Rahmah, K., Suyatna, A., Distrik, I. W., Viyanti, V. and Herlina, K. (no date) "Development of PjBL-STEM Integrated Student Worksheets (LKPD) in Differentiated Learning to Improve Student's Scientific Literacy Skills", Sebatik, 29(2).
Submitted: 2025-06-25 Accepted: 2025-08-08 Published: 2025-12-26
Sebatik Vol. 29 No. 2 December 2025
ISSN: 1410-3737(p) 2621-069X(e)

DOI:10.46984/sebatik.v29i1.2621

Development of PjBL-STEM Integrated Student Worksheets (LKPD) in Differentiated Learning to Improve Student's Scientific Literacy Skills

Karlina Rahmah 1), Agus Suyatna 2), I Wayan Distrik 3), Viyanti 4), Kartini Herlina 5)

[1,2,3,4,5]Magister Pendidikan Fisika, Universitas Lampung
[1,2,3,4,5]Jl. Prof. Dr. Sumantri Brojonegoro No. 1 Bandar Lampung, 35145
E-mail: karlinarahmah27@gmail.com[1)], asuyatna@yahoo.com[2)], wayandistrik8@gmail.com[3)]
viyanti.1980@fkip.unila.ac.id[4)], kartini.herlina@fkip.unila.ac.id[5)]

ABSTRACT

This study aims to develop a Student Worksheet (LKPD) integrated with Project-Based Learning (PjBL) and STEM within differentiated instruction to improve students' scientific literacy skills in a valid, practical, and effective manner. This research is a development study using the ADDIE model, which consists of five stages: Analyze, Define, Design, Implementation, and Evaluation. The results of data analysis show that the developed LKPD is valid for stimulating students' scientific literacy skills on the topic of renewable energy, with an overall validity percentage of 91.93%. This validity includes 92.80% for content, 92.70% for construct, and 90.27% for language aspects. The practicality of the LKPD reached 91.56%, categorized as very practical. The practicality assessment consisted of 90.90% for implementation, 90.62% for readability, and 93.18% for attractiveness. In terms of effectiveness, the LKPD obtained an N-Gain score of 0.5, which falls into the moderate category. The average pretest score was 39.72, which increased to 74.72 on the posttest. Based on the analysis results, it can be concluded that the LKPD integrated with PjBL-STEM and differentiated instruction is valid in terms of content, language, and construct. The practicality of the LKPD is categorized as very practical in terms of implementation, attractiveness, and readability, making it suitable for use in senior high school physics learning (Phase E) under the Merdeka Curriculum with the topic of Renewable Energy. The effectiveness of the LKPD is categorized as moderate, indicating that it can stimulate students' scientific literacy skills on the topic of renewable energy.

***Keywords**: LKPD, PjBL-STEM, Differentiated Instruction, Scientific Literacy, Renewble Energy.*

1. INTRODUCTION

Education is the process of teaching and learning aimed at developing students' cognitive potential, attitudes, and skills (Nainggolan, 2020). Education can never be separated from human life, as it serves as a form of preparation to face future challenges in a better and more competitive way. In this context, school is a formal educational institution whose existence is highly strategic and plays a crucial role in nurturing high-quality talents (Surbakti, 2022). Data from the 2022 PISA survey shows that while Indonesia's science education ranking improved by six positions, its science literacy score declined by 13 points (Kemendikbudristek, 2023). Based on the 2022 Trends in International Mathematics and Science Study (TIMSS) mapping results in the field of scientific literacy, Indonesia ranked 40th out of 42 participating countries. Indonesian students' scientific literacy remains low, ranking 67th out of 81 participating countries (Salamah, dkk, 2022).

The low level of scientific literacy among Indonesian students is attributed to school culture and environmental factors that have not yet supported activities encouraging students to analyze, think critically, and apply scientific knowledge in daily life (Ramadhanty, dkk, 2020). The dominance of teacher-centered learning approaches has also contributed to students' low interest in science subjects. A study conducted by (Takda, dkk, 2023) on high school students in Southeast Sulawesi revealed that students' scientific literacy, particularly in process skills, remains low. Specifically, skills such as observing, classifying data, interpreting scientific evidence, and drawing conclusions only achieved a score of 24.3%.

In the context of science application in Indonesia, students still struggle to connect the scientific knowledge they learn with real-life phenomena, mainly due to the lack of opportunities to experience and make those connections. In addition, their ability to think logically, systematically, and rationally about the scientific concepts being taught remains low (Yusmar & Fadilah, 2023). In several Indonesian provinces, scientific literacy has been assessed annually through the Regional Standardized Assessment (ASPD). Results from ASPD show that many students scored below the average. Therefore, the presence of teachers as educational facilitators is expected to help address the lack of scientific literacy skills among students. The teacher's role is crucial in delivering learning through appropriate instructional models and teaching materials, enabling students to better understand scientific literacy concepts. Teachers must have wellprepared lesson plans to enhance students' scientific literacy skills, especially in physics education.

This indicates a pressing need to develop students' scientific literacy skills, especially to support their understanding of physics education. Based on these issues, it is necessary to find a way to develop students' scientific literacy skills as an effort to help them better understand physics learning. One effective approach is to implement a learning model as a solution to the existing problems. The implementation of Project-Based Learning (PjBL) has shown promise. A study by Nuraini and Muliawan (2020) reported that 95% of students were more interested in learning science when it was linked to real-life problems.

In addition to PjBL, today's education system must adapt to the era of globalization by incorporating learning approaches that integrate Science, Technology, Engineering, and Mathematics (STEM). Student-centered learning can be implemented through differentiated instruction. This instructional strategy consists of three types: content differentiation, process differentiation, and product differentiation. Differentiated instruction addresses student diversity by considering three key aspects: readiness, interest, and learning profile (Astiti, dkk, 2021).

However, challenges still remain, as many student worksheets (LKPD) used in schools are not yet suitable for differentiated learning (Istiqomah & Timur, 2021). In addition, many teachers still use instructional strategies that treat all students the same, ignoring their individual needs and learning interests, which results in suboptimal learning outcomes. A study conducted by Sulistiani (2024) found that only 12.7% of high school teachers in Lampung Province independently develop their own LKPDs, while the remaining 87.3% rely on external sources such as textbooks, online materials, or worksheets from other schools.

Based on the issues described above, and to meet the demands of future learning, this study was conducted to develop a PjBL-STEM Integrated Student Worksheet (LKPD) within Differentiated Instruction to Improve Students' Scientific Literacy Skills**.**

2. FOCUS AND SCOPE

This study aims to develop a Student Worksheet (LKPD) integrated with Project-Based Learning (PjBL) and STEM within differentiated instruction to improve students' scientific literacy on the topic of renewable energy. This research was conducted at SMAN 1 Metro, Lampung, involving Grade X Phase E senior high school students.The scope of this study includes:

1. The differentiated instruction referred to in this study is based on the model introduced by Tomlinson (1999)
2. LKPD contains activities that support the Project-Based Learning (PjBL)–STEM model introduced by Laboy Rush (2010).
3. Scientific literacy is assessed based on several indicators defined by PISA (2015), including the ability to explain scientific phenomena, evaluate and design scientific investigations, and interpret data and scientific evidence.
4. The LKPD covers renewable energy material as outlined in the Phase E of the *Kurikulum Merdeka* (Independent Curriculum), aligned with the learning outcomes (Capaian Pembelajaran/CP) for the elements of physics understanding and scientific literacy.
5. The validity of the LKPD is reviewed from three aspects: content validity, language validity, and construct validity. The LKPD is considered valid if it obtains an average validity score of more than 60%.
6. The practicality of the LKPD is evaluated based on three criteria: implementation, readability, and attractiveness. The LKPD is considered practical if it achieves an average percentage above 60% across all three aspects.
7. The effectiveness of the LKPD is determined using the N-Gain score. If the N-Gain score meets the required threshold, the LKPD is considered effective.

3. MATERIALS AND METHODS

This study was conducted based on the ADDIE instructional development model (Branch, 2010), which consists of five stages: Analyze, Design, Development, Implementation, and Evaluation. The research subjects included 36 students from SMAN 1 Metro, two expert lecturers, one physics teacher as a validator, and one teacher as an observer. The study began with the analysis stage, where data were collected regarding the physics learning process and the availability of student worksheets (LKPD) currently used in schools. This data was obtained through a needs analysis questionnaire. After the analysis, the design stage was carried out, during which the researcher created a storyboard to visualize the product to be developed.

Following this, the development stage involved producing the LKPD in detail, including its content, media, and assessment components. These elements were designed to accommodate the diverse needs of students. In this stage, the researcher ensured that the evaluation instruments designed during the design phase could be implemented effectively and efficiently in the product development process. Product validation was conducted by involving expert validators in content, media, and design. If the product was declared valid, it proceeded to the implementation stage or field testing, which included tests for effectiveness and practicality.

During the implementation phase, the researcher conducted a trial of the PjBL-STEM-integrated LKPD within differentiated learning to enhance students' scientific literacy skills. The sample was selected using purposive sampling. The experimental class received treatment using the PjBL-STEM-integrated LKPD with differentiated instruction, while the control class received conventional LKPD. Based on the results obtained from the implementation and data analysis, the next step was the evaluation phase. This evaluation aimed to determine the validity, practicality, and effectiveness of the developed LKPD. The final product resulting from this evaluation stage is a PjBL-STEM-integrated LKPD for differentiated learning on the topic of renewable energy and its applications, which is both practical and effective.

4. RESULTS AND DISCUSSION

The result of this research and development is a differentiated student worksheet (LKPD) integrated with PjBL-STEM to enhance students' scientific literacy skills. This LKPD can accommodate students' needs in terms of learning styles and initial readiness through differentiation in the dimensions of content, process, and product. This allows teachers to simultaneously facilitate students' diverse needs during the classroom learning process. The developed LKPD product can be seen in Figure 1.

Figure 1. Cover LKPD

Based on Figure 1, it can be seen that the developed LKPD consists of three types of worksheets tailored to students' learning styles: auditory LKPD, visual LKPD, and kinesthetic LKPD. These worksheets accommodate students' needs in terms of learning styles and initial readiness through differentiation in the dimensions of content, process, and product. This enables teachers to simultaneously address students' diverse needs during the classroom learning process. The content section of the LKPD contains a sequence of student activities designed to integrate the steps of the applied learning model, namely the Laboy Rush PjBL-STEM model, combined with differentiated instruction to achieve the goal of improving students' scientific literacy skills. The content presented in each LKPD varies according to the students' learning styles.

Students will create scientific projects according to the learning styles of their respective groups. The kinesthetic group will create renewable energy prototypes, such as a waterwheel that generates electricity and a solar-powered car. The visual group will design a poster on renewable energy, while the auditory group will produce a video presentation on renewable energy. The scientific project produced by the kinesthetic learning style group can be seen in Figure 2.

Figure 2. Kinesthetic Products

Based on Figure 2, the kinesthetic group produced scientific projects in the form of a hydroelectric power generator and a solar-powered car. During the testing phase of these projects, students not only observed the rotation of the waterwheel but also measured the voltage generated. This enabled them to draw conclusions about how changes in water volume or flow rate affect the electrical voltage produced by the simple hydroelectric generator. Students were also able to analyze the effect of light intensity on the movement speed of the solar-powered car, evaluate the effectiveness of each component in the waterwheel and solar-powered car in terms of voltage output and movement speed, and examine the relationship between the circuit configurations used in the projects.

Meanwhile, in the auditory and visual groups, students conducted tests on how the concepts of the renewable energy topic were applied in the posters and videos they had designed. They evaluated the feasibility of the products they created and analyzed how the ideas and potential of the renewable energy products could be implemented on a larger scale. The scientific projects from the auditory and visual groups are shown in Figure 3.

Figure 3. Visual and Auditory Products

Based on Figure 3, The scientific product created by the visual learning style group is presented in the form of an infographic poster. The poster contains information about various types of renewable energy, such as solar, wind, hydro, geothermal, and biomass energy. It is designed with visual illustrations, icons, and diagrams that depict the processes of converting renewable energy into electrical energy. Additionally, the information is presented using attractive colors, layout, and text structure, making it both engaging and communicative. This product supports scientific literacy indicators, particularly in the aspects of communicating scientific information and understanding energy concepts through visualization. Meanwhile, the auditory group produced a presentation video. The video contains educational content that explains the topic of renewable energy. This demonstrates the auditory students' ability to process and deliver scientific information verbally-an essential skill in the context of scientific literacy. This aligns with the findings of Rahmawati & Ridwan (2021), who stated that using presentation videos as auditory learning products has proven effective in improving students' understanding of scientific concepts and their engagement in project-based learning.

From these three different products, based on students' learning styles, it can be concluded that each plays an important role in strengthening scientific literacy. At the same time, they serve as a medium for students to communicate scientific ideas and solutions related to renewable energy issues.

The validity assessment of the developed LKPD was conducted by evaluating the alignment of its content with instructional design, media design, and assessment design, all aimed at enhancing students' scientific literacy skills. The validation process involved three validators, consisting of two lecturers from the Master's Program in Physics Education and one physics teacher who has completed a Master's degree in Physics Education. The validation results were obtained in the form of quantitative data based on average scores, which were then converted into qualitative data. The results of the validity assessment are presented in Table 1.

Table 1. **LKPD Validation Results**

No.	Assessment Aspect	Score
1	Construct	92,70%
2	Content	92,80%
3	Language	90,27%
	Average	91,93%

From Table 1, an average percentage score of 91.93% was obtained from the three validators, indicating a high level of validity and confirming that the LKPD is suitable for use in learning activities. The content/material validation scored 92.80%, the language aspect 90.27%, and the construct aspect 92.70%. The feasibility of the LKPD is supported by several reasons: the developed LKPD is aligned with students' needs, and the depth of content includes scientific phenomena commonly encountered in everyday life. The learning material in the LKPD content encourages students to meet scientific literacy indicators, as it presents renewable energy phenomena accompanied by texts, images, videos, graphs, diagrams, and activities that relate to real-life situations. This LKPD is also designed to be integrated with PJBL-STEM, which includes project idea generation, simple sketching, and experiment analysis, thus supporting science literacy-based learning. The teaching method applied in this LKPD is differentiated instruction. The LKPD plays a vital role in supporting student learning facilities by being tailored to students' individual needs and interests, thereby helping them achieve optimal learning outcomes effectively.

The practicality of the product was evaluated through observations of the implementation and use of the LKPD during learning, conducted by a teacher acting as an observer. The results of the product practicality evaluation are shown in Table 2,

Table 2. Evaluation of LKPD Implementation, Readability, and Attractiveness

Assessed Aspect	Score	Criteria
Implementation	90,90%	Very Good
Readability	90,62%	Very Good
Attractiveness	93,18%	Very Good
Average	**91,56%**	
Criteria	**Very Good**	

Based on Table 2, the percentage analysis of implementation, readability, and attractiveness, an average score of 91.56% was obtained. Specifically, the implementation aspect scored 90.90%, readability 90.62%, and attractiveness 93.18%. Since the average score is above the 60% threshold, it can be concluded that the LKPD developed in this study is practically applicable for use in differentiated learning for Grade X SMA/MA under the Merdeka Curriculum. The material presented in the LKPD is structured in various formats aimed at increasing student engagement. The LKPD was designed using the Canva application, which offers ease of use and a variety of design elements, including text, images, and even videos. From a construct perspective, the integration of instructional materials with technology provides a more engaging and in-depth learning experience, while also preparing students to face technological challenges in problem-solving.

The effectiveness of the LKPD integrated with PjBL-STEM and differentiated instruction can be determined through the calculation of the N-Gain score based on students' pretest and posttest results. The learning using this LKPD was directly conducted by the researcher to measure the improvement in students' scientific literacy using a scientific literacy test instrument in the form of essay questions. Each question was designed to enhance students' scientific literacy skills on the topic of renewable energy. In the experimental class, learning was conducted using the LKPD, with activities aligned with the PjBL model by Laboy Rush (2010) and adapted to each student's learning style as part of differentiated instruction. Meanwhile, the control class used a conventional learning model. Out of 36 students, the majority showed a significant improvement in learning outcomes, as illustrated in Figure 4.

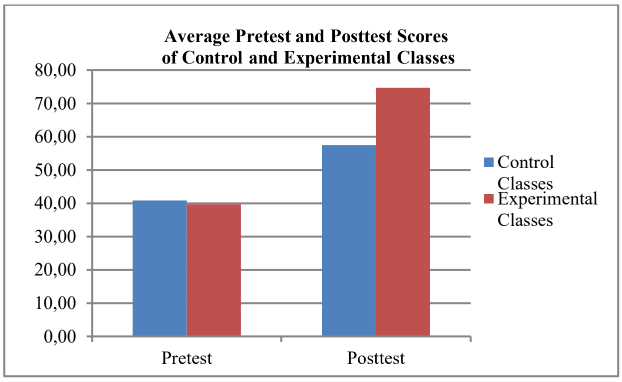

Figure 4. Average Pretest and Posttest

Based on Figure 4, it can be seen that the average pretest score of the experimental class before the implementation of the learning was 39.72, while the average posttest score after the learning was 74.72, with a difference of 35 points between the pretest and posttest averages. Meanwhile, the control class obtained an average pretest score of 40.83 and an average posttest score of 57.5, with a difference of 16.67 points between the pretest and posttest averages. The control class had a slightly higher average pretest score compared to the experimental class. Both classes showed improvement after the implementation of differentiated learning using the LKPD integrated with PjBL-STEM on the topic of renewable energy. However, the increase in the average score of the experimental class was greater than that of the control class. This indicates an improvement in learning outcomes after using the LKPD. The pretest and posttest scores of the students were analyzed using the N-Gain calculation, as shown in Figure 5.

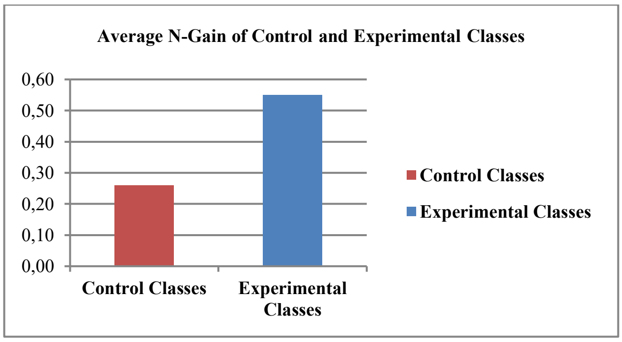

Figure 5. Everage N-Gain

Based on the N-Gain data in Figure 5, it can be seen that the experimental class obtained an average N-Gain score of 0.55, which falls into the medium category, after the implementation of learning using the PjBL-STEM-integrated LKPD with differentiated instruction on the topic of renewable energy. Meanwhile, the control class obtained an average N-Gain score of 0.26, categorized as low, after the implementation of conventional LKPD-based learning. Both classes experienced an increase in learning outcomes; however, the N-Gain score in the experimental class was higher than that of the control class. The greater increase in scores in the experimental class indicates that the use of the PjBL-STEM-integrated LKPD within differentiated instruction had a more positive impact on improving students' scientific literacy skills compared to conventional learning. This finding is in line with research conducted by Sari (2022), which showed that the application of PjBL-STEM-based learning can enhance conceptual understanding and scientific literacy, as the learning becomes more contextual and meaningful.

Next, a normality test analysis was conducted using the Kolmogorov-Smirnov test in SPSS 27, and the output was obtained as shown in Table 3 and Table 4**.**

Table 3. Normality Test of Pretest and Posttest in the Control and Experimental Classes

Class	Data	Sig. Value
Control	*Pretest*	0,200
	Postest	0,200
	N-Gain	0,200
Experimental	*Pretest*	0,200
	Postest	0,118
	N-Gain	0,134

Table 4. Normality of Each Learning Style in the Experimental Class

Learning Style	Data	Sig. Value
Auditory	*Pretest*	0,200
	Posttest	0,200
	N-Gain	0,200
Kinesthetic	*Pretest*	0,090
	Posttest	0,200
	N-Gain	0,200
Visual	*Pretest*	0,200
	Posttest	0,200
	N-Gain	0,200

From Table 3, all data groups show a significance value of < 0.05, indicating that the data from both the experimental and control groups are normally distributed. Similarly, Table 4 also shows that all data from each learning style obtained a significance value of > 0.05. Thus, it can be concluded that all data from each differentiated learning style in the experimental group are normally distributed.

Next, an independent sample t-test was conducted to examine the average scientific literacy scores between the control and experimental classes in order to determine whether there was a significant difference in students' scientific literacy scores between the two groups. The results of the independent sample t-test can be seen in Table 5.

Table 5. Independent Sample T-Test Analysis

Assumption	Levene's test Sig.	Equality of Means Sig.
Homogeneous	0,679	0,001
Not Homogeneous		0,001

Based on Table 5, it can be seen that the significance value obtained was 0.001, which is less than 0.05. Therefore, it can be concluded that H_0 is rejected and H_1 is accepted, meaning that there is a significant difference between the average N-Gain scores of students in the experimental and control groups, with a very large effect size. This indicates that the learning approach used in the experimental group was more effective than that of the control group in improving learning outcomes. Which showed that project-based learning with a STEM approach significantly enhances conceptual understanding and scientific literacy, as it emphasizes real-life application. The homogeneity value also indicates that there is a significant difference in the scientific literacy scores between the control and experimental classes.

The One-Way ANOVA test is a statistical test used to compare the means of three or more independent samples. This test is used to determine whether there is a significant difference between the groups. The results of this analysis can be seen in Table 6.

Table 6. One-Way ANOVA Analysis

Learning Style	Homogeneity	Sig. (Anova)
Auditory	0,605	0,307
Kinesthetic		
Visual		

Based on Table 6, The results of the one-way ANOVA test analysis showed a homogeneity value of 0.605, which is greater than 0.05. This indicates that the three learning style groups have homogeneous variances. Meanwhile, the ANOVA output revealed a significance value of 0.307, which is also greater than 0.05. Therefore, it can be concluded that there is no significant difference in the average scientific literacy scores among the three learning style groups. This finding suggests that even though students have different learning styles, the developed LKPD is able to accommodate all styles proportionally, resulting in no significant difference in scientific literacy achievement between groups. This aligns with the study by Rahmawati & Widodo (2022) published in the Jurnal Pendidikan Sains Indonesia, which stated that PjBL-STEM learning combined with a differentiated approach can meet diverse learning needs without creating achievement gaps among learning styles. According to Tomlinson (2001), differentiated instruction enables teachers to design learning experiences that are adaptive to students' needs without compromising core learning objectives.

The highest average posttest scores were found in the scientific literacy indicator of explaining scientific phenomena, while the lowest were in the indicator of evaluating and designing scientific investigations. According to Bybee (2013), scientific literacy includes three main competencies: explaining scientific phenomena, evaluating and designing scientific investigations, and interpreting data and scientific evidence. Among these, the ability to evaluate and design investigations is often the most challenging for students, as it requires a high level of conceptual understanding and repeated, reflective scientific experiences.

This finding aligns with research by Fitriani (2021), which stated that students' ability to explain scientific concepts improved significantly after the implementation of project-based learning, but their ability to design and evaluate experiments remained low due to a lack of systematic practice. Mulyani & Suparmi (2020) also noted that conceptual understanding in scientific literacy is easier to improve than scientific evaluation skills, largely due to limited time and students' lack of experience.

Based on the data analysis and the explanation regarding the learning process using the developed LKPD, it can be concluded that overall learning objectives were achieved. Therefore, the PJBL-STEM-integrated LKPD, implemented through differentiated learning and aligned with each energy-related topic within the renewable energy material, is effective in improving students' scientific literacy skills.

5. CONCLUSION

The validity of the PjBL-STEM-integrated LKPD in differentiated learning is categorized as very valid, The LKPD was validated in terms of content, construct, and language by expert reviewers, yielding scores of 92.80% (content), 92.70% (construct), and 90.27% (language), with an average score of 91.93%, classified as very valid. Its practicality is also categorized as very practical, making it appropriate for classroom implementation. Practicality scores include 90.90% for implementation, 90.62% for readability, and 93.18% for attractiveness, with an overall average of 91.56%. In terms of effectiveness, the LKPD is classified as moderately effective in improving students' scientific literacy, with N-Gain scores of 0.50 (auditory), 0.54 (kinesthetic), and 0.61 (visual), and an overall average of 0.55 in the experimental class. This is also supported by an increase in the average pretest score from 39.72 to 74.72 in the posttest. Therefore, it is concluded that this LKPD is suitable for use in Grade 10 Phase E physics learning under the Merdeka Curriculum, particularly on the topic of renewable energy.

6. SUGGESTIONS

The research showed that the PjBL-STEM-integrated LKPD in differentiated learning on renewable energy is effective in improving students' scientific literacy. Educators are encouraged to conduct further studies on similar LKPD development in other subjects to gain more accurate insights into enhancing scientific literacy through education.

7. REFERENCE

Astiti, K.A., Supu, A., Sukarjita, I.W., Lantik, V., (2021). Pengembangan Bahan Ajar IPA Terpadu Tipe

Connected Berbasis Pembelajaran Berdiferensiasi Pada Materi Lapisan Bumi Kelas VII. Jurnal Pendidikan Dan Pembelajaran Sains Indonesia (JPPSI), 4(2), pp.112-120.

Bybee, R. W. (2013). Scientific literacy: Explaining phenomena, evaluating and designing investigations, interpreting data and evidence.

Branch, R. M. (2010). Instructional Design: The ADDIE Approach. Springer, New York.

Fanani, M. (2018). Analisis faktor penyebab rendahnya literasi sains siswa di Indonesia. Jurnal Pendidikan Sains Indonesia, 6(2), 134–140.

Fitriani, N. (2021). Meningkatkan Literasi Sains Peserta Didik melalui Model Pembelajaran Berbasis Proyek (Project Based Learning). Jurnal Inovasi Pendidikan IPA. 7(1). 45–53.

Istiqomah, N., Timur, D. (2021). Analisis kebutuhan lembar kerja peserta didik dalam pembelajaran berdiferensiasi. Jurnal Pendidikan Dasar, 12(1), 71–80.

Kemendikbudristek. (2023). Rangkuman hasil survei PISA 2022. Jakarta: Badan Standar, Kurikulum, dan Asesmen Pendidikan.

Laboy-Rush, D. (2010). Integrated STEM Education through Project-Based Learning. STEM Solutions Manager.

Mulyani, S., Suparmi. (2020). Analisis Literasi Sains Peserta Didik pada Materi Energi: Studi pada SMA di Jawa Tengah. Jurnal Pendidikan Sains Indonesia. 8(3). 215–224.

Nainggolan, D. (2020). Pendidikan Sebagai Sarana Pengembangan Potensi Peserta Didik. Jurnal Pendidikan Indonesia. 5(1). 45-52.

Nuraini., Muliawan, D. (2020). Efektivitas penerapan model PjBL terhadap minat belajar sains siswa. Jurnal Pendidikan Sains Indonesia, 8(2), 210–217.

PISA. (2015). PISA 2015 Results (Volume I): Excellence and Equity in Education. Paris: OECD Publishing.

Rahmawati, R., Ridwan, M. (2021). Efektivitas Media Video Pembelajaran terhadap Literasi Sains Peserta Didik dengan Gaya Belajar Auditori. Jurnal Pendidikan Fisika. 9(3). 177–183.

Rahmawati, R., Widodo, A. (2022). Pembelajaran STEM Berdiferensiasi dalam Mengakomodasi Perbedaan Gaya Belajar. Jurnal Pendidikan Sains Indonesia. 10(2). 92–101.

Ramadhanty, J.A. (2020). Budaya sekolah dan pengaruhnya terhadap kemampuan literasi sains siswa. Jurnal Pendidikan dan Pembelajaran Sains, 4(2), 45–52.

Safarati, A., Fatma, N. (2023). Pembelajaran berdiferensiasi dalam konteks Merdeka Belajar. Jurnal Pendidikan Inklusif, 5(1), 66–75.

Salamah, M., (2022). Analisis kemampuan literasi sains siswa Indonesia berdasarkan data PISA. Jurnal Penelitian Pendidikan IPA, 6(1), 89–95.

Sari, M. P. (2022). Pengaruh Model Project Based Learning Berbasis STEM terhadap Literasi Sains Peserta Didik. Jurnal Pendidikan Sains. 6(1). 37–45.

Sulistiani, D. (2024). Kemandirian Guru dalam Pengembangan LKPD pada Pembelajaran Berdiferensiasi di Provinsi Lampung.

Surbakti, E. (2022). Tantangan Pendidikan Abad ke-21 Dalam Era Revolusi Industri 4.0. Jurnal Ilmiah Pendidikan. 10(3). 200-210.

Takda, A., Sutrio, S., & Wahyudi, W. (2023). Kemampuan Literasi Sains Peserta Didik SMA pada Keterampilan Proses Sains di Sulawesi Tenggara. Jurnal Ilmiah Pendidikan Fisika. 11(1). 12–21Jurnal Evaluasi dan Kurikulum. 14(1). 44–52.

Tomlinson, C. A. (1999). The Differentiated Classroom: Responding to the Needs of All Learners. ASCD.

Yusmar, Y., Fadilah, R. (2023). Keterkaitan Konsep Sains dengan Fenomena Kehidupan Sehari-hari dalam Meningkatkan Literasi Sains Siswa. Jurnal Pendidikan Sains Indonesia. 11(1). 45–53.