



Improving Concept Understanding and Learning Outcomes of Elementary School Students through Science Textbooks Based on Learning Cycle 7E Model

Rena Elia^{1*}, Solfema¹, Yalvema Miaz¹, Zelhendri Zen¹

¹Pendidikan Dasar, Fakultas Ilmu Pendidikan, Universitas Negeri Padang, Indonesia

Received: May 15, 2024

Revised: June 30, 2024

Accepted: July 25, 2024

Published: July 31, 2024

Corresponding Author:

Rena Elia

rena.amabel@gmail.com

DOI: [10.29303/jppipa.v10i7.7662](https://doi.org/10.29303/jppipa.v10i7.7662)

© 2024 The Authors. This open access article is distributed under a (CC-BY License)



Abstract: This research aims to develop textbooks based on the Learning Cycle 7E approach for learning Science of Nature and Environment (IPAS) in grade IV Elementary School. The textbook development process includes needs analysis, design, validation, revision, and implementation. The validity of the coursebook was evaluated by experts in the aspects of material, media, and language. Practicality was assessed by teachers and students, while the effectiveness was tested using paired t-test. The results showed that the developed coursebooks were highly valid in terms of material, media, and language, based on expert validation. Teachers and students rated the textbook as very practical to use. The effectiveness test indicated a significant increase in students' understanding and learning outcomes after using the textbook. In conclusion, this Learning Cycle 7E-based textbook is effective and relevant in improving the quality of IPAS learning in grade IV SD.

Keywords: Concept understanding; Learning Cycle 7E Model; Learning Outcomes; Science; Teaching Materials

Introduction

In education, textbooks play a very important role in providing a good learning experience for students. The main goal is to help students understand important concepts and use them in everyday life (Saputro et al., 2021; Wati & Suhardi, 2022; Yulianti et al., 2020). In science subjects, understanding concepts is very important because it helps students understand the surrounding nature (Sari et al., 2024; Sumarni et al., 2022; Tunga & Jumadi, 2022). The importance of concept understanding is not only in mastering the lesson, but also in building solid knowledge (Islami et al., 2023; Oktarisma & Amini, 2023). With a good understanding, students can develop critical thinking and problem-solving skills, which are important for future life and work. Concept understanding also helps students develop a scientific attitude (Hasanah, 2021; Lubis et al., 2023; Sasmita et al., 2022).

The creation of effective Science teaching materials has a very important purpose in improving the quality of learning. One of the main goals is to create interesting and relevant learning experiences for students (Sabil et al., 2021; Sekarwangi et al., 2021; Simbolon & Koeswanti, 2020). When teaching materials are geared towards being interesting, students are more likely to be actively involved in learning and have high motivation to understand the concepts being taught. Besides the importance of interesting materials, the relevance of teaching materials is also a key factor (Amin et al., 2021; Damayanti & Putra, 2021). Relevant teaching materials will allow students to see the connection between the science concepts learned and their daily experiences. In this way, students can more easily understand the importance of the concept in their lives and become more motivated to learn (Adiani & Kristiantari, 2020; Hidayah & Mustadi, 2021; Rati & Rediani, 2021).

How to Cite:

Elia, R., Solfema, S., Miaz, Y., & Zen, Z. (2024). Improving Concept Understanding and Learning Outcomes of Elementary School Students through Science Textbooks Based on Learning Cycle 7E Model. *Jurnal Penelitian Pendidikan IPA*, 10(7), 4433-4441. <https://doi.org/10.29303/jppipa.v10i7.7662>

Based on a preliminary study conducted in one of the schools in Agam Regency, West Sumatra, it appears that learning is often influenced by the teacher's approach which tends to be dominant, which has an impact on students' dependence on direct instructions from the teacher. Lack of activation of students' prior knowledge, presentation of material that is difficult to understand, and unattractive textbook design are also the main problems.

Teaching materials that are not connected to students' daily contexts and the lack of student-centered learning are other challenges. In addition, limitations in engaging students in problem solving and reliance on information delivery alone hinder interactive and in-depth learning. Therefore, efforts are needed to change the learning approach to be more responsive to students' needs, promote students' independence, and integrate materials with their life context to create a more meaningful and effective learning experience.

One approach that can be used is the development of textbooks based on the Learning Cycle 7E learning model (Hidayah & Mustadi, 2021; Mustikaningrum et al., 2021; Wedaswari & Tegeh, 2023). This model provides a comprehensive framework for integrating student-centered learning concepts, facilitating exploration, deep understanding, and practical application of the subject matter. By using this approach, coursebooks can be designed to activate students' prior knowledge, present material with stages that are appropriate to their level of understanding, and offer activities that are interesting and relevant to everyday life.

In addition, the Learning Cycle 7E learning model also encourages student independence in problem solving, by providing space for exploration and reflection on the concepts learned. Thus, the use of Learning Cycle 7E-based textbooks is expected to provide an effective solution in improving the quality of learning, stimulating students' interest, and developing their deep concept understanding and critical thinking skills (Azhar et al., 2023; Mustika & Ain, 2020; Supasorn et al., 2022; Vista & Sukma, 2023; Yani et al., 2023).

Research by Rawa et al. (2021) focuses on making flat geometry modules for seventh grade junior high school students. This module discusses material about lines, angles, triangles, and quadrilaterals. The results show that the module is useful and suitable for use in learning. Furthermore, research by Tarigan et al. (2022) created an e-module for learning about buffer solutions at the secondary education level. This e-module helps students learn better.

Finally, research by Ilma et al. (2022) developed an electronic practicum guide on acid-base based on the Learning Cycle 7E learning model and the concept of green chemistry. The results showed that the practicum

guide was very useful based on expert assessment. These three studies show that using the Learning Cycle 7E learning model can create better teaching materials in various lessons. With a focus on students and structured learning steps, these teaching materials provide a better learning experience for students.

This research introduces the development of textbooks based on the Learning Cycle 7E learning model as a solution. This model integrates student-centered learning concepts, facilitating exploration, deep understanding, and practical application of subject matter (Kasli et al., 2022; Nurdini et al., 2021). The coursebook is designed to activate students' prior knowledge, present material in stages, and offer relevant activities. This approach also encourages independence in problem solving through exploration and reflection.

Although previous studies have used the Learning Cycle 7E model for various teaching materials at the junior and senior high school levels (Ilma et al., 2022; Rawa et al., 2021; Tarigan et al., 2022), there has been no research that focuses on developing science textbooks based on this model in elementary schools. This research is expected to significantly improve elementary school students' understanding of science concepts and learning outcomes, making it an effective and relevant solution in improving the quality of science learning in elementary schools.

Method

The type of research conducted is research and development, which involves the process of collecting, processing, analyzing, and presenting data systematically and objectively to create a product that can solve the problem at hand. The focus of the research is to produce textbooks using the Learning Cycle 7E model that are valid, practical, and effective. The development model used refers to the 4-D model, which consists of four main stages: defining, designing, developing, and disseminating.

The steps of developing coursebooks begin with the defining stage, where Merdeka Curriculum and BSKAP Head Decree Number 008/H/KR/2022 become the focus of analysis to understand learning objectives and materials. Furthermore, through needs analysis, the coursebooks used in elementary schools were examined to ensure compliance with good coursebook criteria. An analysis of student characteristics was also conducted to identify aspects such as age, motivation, and background that influence the design of the coursebook. The design stage involves the preparation of coursebooks by following the core competencies and

basic competencies, and including components such as titles, instructions for use, and evaluations.

After that, the development stage involves validating the coursebook by experts to determine the functionality and consistency of the content, and testing the coursebook in real learning situations to assess its ease of use and usefulness. The last stage is dissemination, where the developed coursebooks are used in other schools to test their effectiveness on different subjects, by measuring student progress and completion of expected competencies.

Result and Discussion

This development procedure is in accordance with the stages of the 4-D development model. Development activities begin with analyzing the curriculum, designing teaching modules and textbooks and so on following the steps of textbook development.

Defining Stage Curriculum Analysis

The Merdeka Curriculum for grade IV elementary schools sets learning targets that include understanding science concepts, application in everyday life, science process skills, and the formation of scientific attitudes. By referring to the principles of the 7E learning cycle, such as Engage, Explore, Explain, Elaborate, Evaluate, Extend, and Evaluate, we can identify shortcomings and opportunities for improvement in learning approaches that can be adjusted. The learning objectives in the Merdeka Curriculum emphasize the achievement of concept understanding, science process skills, and the formation of scientific attitudes.

However, there is room to improve the accuracy in formulating learning objectives that are more focused on developing critical thinking skills, communication skills, and student creativity, in accordance with the principles of the 7E learning cycle. Learning strategies in the Merdeka Curriculum have involved various methods such as lectures, group discussions, experiments, and field observations. However, there is an opportunity to enrich more active, collaborative, and reflective strategies in accordance with the principles of the 7E learning cycle, such as discovery, research, application, and evaluation of science concepts.

The development of learning cycle 7E-based textbooks must pay attention to the structure and content in accordance with the Merdeka Curriculum. This includes the preparation of learning materials that are interesting, relevant, and easily understood by students, as well as learning activities that encourage exploration, reflection, and active student participation. The coursebook should also provide students with

opportunities to develop critical thinking, communication, and collaboration skills, in line with the principles of the 7E learning cycle.

Needs Analysis

Textbooks used in elementary schools have covered a wide range of material and are in accordance with the applicable curriculum. The content includes science concepts that are in accordance with the understanding of grade IV students, but needs to pay attention to a variety of learning activities that are more interesting and relevant to students' daily lives. The structure of the textbook is quite good with an organized arrangement of material and a logical sequence of topics.

However, it needs further assessment of the ease of reading the coursebook, especially in the use of language that can be understood by grade IV elementary school students. The textbook does not fully follow the principles of the 7E learning cycle as a whole. Although there is an attempt to explain the material sufficiently, there are still shortcomings in providing opportunities for students to be actively involved in learning and encouraging exploration, reflection, and active involvement of students.

From this analysis, it can be seen that the textbooks used have covered some of the criteria for good textbooks, but there is still room for improvement. It is necessary to identify existing deficiencies, such as the lack of variety of learning activities and incompatibility with the principles of the 7E learning cycle, and ask questions about how coursebooks can be improved or refined according to the needs of science learning in grade IV elementary schools.

Analysis of Student Characteristics

Grade IV elementary school students have generally reached a more mature stage of development compared to the previous stages. However, they still need learning approaches that are interesting and appropriate to their level of development. Students' skills and initial understanding of science concepts are very diverse. Therefore, coursebooks should present material in stages, starting from simple to complex, to meet their learning needs. In developing textbooks, it is important to pay attention to the interests and learning motivation of grade IV students.

The learning materials presented should be relevant to students' daily lives and able to maintain their interest during the learning process. Students' physical limitations or special needs should also be considered. The coursebook should be adaptable to students' special needs or provide additional support if needed. In addition, students' social and cultural characteristics need to be considered so that learning

materials can be relevant to their life experiences. Textbook development should respect the cultural diversity that exists in the classroom.

The coursebook should support the development of students' independence in learning, but also provide opportunities for collaboration and interaction between

students, in accordance with the principles of the 7E learning cycle.

Design Stage

Researchers designed coursebooks in accordance with core and basic competencies, following the components of coursebooks.

Table 1. Teaching Material Design

Steps	Details
Identification of Learning Objectives	Analyzing the applicable curriculum to determine the core competencies and basic competencies that must be achieved by grade IV students. Establish learning objectives that are specific, measurable, and in accordance with the core competencies and basic competencies established
Textbook Structure Organization	Dividing the coursebook into chapters or learning units that are in accordance with the curriculum and the core competencies and basic competencies to be taught. Develop a textbook structure that follows the principles of the 7E learning cycle, such as Engage, Explore, Explain, Elaborate, Evaluate, Extend, and Evaluate
Development of Learning Materials	Developing learning materials that include science concepts that are in accordance with the level of understanding of grade IV students. Presenting the material in an interesting manner, relevant to students' daily lives, and adapted to their learning styles
Development of Learning Activities	Arranging a series of learning activities that follow the principles of the 7E learning cycle for each chapter or learning unit. Organizing learning activities in stages, starting from the concept introduction stage to the application of concepts in practical situations
Provision of Learning Resources	Provide additional learning resources that support concept understanding, such as learning videos, images, or interactive simulations. Prioritizing the use of learning resources that are easily accessible and in accordance with the needs of grade IV students
Evaluation and Assessment	Develop evaluation instruments that are in accordance with the learning objectives and the core competencies and basic competencies set out. Conduct regular formative and summative evaluations to monitor student learning progress and evaluate learning effectiveness

Development Stage Validity

Teaching materials are validated by experts for material, media, and language.



Figure 1. Cover and Learning Instructions



Figure 2. Display of Teaching Material Content

Material Validation

All indicators have a validation percentage above 96%, with an overall average of 98.3%. In conclusion, the validated materials are highly valid with the category Very Valid.

Table 2. Recapitulation of Material Validation Results

Indicator	Percentage (%)	Category
Independent Learning	96	Very Valid
Learning Completely	96	Very Valid
Self-standing	100	Very Valid
Adaptive	100	Very Valid
Friendly	100	Very Valid
Textbook Components	96	Very Valid
Aspects of the Learning	100	Very Valid
Cyrcl 7E Model		
Average	98.3	Very Valid

Media Validation

Table 3. Media Validation Recapitulation Results

Indicator	Percentage (%)	Category
Graphic Quality	96	Very Valid
Cover	96	Very Valid
Content	100	Very Valid
Readability	96	Very Valid
Usability	100	Very Valid
Average	98	Very Valid

Overall, the average percentage of media validation is 98%, with the category Very Valid. The validated media is very valid for use.

Language Validation

Table 4. Recapitulation of Language Validation Results

Indicator	Percentage (%)	Category
Readability of text	100	Very Valid
Straightforward	85	Very Valid
Conformity with language rules	100	Very Valid
Effective and efficient language use	100	Very Valid
Average	96	Very Valid

The average percentage of language validation is 96%, categorized as Very Valid. The language in the

Table 7. Paired T-Test Results

Paired Samples Statistics		Mean	N	Std. Deviation	Std. Error Mean				
Pair 1	PRE TEST	75.0435	23	9.62231	2.00639				
	POST TEST	93.9565	23	2.26592	0.47248				
Paired Samples Correlations									
Pair 1	PRE TEST & POST TEST		N	Correlation	Sig.				
			23	0.559	0.006				
Paired Samples Test									
		Mean	Paired Differences	t	df	Sig. (2-tailed)			
			Std. Deviation						
			Std. Error Mean						
			95% Confidence Interval of the Difference						
			Lower	Upper					
Pair 1	PRE TEST - POST TEST	-18.91304	8.5648	1.78588	-22.61674	-15.20935	-10.59	22	0

teaching materials is very valid, but the assignment aspect needs further attention.

Practicality

Teacher Practicality

Table 5. Teacher Practicality Recapitulation Results

Indicator	Percentage (%)	Category
Language suitability	96	Very Practical
Readability and comprehension	88	Very Practical
Practicality and efficiency	96	Very Practical
Increased student ability	96	Very Practical
Average	94	Very Practical

The table shows that the coursebook is considered very practical to be used by teachers in the learning process, with an average overall percentage reaching 94%.

Student Practicality

Table 6. Recapitulation of Student Practicality Results

Indicator	Percentage (%)	Category
Practical in Learning	88	Very Practical
Improved learning outcomes	85	Very Practical
Independent and creative learning	88	Very Practical
Average	87	Very Practical

The table shows that the coursebook is considered very practical by students in the learning process, with an average overall percentage reaching 87%.

Effectiveness

In the effectiveness stage, an evaluation was conducted using a paired t-test to assess whether the coursebook was effective in improving the quality and learning outcomes of students.

The paired t-test results showed a significance p-value of 0.000 (less than 0.05). indicates that the difference between the pre-test and post-test is statistically significant. This study produced important findings in three main aspects: Validity, Practicality, and Effectiveness. The teaching materials have gone through a careful validation process by experts in three aspects: material, media, and language. All aspects of validation, whether material, media, or language, show a high level of validity, with an average validation percentage above 96%. This confirms that these teaching materials are highly valid for use in learning.

Practicality evaluation was conducted on both teachers and students. The evaluation results showed that the coursebook was considered very practical by both groups. Teachers found this coursebook very practical in learning, with an average overall percentage reaching 94%. Similarly, students also considered this coursebook very practical in learning, with an average overall percentage reaching 87%. The effectiveness evaluation was conducted using paired t-test to assess whether the coursebook was effective in improving the quality and learning outcomes of students.

The test results show that the difference between the pre-test and post-test is statistically significant, with a p-value of 0.000 (less than 0.05). This confirms that the textbook is effective in improving the quality and learning outcomes of students. Overall, this study provides strong support for the feasibility and effectiveness of learning cycle 7E-based textbooks for science learning in grade IV elementary school.

This study produced important findings in three main aspects: Validity, Practicality, and Effectiveness, which are supported by theory and related research. The validity of the teaching materials, as measured through expert validation, shows a high level of validity, in accordance with theories that emphasize the importance of the accuracy and feasibility of teaching materials in improving learning. Expert validation is a critical step in ensuring that the materials, media and language used in the coursebook meet the set standards and are relevant to the learning objectives (Gede et al., 2020; Hariyanto et al., 2020).

The practicality of the coursebooks, evaluated by both teachers and students, received support from theory which emphasizes the importance of affordability and convenience in the use of teaching materials. Practicality evaluations by teachers highlighted the importance of coursebooks that are easy to implement in the classroom context, while evaluations by students showed that coursebooks provide an enjoyable and enriching learning experience.

The results of the effectiveness test, which showed significant improvements in students' learning quality and outcomes, are consistent with effective learning

theory that emphasizes the importance of implementing appropriate learning strategies (Asrizal et al., 2022; Irfandi et al., 2023; Ramdani et al., 2021). The effectiveness test confirms that the use of learning cycle 7E-based textbooks is able to produce positive changes in student understanding and performance, strengthening the claim that this approach is an effective learning method in the context of science learning in grade IV elementary school (Azman & Johari, 2022; Djajadi & Rauf, 2020; Rosana et al., 2021).

The difference of this research from previous research lies in the use of learning cycle 7E-based learning approach in developing textbooks for science learning in grade IV elementary school. The implication of this finding is that the use of this approach can improve the validity, practicality, and effectiveness of teaching materials in that context. However, this study also faced some obstacles, such as limitations in the number of samples or limited time to collect data. Therefore, further research with a larger sample size and longer duration may be needed for further validation.

In the face of these obstacles, suggestions for future research are to expand the range of research by involving more subjects and educational institutions. In addition, it is important to pay attention to the cultural and environmental context of students in developing coursebooks to suit their needs and characteristics. Finally, further research could explore the long-term impact of using learning cycle 7E-based coursebooks on students' academic achievement and skills in science.

Conclusion

This study shows that the development of learning cycle 7E-based textbooks for learning science in grade IV elementary schools has high validity, practicality, and effectiveness. The validity of the teaching materials is proven through the validation process by experts, which shows that the materials, media, and language used are very valid and in accordance with learning standards. The practicality was evaluated by both teachers and students, confirming that this coursebook is easy to use and provides a fun learning experience. The results of the effectiveness test showed significant improvements in students' understanding and learning outcomes, confirming that the learning approach used is effective in improving the quality of learning. Therefore, the use of learning cycle 7E-based textbooks can be considered as an appropriate and relevant approach to improve science learning in grade IV elementary schools.

Acknowledgments

Thank you to all parties who have helped in this research so that this article can be published.

Author Contributions

All authors contributed to writing this article.

Funding

No external funding.

Conflicts of Interest

No conflict interest.

References

- Adiani, N. P., & Kristiantari, M. G. R. (2020). The positive impact of auditory intellectually repetition learning model assisted by domino card on mathematics learning outcomes. *International Journal of Elementary Education*, 4(3), 270–280. <https://doi.org/10.23887/ijee.v4i3.25488>
- Amin, A., Alimni, A., Kurniawan, D. A., Azzahra, M. Z., & Septi, S. E. (2021). Parental communication increases student learning motivation in elementary schools. *International Journal of Elementary Education*, 5(4), 622–630. <https://doi.org/10.23887/ijee.v5i4.39910>
- Asrizal, A., Yurnetti, Y., & Usman, E. A. (2022). ICT Thematic Science Teaching Material with 5E Learning Cycle Model to Develop Students' 21st-Century Skills. *Jurnal Perndidikan IPA Indonesia*, 11(1), 61–72. <https://doi.org/10.15294/jpii.v11i1.33764>
- Azhar, N., Junilita, W., & Irawan, D. (2023). Enhancement of Mastery Physics Concept of Momentum and Impulse Among Class X High School Students by Implementing 8E Leaning Model. *Jurnal Penelitian Pendidikan IPA*, 9(12), 11735–11740. <https://doi.org/10.29303/jppipa.v9i12.5305>
- Azman, A. N., & Johari, M. (2022). Investigating the Effectiveness of Videos Designed Using Cognitive Load Theory on Biology Students' Academic Achievement. *Jurnal Perndidikan IPA Indonesia*, 11(3), 461–468. <https://doi.org/10.15294/jpii.v11i3.37324>
- Damayanti, P. Y., & Putra, M. (2021). Pop-Up Book Learning Media on the Pancasila and Civic Education Learning Content. *International Journal of Elementary Education*, 5(1), 166–174. <https://doi.org/10.23887/ijee.v5i1.32280>
- Djajadi, M., & Rauf, A. (2020). Learning Physics of Motion and Force Using the Outdoor Activities: An Effort to Increase Students' Interest and Achievement at Secondary School. *Jurnal Perndidikan IPA Indonesia*, 9(2), 208–218. <https://doi.org/10.15294/jpii.v9i2.24001>
- Gede, I., Dantes, N., & Yudiana, K. (2020). Thematic Learning Plan with a Nature of Science Learning Model in The Fourth Grade of Elementary School. *International Journal of Elementary Education*, 4(4), 447–453. <https://doi.org/10.23887/ijee.v4i4.27208>
- Hariyanto, H., Utaminingsih, S., & Santoso, S. (2020). TBLA Mastery of Mathematical Concepts Through TPS (Think Pair Share) Learning Model Aided by Conversion Tool Games. *International Journal of Elementary Education*, 4(3), 314–314. <https://doi.org/10.23887/ijee.v4i3.28516>
- Hasanah, N. (2021). The Role of Madrasah Ibtidaiyah in Building Student Characters in The Era Of The 4.0 Industrial Revolution. *Nazhruna: Jurnal Pendidikan Islam*, 4(2), 310–319. <https://doi.org/10.31538/nzh.v4i2.1304>
- Hidayah, L. R., & Mustadi, A. (2021). The implementation of the flipped classroom for early grade students in elementary school. *International Journal of Elementary Education*, 5(1), 98–106. <https://doi.org/10.23887/ijee.v5i1.33151>
- Ilma, H., Marlina, L., & Pratiwi, R. Y. (2022). Penuntun Praktikum Elektronik Berbasis Green Chemistry dengan Model Pembelajaran Learning Cycle-7E pada Materi Asam-Basa. *Orbital: Jurnal Pendidikan Kimia*, 6(1), 60–77. <https://doi.org/10.19109/ojpk.v6i1.12018>
- Irfandi, I., Sudarma, T. F., Festiyed, F., Yohandri, Y., Diliarosta, D., Surahman, S., & Siregar, A. M. (2023). E-Learning and Physics Teaching Materials Based on Malay Ethnoscience on the East Coast. *Jurnal Pendidikan IPA Indonesia*, 12(3), 366–376. <https://doi.org/10.15294/jpii.v12i3.45442>
- Islami, Z. R., Sidiq, F., & Kurniawan, R. (2023). Constructing Students Environmental Sensitivity Through Literacy. *Jurnal Penelitian Pendidikan IPA*, 9(9), 7731–7739. <https://doi.org/10.29303/jppipa.v9i9.5146>
- Kasli, E., Farhan, A., Susanna, S., Herliana, F., & Wahyuni, S. (2022). Overview of Teacher Ability Using Core Type Cooperative Model with Blended Learning Method to Increase Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, 8(2), 1012–1017. <https://doi.org/10.29303/jppipa.v8i2.1241>
- Lubis, R. M., Suryani, I., Syahputra, A., & Sahila, W. (2023). The Importance of Islamic Education for The Mental Health of Youth in Using Social Media. *Nazhruna: Jurnal Pendidikan Islam*, 6(1), 88–103. <https://doi.org/10.31538/nzh.v6i1.2703>
- Mustika, D., & Ain, S. Q. (2020). The Understanding Improvement of Natural Science Concept of Primary School Teacher Education Department

- Students Using Project-Based Learning Model. *International Journal of Elementary Education*, 4(4), 566–74. <https://doi.org/10.23887/ijee.v4i4.28424>
- Mustikaningrum, G., Widiyanto, W., & Mediatati, N. (2021). Application of The Discovery Learning Model Assisted by Google Meet to Improve Students' Critical Thinking Skills and Science Learning Outcomes. *International Journal of Elementary Education*, 5(1), 30–38. <https://doi.org/10.23887/ijee.v5i1.34344>
- Nurdini, I. S., Sutoyo, S., & Setiarso, P. (2021). The Effectiveness of Learning Tools Using the 5E Learning Cycle Model to Improve Mastery of Concepts and Generic Science Skills. *Jurnal Penelitian Pendidikan IPA*, 7(2), 184–190. <https://doi.org/10.29303/jppipa.v7i2.672>
- Oktarisma, S., & Ammini, R. (2023). Development of an Integrated Thematic Learning Module Based on Problem Based Learning to Improve Primary School Students' Critical Thinking Abilities. *Jurnal Penelitian Pendidikan IPA*, 9(12), 11956–11967. <https://doi.org/10.29303/jppipa.v9i12.5999>
- Ramdani, A., Jufri, A. W., Gunawan, G., Fahrurrozi, M., & Yustiqvar, M. (2021). Analysis of Students' Critical Thinking Skills in terms of Gender Using Science Teaching Materials Based on The 5E Learning Cycle Integrated with Local Wisdom. *Jurnal Pendidikan IPA Indonesia*, 10(2), 187–199. <https://doi.org/10.15294/jpii.v10i2.29956>
- Rati, N. W., & Rediani, N. N. (2021). Teachers and Parents Perspective: Is It Difficult for Project-Based Learning (PjBL) During the Covid-19 Pandemic? *International Journal of Elementary Education*, 5(4), 515–524. <https://doi.org/10.23887/ijee.v5i4.40836>
- Rawa, N. R., Bela, M. E., & Pegi, M. J. (2021). Pengembangan Bahan Ajar Geometri Datar Berbasis Model Learning Cycle 7E untuk Siswa SMP. *Jurnal Ilmiah Pendidikan Citra Bakti*, 8(1), 25–37. <https://doi.org/10.38048/jipcb.v8i1.132>
- Rosana, D., Kadarisman, N., Purwanto, A., & Sari, E. K. (2021). The Effect of Learning Biophysics with STEM Approach on Science Process Skills and Critical Thinking: Field Study on Application of NA-AOGS for Increasing Soybean Productivity and Growth Rate. *Jurnal Pendidikan IPA Indonesia*, 10(3), 447–461. <https://doi.org/10.15294/jpii.v10i3.30695>
- Sabil, H., Asrial, A., Syahrial, S., Robiansah, M. A., Zulkhi, M. D., Damayanti, L., Kiska, N., Silvia, N., & Ubaidillah, U. (2021). Online Geoboard Media Improves Understanding of Two-dimensional Flat Shape Concepts in Elementary School Students. *International Journal of Elementary Education*, 5(4), 685–691. <https://doi.org/10.23887/ijee.v5i4.41785>
- Saputro, I., Winarni, R., & Indriayu, M. (2021). The Implementation of Civic Education as a Means of Internalizing Nationalism to Primary School Students. *International Journal of Elementary Education*, 5(1), 131–141. <https://doi.org/10.23887/ijee.v5i1.33364>
- Sari, M. P., Muttaqin, A., Putri, R. E., & Oktavia, R. (2024). Integrating Ethnoscience on Critical-Thinking Oriented Web-Based E-Module of Secondary School Science. *Jurnal Penelitian Pendidikan IPA*, 10(1), 371–384. <https://doi.org/10.29303/jppipa.v10i1.5928>
- Sasmita, R. N., Sapriya, S., & Maryani, E. (2022). Critical thinking on social studies learning for elementary school students. *Nazhruna: Jurnal Pendidikan Islam*, 5(3), 1377–1387. <https://doi.org/10.31538/nzh.v5i3.2355>
- Sekarwangi, T., Sartono, K. E., Mustadi, A., & Abdulah, A. (2021). The Effectiveness of Problem Based Learning-Based Interactive Multimedia for Elementary School Students. *International Journal of Elementary Education*, 5(2), 308–314. <https://doi.org/10.23887/ijee.v5i2.31603>
- Simbolon, R., & Koeswanti, H. D. (2020). Comparison of Pbl (Project Based Learning) models with Pbl (Problem Based Learning) models to determine student learning outcomes and motivation. *International Journal of Elementary Education*, 4(4), 519–529. <https://doi.org/10.23887/ijee.v4i4.30087>
- Sumarni, S., Haryati, S., Trisnowati, E., Siswanto, S., Al Firdaus, M. M., & Singgih, S. (2022). Comparison Analysis of Junior High School Science Textbooks in Indonesia and Singapore View from Nature of Science (NoS) Aspects. *Jurnal Penelitian Pendidikan IPA*, 8(4), 1707–1713. <https://doi.org/10.29303/jppipa.v8i4.1638>
- Supasorn, S., Wuttisela, K., Moonsarn, A., Khajornklin, P., Jarujamrus, P., & Chairam, S. (2022). Grade-11 students' conceptual understanding of chemical reaction rate from learning by using the small-scale experiments. *Jurnal Pendidikan IPA Indonesia*, 11(3), 433–448. <https://doi.org/10.15294/jpii.v11i3.36535>
- Tarigan, Y. B., Amir, H., & Ginting, S. M. (2022). Pengembangan E-Modul Berbasis Learning Cycle 7E pada Materi Larutan Penyangga. *Alotrop: Jurnal Pendidikan Dan Ilmu Kimia*, 6(1), 62–69. <https://doi.org/10.33369/alo.v6i1.21754>
- Tunga, M. F., & Jumadi, J. (2022). Content analysis of physics textbooks for senior high school on the principle of direct current circuits. *Jurnal Penelitian Pendidikan IPA*, 8(1), 414–422. <https://doi.org/10.29303/jppipa.v8i1.1294>
- Vista, A., & Sukma, E. (2023). Writing Narrative Essays Using the Problem-Based Learning Model Assisted by Series Drawings in Elementary Schools. *Jurnal*

- Penelitian Pendidikan IPA*, 9(12), 12182–12190.
<https://doi.org/10.29303/jppipa.v9i12.6069>
- Wati, E., & Suhardi, S. (2022). The Improvement of reading comprehension ability in explanation text with PORPE Strategy. *International Journal of Elementary Education*, 6(1), 149–157.
<https://doi.org/10.23887/ijee.v6i1.40043>
- Wedaswari, N. M. N., & Tegeh, I. M. (2023). Science Learning Videos Based on Contextual Approaches for Grade V Elementary Schools. *International Journal of Elementary Education*, 7(3).
<https://doi.org/10.23887/ijee.v7i3.61768>
- Yani, A., Mochsen, R. A., & Karmaley, C. S. (2023). Advance Organizer Learning Model to Improve Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, 9(SpecialIssue), 614–618.
<https://doi.org/10.29303/jppipa.v9ispecialissue.6229>
- Yulianti, N. M. K., Negara, I. G. A. O., & Sujana, I. W. (2020). Contribution of naturalist intelligence and learning participation toward students' knowledge competence in science. *International Journal of Elementary Education*, 4(3), 366–375.
<https://doi.org/10.23887/ijee.v4i3.26298>