle II increased significantly to 72.07. The difference in average scores of 17.59 shows that the Problem Based Learning model is effective in helping students understand the concept of changes in the state of matter better. Although the post-test variance score (438.42) is higher than the pre-test variance score (239.90), which means that there is a more varied distribution of scores, this does not reduce the meaning of the significant increase in scores. Overall, it can be concluded that the implementation of the Problem Based Learning model has succeeded in improving the quality and learning outcomes of students related to the material on changes in the state of matter.

Additionally, this study has a lot of drawbacks. This study's flaws are evident from a number of angles. The quantity of student samples used is a major drawback. Only thirty fifth

graders from Ciracas 13 Public Elementary School, East Jakarta participated in this study. Although this number has met the minimum requirements for collecting relevant data, from a generalization perspective, this limited number of samples has not been able to fully represent the patterns or levels of understanding of students in other schools with different contexts and characteristics. Therefore, the results of this study cannot be used as a reference or generalized to a wider student population. From the data collection method used, there are also limitations related to the research instrument. The pre-test and post-test questions are indeed arranged based on the grid and level of difficulty of the questions that are in accordance with the theme of changes in the form of objects, but the questions are more focused on measuring the cognitive aspects of students. Other aspects of students' understanding, such as critical thinking skills, everyday problem-solving skills, and scientific communication skills, cannot be fully measured through the questions used. In other words, the questions used cannot fully reveal students' abilities from various other learning domains, especially from the affective and psychomotor aspects.

Other limitations are also seen from the relatively short research implementation time. Only within a specific time frame was data collection conducted in compliance with the classroom action research cycle. With a limited data collection period, it is not yet known with certainty whether the level of student understanding can persist and develop over time. This makes the study unable to provide a comprehensive picture of the long-term development of student understanding related to changes in the form of objects.

Students need to be more self-assured and have a positive mindset in order to be flexible when learning, particularly when the curriculum involves items that need conceptual comprehension. Improving learning results, particularly in the cognitive domain, will be substantially aided by an engaged and enthusiastic approach to the learning process. It is expected of science teachers to be creative in order to innovate teaching methods that enhance science learning outcomes in the cognitive domain, such as using interactive visual aids or a straightforward experimental approach. In order to increase student learning outcomes particularly in the area of comprehending the concept of changes in the shape of objects this attempts to make learning more engaging and relevant. It is anticipated that school administrators would be able to give teachers the chance to take part in different forms of learning competency training as part of the implementation of education.

Conclusion

This study demonstrates that the implementation of the Problem Based Learning model significantly enhances the science learning outcomes of fifth-grade students at Ciracas 13 Public Elementary School, East Jakarta, specifically on the topic of changes in the state of matter. Students' average scores increased by 17.59 points, from 54.48 in the pre-test to 72.07 in the post-test ($p < 0.05$). Beyond cognitive improvements, the Problem Based Learning model also positively influenced student learning behavior, evident in their increased engagement, confidence, and enthusiasm throughout the learning process. Thus, the Problem Based Learning approach has proven effective in fostering active student involvement, improving conceptual understanding, and making the learning experience more meaningful and contextual. However, this study is limited by sample size, scope of assessment aspects, and implementation duration.

Further research is needed to explore the long-term impact of Problem Based Learning and its broader effectiveness in diverse educational contexts.(Fatimah, n.d.)

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Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

References

Aulia, D., Putri, A., Anugrah, D., & Ninawati, M. (2024). *Penerapan metode jarimatika di Pusat Pemulihan Dalam Komuniti (PPDK) Changlun untuk anak berkebutuhan khusus*. *[Nama jurnal tidak tercantum]*, 1(2), 67–71.

Fatimah, S. (n.d.). *Kurikulum Merdeka menggunakan model Problem Based Learning (PBL) di kelas IV Sekolah Dasar Negeri 5 Kawunglarang*. *[Nama jurnal tidak tercantum]*, 1, 327–333. https://doi.org/10.25134/jguruku.v2i2

Fauziah, N., & Sukmawati, W. (2023). Stacking analysis of higher thinking skills of class V elementary school students on the material of movement organs using the RADEC model. *Jurnal Penelitian Pendidikan IPA*, 9(1), 1–4. https://doi.org/10.29303/jppipa.v9i7.3926

Febianti, F. A., & Sukmawati, W. (2024). Improving students' science literacy skills through treasure hunting games with Problem Based Learning model. *Jurnal Penelitian Pendidikan IPA*, 10(9), 6363–6375. https://doi.org/10.29303/jppipa.v10i9.7996

Fitria, A., & Sukmawati, W. (2024). The influence of magnetic media usage on improving reading literacy skills in material understanding of objects in second grade elementary school. *Jurnal Penelitian Pendidikan IPA*, 10(9), 6426–6433. https://doi.org/10.29303/jppipa.v10i9.7991

Fitria, M. N., & Sukmawati, W. (2022). Analisis perbedaan hasil belajar pada pembelajaran matematika secara daring dan luring siswa kelas V SDN Tegal Alur 21 Petang. *Ideas: Jurnal Pendidikan, Sosial, dan Budaya*, 8(3), 833. https://doi.org/10.32884/ideas.v8i3.853

Hartomo, R. M., & Sukmawati, W. (2024). The effect of digital flipbook media on improving science literacy on human digestive system materials among elementary school students. *Jurnal Penelitian Pendidikan IPA*, 10(9), 6260–6270. https://doi.org/10.29303/jppipa.v10i9.7994

Ifdaniyah, N., & Sukmawati, W. (2024). Analysis of changes in students' science literacy ability in class V elementary school science learning using the RADEC model. *Jurnal Penelitian Pendidikan IPA*, 10(2), 681–688. https://doi.org/10.29303/jppipa.v10i2.3952

Istiqomah, N., & Sukmawati, W. (2023). Stacking analysis of the mastery of science concepts in the RADEC learning model for grade IV elementary students. *Jurnal Penelitian Pendidikan IPA*, 9(10), 7993–8000. https://doi.org/10.29303/jppipa.v9i10.3999

Izzati, T. G., & Sukmawati, W. (2024). Increasing science literacy through make a match learning media on human growth materials in class V of elementary school. *Jurnal Penelitian Pendidikan IPA*, 10(9), 6541–6551. https://doi.org/10.29303/jppipa.v10i9.7995

Kusnadi, N. F., & Sukmawati, W. (2023). Analysis of changes in the level of difficulty of elementary school students in learning the RADEC model on the concept of energy transformation using the Rasch model. *Jurnal Penelitian Pendidikan IPA*, 9(Special Issue), 1121–1127. https://doi.org/10.29303/jppipa.v9ispecialissue.4036

Muthi'ah, N. M., & Sukmawati, W. (2023). Racking analysis instrument mastery test concepts in learning science using the RADEC model in elementary school students. *Jurnal Penelitian Pendidikan IPA*, 9(Special Issue), 1137–1143. https://doi.org/10.29303/jppipa.v9ispecialissue.3976

Novianti, R., Aisyah, W. N., & Sukmawati, W. (2023). Analysis of students' answer error on understanding of energy concept in Conceptual Change Text (CCT)-based learning. *Jurnal Penelitian Pendidikan IPA*, 9(2), 505–508. https://doi.org/10.29303/jppipa.v9i2.2049

Nurliana, N., & Sukmawati, W. (2023). Stacking analysis on the application of the RADEC model to the creativity of fifth grade elementary school students on water cycle material. *Jurnal Penelitian Pendidikan IPA*, 9(8), 5964–5970. https://doi.org/10.29303/jppipa.v9i8.3951

Putri, N. T., & Sukmawati, W. (2024). Improving science literacy in elementary schools through the application of the RADEC model. *Jurnal Penelitian Pendidikan IPA*, 10(8), 6230–6238. https://doi.org/10.29303/jppipa.v10i8.7993

Ramadhani, I. N., & Sukmawati, W. (2022). Analisis pemahaman literasi sains berdasarkan gender dengan tes diagnostik three-tier multiple choice. *Ideas: Jurnal Pendidikan, Sosial, dan Budaya*, 8(3), 781. https://doi.org/10.32884/ideas.v8i3.860

Saputri, A. L., & Sukmawati, W. (2024). The influence of the Team Games Tournament (TGT) learning model assisted by Wordwall on the scientific literacy of class V elementary school students. *Jurnal Penelitian Pendidikan IPA*, 10(7), 3787–3798. https://doi.org/10.29303/jppipa.v10i7.7992

Sukmawati, W. (2020). Techniques adopted in teaching students organic chemistry course for several years. *Jurnal Inovasi Pendidikan IPA*, 6(2), 247–256. https://doi.org/10.21831/jipi.v6i2.38094

Sukmawati, W. (2021). Is conceptual learning based on Conceptual Change Text (CTT) effectively applied to PGSD students' science classes? *Jurnal Inovasi Pendidikan IPA*, 7(2), 171–181.

Sukmawati, W. (2023). Analysis of changes in students' scientific literacy ability after attending lectures using the RADEC model. *Jurnal Penelitian Pendidikan IPA*, 9(3), 1039–1044. https://doi.org/10.29303/jppipa.v9i3.2846

Sukmawati, W., Kadarohman, A., Sumarna, O., & Sopandi, W. (2021a). Analysis of reduction of COD (Chemical Oxygen Demand) levels in tofu waste using activated sludge method. *Moroccan Journal of Chemistry*, 9(2), 339–345. https://doi.org/10.48317/IMIST.PRSM/morjchem-v9i2.27586

Sukmawati, W., Kadarohman, A., Sumarna, O., & Sopandi, W. (2021b). The relationship of basic chemical [judul tidak lengkap]. *Journal of Engineering Science and Technology*, [volume tidak tercantum], 42–48.

Sukmawati, W., Sari, P. M., & Yatri, I. (2022). Online application of science practicum video based on local wisdom to improve students' science literacy. *Jurnal Penelitian Pendidikan IPA*, 8(4), 2238–2244. https://doi.org/10.29303/jppipa.v8i4.1940

Sukmawati, W., & Wahjusaputri, S. (2024). Integrating RADEC model and AI to enhance science literacy: Student perspectives. *Jurnal Penelitian Pendidikan IPA*, 10(6), 3080–3089. https://doi.org/10.29303/jppipa.v10i6.7557

Sulistiani, N. A., & Sukmawati, W. (2024). The relationship between e-book material on grouping animals based on food type and the scientific literacy ability of students in elementary schools. *Jurnal Penelitian Pendidikan IPA*, 10(7), 3913–3919. https://doi.org/10.29303/jppipa.v10i7.8248

Wahjusaputri, S., Nastiti, T. I., Bunyamin, B., & Sukmawati, W. (2024). Development of artificial intelligence-based teaching factory in vocational high schools in Central Java Province. *Journal of Education and Learning (EduLearn)*, 18(4), 1234–1245. https://doi.org/10.11591/edulearn.v18i4.21422

Wahjusaputri, S., Sukmawati, W., Nastiti, T. I., & Noorlatipah, V. (2022). Strengthening teacher pedagogical literacy after the Covid-19 pandemic in vocational secondary education in Banten Province. *Jurnal Pendidikan Vokasi*, 12(2), 181–188. https://doi.org/10.21831/jpv.v12i2.47119

Wati Sukmawati, A., Kadarohman, A., Sumarna, O., Sopandi, W., & Fitriani, Y. Y. (2023). Item response analysis of understanding concepts of material chemistry with RADEC models in pharmaceutical students. *Journal of Engineering Science and Technology*, 18(4), 2132–2147.