JPPIPA 11(8) (2025)

Jurnal Penelitian Pendidikan IPA

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

The Effect of the Use of Kosica Media (Light Properties Box) on the Understanding of the Concept of Light Properties in Grade 4 Elementary School Students

Cahya Amalia Ramadhanti[1*], Wati Sukmawati[1]

[1] Elementary School Teacher Education, Faculty of Teacher Training and Education, Prof. Dr. Hamka Muhammadiyah University, Jakarta, Indonesia.

Received: May 30, 2025
Revised: July 23, 2025
Accepted: August 25, 2025
Published: August 31, 2025

Corresponding Author:
Cahya Amalia Ramadhanti
comcahya.amaliar@uhamka.ac.id

DOI: 10.29303/jppipa.v11i8.11540

Abstract: This study aimed to examine the effect of KOSICA (Box of Light Properties) media on elementary students' conceptual understanding of light properties. The research was conducted at SDN Duren Tiga 13 Pagi, South Jakarta, using a quasi-experimental design involving two groups: control and experimental. The experimental group learned using KOSICA, while the control group received conventional instruction. An independent samples t-test revealed a significant difference between the groups ($t = -4.460$, $p = 0.000$), with higher post-test scores in the experimental group. Additionally, Rasch model stacking analysis showed that most students in the experimental class improved after the intervention. These findings suggest that KOSICA is an effective contextual tool to enhance science learning in elementary schools.

Keywords: Conceptual understanding; Kosica; Learning media; Properties of light; Quasi experiment; Rasch

Introduction

Education is a conscious and planned process aimed at optimally developing students' full potential, encompassing spiritual, cognitive, affective, and psychomotor domains (Marbun et al., 2019; Rahman et al., 2022). At the elementary school level, one of the main challenges in learning is presenting abstract concepts through concrete and meaningful approaches. Therefore, the use of interactive and contextual learning media is essential (Izzah et al., 2022). Science, particularly the topic of the properties of light, requires students to be directly involved in learning in order to fully understand concepts such as reflection, refraction, and absorption (Hartomo et al., 2024; Lestari et al., 2024a, 2024b).

However, direct observations by the researcher at SD Negeri Pinang Ranti 05 revealed that most students still struggle to grasp these concepts (Ramadhani et al., 2022; Sukmawati, 2020; Wahjusaputri et al., 2022). This difficulty stems from the dominant use of lecture-based methods and textbooks without adequate support from visual and experimental learning media (Aulia et al., 2024; Febianti et al., 2024; Latifah et al., 2024).

Previous studies have shown that the KOSICA (Kotak Sifat Cahaya or Box of Light Properties) media is effective in improving students' understanding of light concepts (Fadhilah et al., 2022; A. P. Lestari et al., 2016; Malo et al., 2025). However, the novelty of this research lies in the "development of a modified KOSICA media design" that presents light phenomena in a more tangible way, and in the use of a "quasi-experimental two-class approach" (experimental and control classes), which has rarely been explored in prior studies.

In addition, interviews with teachers at the research site revealed that the KOSICA media has never been used in learning, even though they acknowledged its potential to increase students' learning motivation and

How to Cite:
Ramadhanti, C. A., & Sukmawati, W. (2025). The Effect of the Use of Kosica Media (Light Properties Box) on the Understanding of the Concept of Light Properties in Grade 4 Elementary School Students. *Jurnal Penelitian Pendidikan IPA*, *11*(8), 644–650. https://doi.org/10.29303/jppipa.v11i8.11540

conceptual understanding. This indicates a real need in the field for innovative learning media that can bridge science concepts with students' real-world experiences. (Fitria et al., 2024; Sukmawati, 2021; Sukmawati et al., 2024; Wahjusaputri et al., 2022).

There fore, this research is crucial to address that gap and to offer an alternative learning medium that is both innovative and effective. The primary objective of this study is to examine the effect of using KOSICA media on fourth-grade students' understanding of the properties of light through a quasi-experimental approach. This study is expected to contribute to improving the quality of science education in elementary schools and to enrich the literature on the development of contextual learning media.

Method

This research was conducted at SDN Duren Tiga 13 Pagi, South Jakarta in April 2025. The researcher uses a quantitative method with a quasi-experimental type of research (Ary et al., 2009). Quasi-experimentation can be referred to as an experiment that has a treatment, impact measurement, experimental unit but does not use random assignments to create comparisons in order to infer changes caused by the treatment (El-Tonsy, 2016). The research design used in this study is a "quasi-experimental design" involving two groups: an experimental class and a control class. This study applies an *intact group design, in which the student groups were already formed naturally by the school (pre-existing classes). The researcher did not assign students individually to each group but instead conducted "random assignment at the class level" to determine which class would serve as the experimental group and which as the control group.

The experimental group received treatment in the form of learning using "KOSICA (Kotak Sifat Cahaya or Box of Light Properties)" media developed by the researcher, delivered through a contextual approach. This media allows students to directly observe various light phenomena such as reflection, refraction, and absorption through real visualizations and simple experiments inside the box. This approach is designed to connect scientific concepts with students' real-world experiences, making the learning process more meaningful.

In contrast, the control group followed learning using a "conventional approach", which relied on teacher lectures and textbooks without the use of interactive learning media. This method reflects the typical teaching practices previously applied at the school. The form of questions in this study is multiple choice with a total of 25 questions. Test results will be obtained as scores when students have completed the test, both the pre-test and the last test after treatment (post-test) completed by the student, especially students in grades IV-A (control class) 24 students and IV-B (experimental class) 24 students.

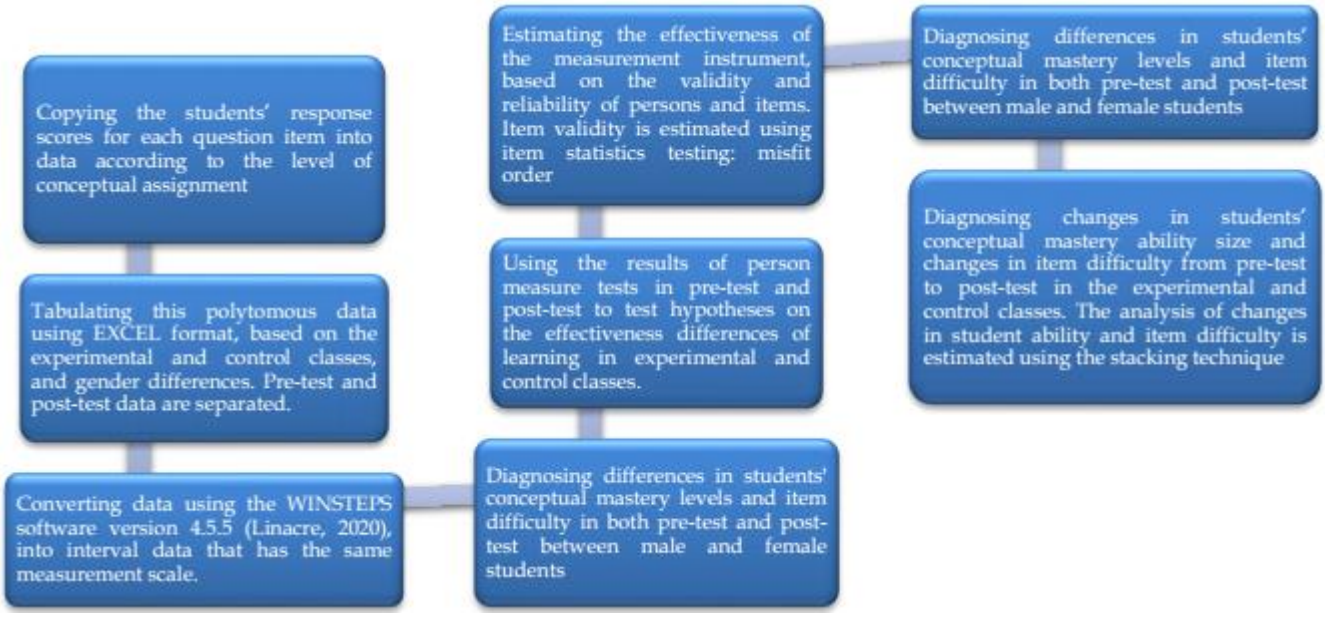

Figure 1 Steps of stacking analysis using the Rasch model

This design was chosen to comparatively measure the effect of using KOSICA media on students' conceptual understanding of the properties of light between the two groups. The treatment implementation flow can be illustrated as follows:

Treatment Flow Diagram
Subject Selection

a. Class IV-A and IV-B at SDN Duren Tiga 13 Pagi.
b. Number of students in each class is recorded (IV-A = 24 students; IV-B = 24 students).

Class Randomization

a. A lottery is conducted to assign.
b. Class IV-A as the control group.
c. Class IV-B as the experimental group

Treatment Implementation

a. Experimental Group (IV-B): Learning with KOSICA media (contextual approach).
b. Control Group (IV-A): Conventional learning (lecture and textbook-based.

Learning Outcome Measurement

Both groups receive a pretest and posttest to assess their understanding of the properties of light.

Data analysis was carried out through understanding the concepts provided before and after treatment. These values are analyzed with a stacking analysis approach. According to Sukarelawan et al. (2024), stacking analysis in Rasch modeling is a longitudinal analysis technique used to compare the ability of individuals (learners) before and after treatment in understanding the concept of the properties of light. After the results are obtained, data processing is carried out by stacking analysis using the RASCH model (Nurliana et al., 2023), with steps as in figure 1.

Result and Discussion

This study compares two instructional methods: conventional teaching using PowerPoint presentations designed through the Canva application, and experimental teaching utilizing the KOSICA media. The purpose of this comparison is to examine the effects of each method on fourth-grade elementary school students. The instrument used demonstrated good content validity, although its individual reliability was low—likely due to the small sample size. Nevertheless, the instrument was still considered appropriate for enhancing students' understanding of the properties of light.

To provide an initial overview of students' conceptual understanding, descriptive statistics were first calculated. Table 1 presents the statistical data of the posttest scores for each group. The results show that the control class achieved an average score of 40.00 with a standard deviation of 17.811, while the experimental class obtained an average score of 64.17 with a standard deviation of 19.684. This difference in average scores indicates a notable disparity in performance between the two groups.

Table 1. Group Statistic

Class	N	Mean	Std. Deviation	Std. Error
Posttest_control	24	40.00	17.811	3.636
Posttest_experiment	24	64.17	19.684	4.018

Table 2 presents the results of the Independent Samples t-test, which indicate a significant difference between the posttest scores of the control class and the experimental class. Based on Levene's test, the significance value is 0.457 (> 0.05), indicating that the variances of the two groups can be assumed to be equal. Furthermore, the t-test results show a t value of -4.460 with degrees of freedom (df) = 46 and a significance value (Sig. 2-tailed) of 0.000 (< 0.05). This suggests that the difference between the two groups is statistically significant. The mean difference between the experimental and control groups is -24.167, with a 95% confidence interval ranging from -35.074 to -13.260. Thus, the use of KOSICA media in learning has a significant impact on improving students' conceptual understanding compared to conventional teaching methods.

Table 2. Independent Samples Test

F (levene)	Sig. (levene)	t	df	P (2-tailed)	Mean diff	95% CI lower	95%CI upper
0.563	0.457	-4.460	46	0.000	-24.167	-35.074	-13.260
		-4.460	45.548	0.000	-24.167	-35.077	-13.257

After the results were obtained, the data were processed using stacking analysis with the Rasch model

Analysis of Control Class Students Taught with the Cooperative Learning Model

Based on the data in Table 3, which presents the pre-test and post-test scores of 24 students in the control class, the Rasch model analysis grouped students into three categories based on changes in scores from pre-test to post-test: increased, decreased, and unchanged. Out of a total of 24 participants: 13 students (54.2%) showed an increase in scores, 7 students (29.2%) experienced a decrease in scores, and 4 students (16.6%) had no change in scores (Izzati et al., 2024; Putri et al., 2024; Sukmawati, 2020; Sulistiani et al., 2024).

Table 3. Measurement of Students' Scores Based on the Scale of Understanding Class Concepts

Participants	Pretest	Postetst	Measure Pretest-Posttest	Information
1	-4.14	-5.46	-1.32	Decreased
2	-4.31	-3.2	1.11	Increase
3	-3.86	-4.14	-0.28	Decreased
4	-3.64	-3.28	0.36	Increase
5	-3.45	-3.54	-0.09	Decreased
6	-3.54	-3.64	-0.1	Decreased
7	-3.37	-3.45	-0.08	Decreased
8	-3.28	-2.21	1.07	Increase
9	-2.63	-3.03	-0.4	Decreased
10	-3.99	-3.11	0.88	Increase
11	-4.31	-4.31	0	Remain
12	-3.99	-4.14	-0.15	Decreased
13	-3.74	-3.54	0.2	Increase
14	-3.37	-2.74	0.63	Increase
15	-3.54	-3.45	0.09	Decreased
16	-3.64	-3.37	0.27	Increase
17	-3.37	-3.03	0.34	Increase
18	-3.03	-2.52	0.51	Increase
19	-3.37	-3.03	0.34	Increase
20	-3.86	-3.54	0.32	Increase
21	-3.11	-3.11	0	remain
22	-3.54	-3.54	0	Remain
23	-3.74	-3.28	0.46	Increase
24	-3.64	-3.64	0	remain

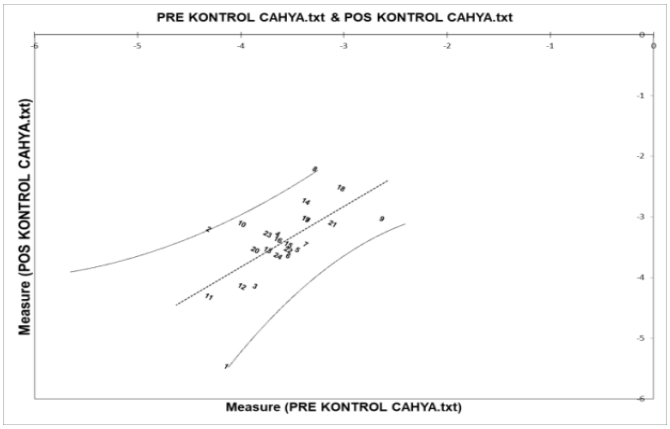

Figure 2. Chart arrangement of change in concept understanding of control class students

Students categorized in the increased group include participants number 2, 4, 8, 10, 13, 14, 16, 17, 18, 19, 20, and 23. The highest increase in score was recorded by participant number 2 with a gain of 1.11 points, while the smallest increase was shown by participant number 13 with an increase of only 0.20 points. The decreased group consists of participants number 1, 3, 5, 6, 7, 9, 12, and 15. The greatest score decrease occurred with participant number 1, who had a -1.32 point drop from pre-test to post-test (Saputri et al., 2024; Sukmawati et al., 2024, 2024; Wahjusaputri et al., 2024). Meanwhile, the unchanged group includes participants number 11, 21, 22, and 24. These students showed the same scores on both the pre-test and post-test, indicating no change in their performance (Ifdaniyah et al., 2024; Kusnadi et al., 2023; Muthi'ah et al., 2023; Sukmawati et al., 2024).

Analysis of Experimental Class Students Taught Using KOSICA Media

Based on the analysis of students using the Rasch model, it was found that 23 out of 24 students showed improvement. This indicates that the majority of participants experienced positive development after receiving treatment between the pretest and posttest periods. This improvement can be interpreted as an effective result of a learning process aimed at enhancing students' conceptual understanding (M. N. Fitria et al., 2022; Istiqomah et al., 2023; Novianti et al., 2023; Ramadhani et al., 2022).

Table 4. Measurement of Student Scores Based on the Scale of Understanding of Experimental Class Concepts

Participants	Pre-Test	Post-Test	Measure Posttest - Pretest	Information
1	0.07	-0.46	-0.53	Decreased
2	-1.8	-0.28	1.52	Increase
3	-1.51	-0.64	0.87	Increase
4	-0.64	0.61	1.25	Increase
5	-0.64	1.5	2.14	Increase
6	-0.64	2.65	3.29	Increase
7	-0.64	0.25	0.89	Increase
8	-1.51	0.43	1.94	Increase
9	-0.83	1.25	2.08	Increase
10	-1.04	1.25	2.29	Increase
11	-0.28	1.8	2.08	Increase
12	-1.51	-1.04	0.47	Increase
13	-0.83	0.43	1.26	Increase
14	-1.26	0.07	1.33	Increase
15	-0.64	2.16	2.8	Increase
16	0.07	2.65	2.58	Increase
17	-1.04	-0.1	0.94	Increase
18	-1.26	1.25	2.51	Increase
19	-0.83	0.07	0.9	Increase
20	-1.26	-0.64	0.62	Increase
21	-1.04	1.8	2.84	Increase
22	-0.28	2.65	2.93	Increase
23	-1.51	0.61	2.12	Increase
24	0.07	0.43	0.36	Increase

Table 4 presents the pretest and posttest scores of 24 students in the experimental class. Based on the Rasch model analysis, 23 out of 24 students demonstrated increased ability. The highest individual gain was recorded by student number 6, with an increase of 3.29 logits. Other significant improvements were shown by student number 22 (2.93 logits) and student number 21 (2.80 logits). The only student who experienced a decline was student number 1, whose pretest score of 0.07 dropped to -0.46 in the posttest, resulting in a decrease of 0.53 logits.

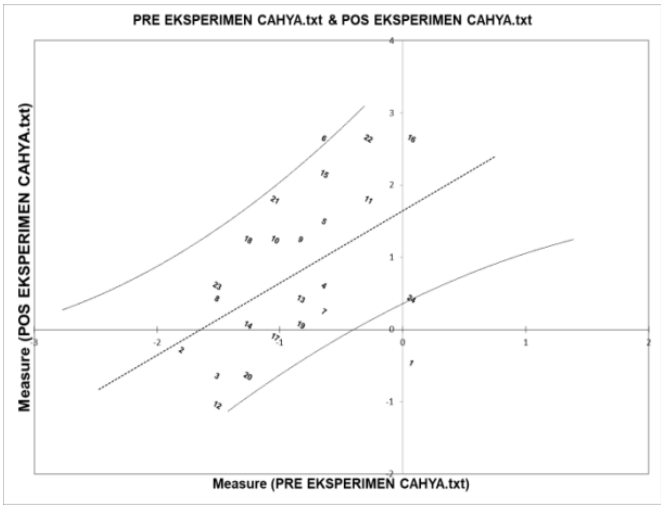

Figure 3. Chart arrangement of change in concept understanding of experimental class students

Discussion

This finding of this study indicate that the use of KOSICA media significantly contributes to improving students' conceptual understanding. Based on the results of the independent sample t-test, there was a significant difference between the post-test scores of students in the control and experimental classes, suggesting that the intervention was effective in enhancing learning outcomes. In the control class, students' performance varied: 13 out of 24 students showed improvement, 4 showed no change, and 8 experienced a decline. In contrast, in the experimental class, almost all students 23 out of 24 demonstrated improvement, with only one student showing a decrease. These findings suggest that the implementation of KOSICA media can enhance student engagement and deepen conceptual understanding more effectively than conventional teaching methods. KOSICA media also provides visual context that helps students connect abstract scientific concepts with real-life experiences.

Figure 4. KOSICA media is an experimental class

Figure 5. Conventional learning in control class

Conclusion

Based on the results of this study, it can be concluded that the use of KOSICA (Box of Light Properties) as a learning medium has a significant impact on improving students' conceptual understanding of the properties of light. KOSICA is designed to present light phenomena such as reflection, refraction, and absorption through a contextual and visual approach, allowing students to engage directly with learning experiences. Compared to conventional teaching methods that rely on lectures and textbooks, the use of KOSICA proves to be more effective in helping students connect abstract scientific concepts with their real-world experiences. Statistical analysis confirmed a significant difference in post-test scores between the experimental and control groups. In addition, stacking analysis using the Rasch model supported this finding by showing that the majority of students in the experimental class experienced increased conceptual understanding after the intervention. These results provide empirical evidence that contextual and interactive learning media like KOSICA can effectively address the challenges of science instruction at the elementary level. Therefore, KOSICA offers a relevant and applicable alternative learning tool that promotes meaningful, student-centered science learning. Its use can enhance students' motivation, engagement, and comprehension, making it a valuable contribution to the development of innovative science education practices in primary schools.

Acknowledgments

Thank you to SDN Duren Tiga 13 and the PGSD Study Program of the University of Muhammadiyah Prof. Dr. Hamka.

Author Contributions

All research activities, data collection, processing, and publication writing is a contribution from CAR. Writing a

research proposal, instrument validation, learning data processing using RACH, and article writing is a significant contribution of WS.

Funding
This research was not funded by any outside party.

Conflicts of Interest
The author states that there is no conflict of interest in the research until the writing of this article. The author also warrants that no circumstances or personal interests can be considered to affect the inaccurate representation or interpretation of the results of the research.

References

Ary, D., Jacobs, L., Razavieh, A., & Sorensen, C. (2009). *Introduction to Research in Education* (8th ed.). Wadsworth Cengage Learning.

Aulia, D., Putri, A., Anugrah, D., Ninawati, M., Amirullah, G., & Handayani, S. L. (2024). Penerapan Metode Jarimatika di Pusat Pemulihan Dalam Komuniti (PPDK) Changlun Untuk Anak Berkebutuhan Khusus. *Jurnal Pengabdian Masyarakat Larisma*, *1*(2), 67–71. https://doi.org/10.56495/jpml.v1i2.788

El-Tonsy, M. M. (2016). Introduction To Medical Parasitology. In *Encyclopedia of Life Support System (EOLSS-UNESCO)* (p. 53). Retrieved from https://www.researchgate.net/publication/259670265_Introduction_To_Medical_Parasitology

Fadhilah, E., Subari, I., & Kirana, A. R. (2022). Penggunaan Media Kotak Sifat Cahaya Dalam Meningkatkan Hasil Belajar Siswa Kelas IV SD Negeri 2 Gedong Air. *Jurnal Ilmiah Mahasiswa Guru Sekolah Dasar*, *1*(2), 473–484. Retrieved from https://www.stkippgribl.ac.id/eskripsi/index.php/pgsd/article/view/570/448

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

Izzah, S. I. N., & Sukmawati, W. (2022). Pengaruh Model Problem Based Learning Terhadap Motivasi Belajar Peserta Didik pada Pembelajaran IPS. *Ideas: Jurnal Pendidikan, Sosial, Dan Budaya*, *8*(3), 765. https://doi.org/10.32884/ideas.v8i3.852

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*(SpecialIssue), 1121–1127. https://doi.org/10.29303/jppipa.v9ispecialissue.4036

Latifah, N., Meliana, S. F., Zulfadewina, Z., & Zulherman, Z. (2024). Menulis Untuk Masa Depan: Pelatihan Artikel Ilmiah Bagi Guru SDN Kramat Jati 11 Jakarta Timur. *Jurnal Pengabdian Masyarakat Madani (JPMM)*, *4*(2), 79–86. https://doi.org/10.51805/jpmm.v4i2.162

Lestari, A. P., Susilawati, S., & Sahib, A. (2016). *Pengaruh Penggunaan Metode Eksperimen Pada Mata Pelajaran IPA Kelas V Materi Cahaya Dan Sifat-Sifatnya Di SDN 02 Selupu Rejang Terhadap Hasil Belajar*. Institut Agama Islam Negeri Curup.

Lestari, A., Widayanti, A., Ninawati, M., Amirullah, G., & Handayani, S. L. (2024). Pemanfaatan Teknik Tie-Dye Untuk Meningkatkan Keterampilan dan Kreativitas Anak Berkebutuhan Khusus di Pusat Pemulihan Dalam Komuniti Changlun. *Jurnal Pengabdian Masyarakat Larisma*, *1*(2), 62–66. https://doi.org/10.56495/jpml.v1i2.785

Malo, F. G., Dinatha, N. M., Dolo, F. X., & Kua, M. Y.

(2025). Pengembangan Alat Peraga Kotak Sifat Cahaya Sebagai Media Pembelajaran Ipas Siswa Sd. *Jurnal Dedikasi Pendidikan*, *9*(1), 383–398. https://doi.org/10.30601/dedikasi.v9i1.5868

Marbun, M., Pakpahan, R., & Tarigan, A. K. (2019). Hubungan Pengetahuan Ibu Hamil Dan Tingkat Ekonomi Tentang Kejadian Stunting Dipuskesmas Parapat Kecamatan Parapat Kabupaten Simalunguntahun 2019. *Jurkessutra: Jurnal Kesehatan Surya Nusantara*, *7*(2). https://doi.org/10.48134/jurkessutra.v7i2.4

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*(SpecialIssue), 1137–1143. https://doi.org/10.29303/jppipa.v9ispecialissue.3976

Novianti, R., Aisyah, W. N., & Sukmawati, W. (2023). Analysis of Student's 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

Rahman, A., Munandar, S. A., Fitriani, A., Karlina, Y., & Yumriani. (2022). Pengertian Pendidikan, Ilmu Pendidikan dan Unsur-Unsur Pendidikan. *Al Urwatul Wutsqa: Kajian Pendidikan Islam*, *2*(1), 1–8. Retrieved from https://journal.unismuh.ac.id/index.php/alurwatul/article/view/7757

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

Sukarelawan, M. I., Indratno, T. K., & Ayu, S. M. (2024). *N-Gain vs Stacking*. Surya Cahya.

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., Lestari Handayani, S., & Yeni, Y. (2022). Is conceptual learning based on conceptual change text (CCT) effectively applied to pgsd students science class? *Jurnal Inovasi Pendidikan IPA*, *7*(2), 171–181. https://doi.org/10.21831/jipi.v7i2.44034

Sukmawati, W., & Rahmiati, R. (2024). Pendampingan Gerakan Literasi Membaca Di Sekolah Dasar. *Martabe : Jurnal Pengabdian Kepada Masyarakat*, *7*(2), 579–584. Retrieved from http://jurnal.um-tapsel.ac.id/index.php/martabe/article/view/14907

Sukmawati, W., & Sari, P. M. (2024). Pendampingan Pembuatan Alat Peraga IPA Berbasis Sel Surya Di Sekolah Dasar Negeri Di Jakarta. *Martabe: Jurnal Pengabdian Kepada Masyarakat*, *7*. https://doi.org/10.31604/jpm.v7i6.2337-2343

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