Vol 10 No 1 2024 DOI : 10.24036/jppf.v10i1.127348 Page : 1-14
JURNAL PENELITIAN PEMBELAJARAN FISIKA (JPPF)
Journal of Physics Learning Research
ISSN 2252-3014 (Print) | ISSN 2746-8445 (Electronic)

Validity and Practicality of Student Worksheet on Project-Based Learning Based Renewable Energy Material for Phase E

Anggia Permana Putri[12], Yenni Darvina[2]*, Desnita[2], Gusnedi[2], Harman Amir[2]

[1] SMA Negeri 1 Banuhampu, West Sumatera Barat, Indonesia
[2] Department of Physics, Universitas Negeri Padang, West Sumatera, Indonesia.

ARTICLE INFORMATION

Received : 2024-01-26
Revised : 2024-02-01
Accepted : 2024-02-22

Correspondence
Email : ydarvina@fmipa.unp.ac.id
Phone :

KEYWORDS :

Student Worksheet, Validity, Practicality.

ABSTRACT

The application of the independent curriculum focuses on crucial material and the student development for character and competence. The Student Worksheet used by teachers does not meet the requirements of the curriculum, i.e. it is project- according to, particularly in relation to renewable energy materials. This research aims to produce Student Worksheet on renewable energy materials according to for project according to learn for phase E that is valid and practical. The method used in this research is research and development (R&D). The model for development used is a 4-D model comprising 4 phases: define, design, develop and disseminate. Indicators were used to assess validity and practicality. In the validity analysis, three validators rated the presentation component as 0.87, visuals as 0.9, content feasibility as 0.83, and language feasibility as 0.9, all of which have excellent standards. Three physics teachers and 60 students did a practicality analysis, yielding an average score of 95% and 81.6%, suggesting that the criteria are extremely practical. According to the analysis of validity and usability, we can say that the Student Worksheet on renewable energy materials according to project- according to learn is valid and practical, so that it can be used in renewable energy learn.

INTRODUCTION

The Merdeka curriculum was designed as a more adaptable curriculum framework that focuses on core materials and students character and competency development (Kemendikbud, 2022; Susanty,2020; & Sapitri, 2022). The Merdeka curriculum is distinguished by a diverse intra-curricular learn approach that emphasizes an optimal content structure. This technique gives students plenty of time to investigate concepts and improve their skills. . The independent curriculum is applied for learn recovery according to for Permendikbudristek No. 56 of 2022 concerning Curriculum Implementation Guidelines in the learn Recovery Framework. The implementation of the independent curriculum aims

to provide a more independent and enjoyable learn experience for students (Susanty, 2020). The success of the curriculum depends largely on how it is implemented (Sari, et al., 2023). The autonomous curriculum is meant to increase reading and writing skills, i.e., critical thinking and communication skills is problem solving (Yamin & Syahrir, 2020). To support the literacy ability of students, teaching materials and Student Worksheet are needed in related with the expectations of the independent curriculum (Sumantri, 2019). In the problems studied, the Student Worksheet method used by teachers did not meet curriculum requirements, i.e., it was project-according to.

Student Worksheets are sheets specifically designed to guide students in the learn process (Depdiknas, 2008; Amir et al., 2022; Daryanto, 2018; & Putri, 2019). Student Worksheet aims to help learners understand the subject matter in a systematic and structured way. Student Worksheet has simpler elements than modules, but is more complex than books, Student WORKSHEET has six elements, including: title, learn guide, basic skills or topic, information for support, tasks or work steps and assessment (Nurdin, 2016). Student Worksheet is a demand for students to actively participate in the process of learn, which makes the role of teachers more likely to guide and monitor the work of students. Also, in the independent study program, the recommended learn model is project-according to learn, so the Student Worksheet is expected to be project-according to.

The project-according to learn model (PjBL) is a model of learn that organizes education into a project (Azmi et al., 2018; Thomas & Stewart, 2000; Larmer et al., 2015). PjBL is an approach who dynamic to learn, in which students actively learn real-life problems, take on challenges and deepen their knowledge (Erlinawati et al., 2019; Markham, 2011). The purpose of PjBL is the independence of students in learn to complete the tasks they face. In the independent curriculum, the model who recommended for learn is PJBL. Guidance by teachers is needed to direct students so that the process of learn can run according to the learn flow. Using this model, students should be able to create a product resulting from the design of each material.. The project implemented is expected to make students find a problem and solve it. The processes for implementing the project follow the PjBL syntax, which includes establishing the core questions, preparing the project planning, making timetables, monitoring the students and project progress, analyzing the results, and evaluating the experiences.

This research was done through interviews with physics teachers and the distribution of questionnaires to students done at SMAN 1 Banuhampu. The first analytic research results, including curriculum used, are still being implemented at SMAN 1 Banuhampu, i.e., the independent curiculum; the teaching materials used are still in form of printet the books in public libraries and government-provided books in general; and teachers' use of Student Worksheet is not in line with the curriculum requirements, i.e., project-according to, particularly in relation to renewable energy. To address the issues at SMAN 1 Banuhampu, a Student Worksheet who can assist pupils in the Merdeka Phase E curriculum in high school is required. The resulting Student Worksheet should actively engage students in the physics learn process, particularly in generating a product that provides relevant and easy-to-understand concepts. According to the above context, this research aims to produce LKPD on renewable energy materials according to for project according to learn for phase E that is valid and practical. The problem studied is what is the degree of validity and practicality of the Student Worksheet on renewable energy materials according to for project-based learning.

METHODS

The type of research used in this study is the Research and Development (R&D) development method. The development model used is the 4-D model by Thiagarajan which has 4 stages, namely Define, Design, Develop, and Dessiminate. The product obtained is LKPD on Renewable Energy material based on Project Based Learning for Phase E at SMA N 1 Banuhampu This research was only carried out until the development stage, namely validation and practicality due to limited time.

At the initial stage, namely Define, a needs analysis was carried out on the research, namely curriculum analysis, analysis of learner characteristics, material analysis and analysis of learning objectives. The next stage is Design, namely the design / framework of Student Worksheet. The PjBL-based Student Worksheet framework made contains several Student Worksheet structures in accordance with (Depdiknas, 2008). In the Student Worksheet there is an Student Worksheet structure developed The structure of the designed Student Worksheet consists of a cover, instructions for using Student Worksheet, learning outcomes to be achieved, brief material, supporting information for tasks and work steps, and assessment.

In the cover design, there is a university logo, curriculum logo, tut wur handayani logo, author's name, LKPD title, phase, group, name, class, and university. The dominant color on the cover is blue. The cover also contains illustrations of renewable energy such as images of windmills and solar panels. On the next page there is a design of LKPD instructions. And for the next page, there is a design of learning outcomes & identity and brief material. The next design is the design of learning outcomes and the design that contains identity & brief material adapted to the independent flow. For the next design is the design of supporting information & tasks and the design of work steps in accordance with the syntax of Project-based learning.

Furthermore, the implementation of the Develop stage of this stage is carried out by validating the assessment by 3 UNP physics lecturers by filling out a validation instrument questionnaire. In the validation instrument there are several components to determine the validity of the LKPD made. These components consist of presentation components, graphical components, content eligibility components, and language eligibility components. After the validation assessment, product revisions were made according to the direction of the validator. After that, the practicality assessment was carried out by teachers and students. In the practicality instrument there are several aspects, namely aspects of attractiveness, aspects of ease of use, aspects of benefits and aspects of clarity of content.

According to for the problems studied, the method used to determine validity and usability is Aiken's V-validity index. The product to be validated is Student Worksheet on PJBL on renewable energy for Phase E at SMA N 1 Banuhampu. In order to determine the validity and usability of the products created, a validity and usability analysis is carried out.

Validity

Validity three UNP physics lecturers completed validation indicator questionnaires to examine the analysis.Before product validity is implemented, validation indicators are referred to according to the grid from the Ministry of Education[8] first. The validation indicator contains several components to determine the validity of the Student Worksheet. The component consists of a presentation component, a graphic component, a content feasibility component, and a language feasibility component.

Validation assessment is used analysis of Aiken's V validity index assessment [21] using the following equation (1).

$$V = \frac{\Sigma s}{n(c-1)} \quad (1)$$

$$s = r - I_o \quad (2)$$

Description:
V = validity index of question items
s = sum of all scores from valitor
l_0 = lowest score in the evaluation category (in this study = 1)
c = highest assessment number
r = validator choice score
n = number of validators

The Aiken's V rating index scale is a range of 0 to 1 with low, medium and high categories as in table 1.

Table 1. Aiken V scale interval

Interval	Category
≤ 0.4	Low
0.4 < V ≤ 0.8	Medium
0.8 < V	High

[22]

Practicality

After the evaluation of the validity analysis, an evaluation of the practical analysis of 3 physics teachers and 60 students of SMA N 1 Banuhampu was conducted. The assessment indicators used are in accordance with the Ministry of Education and National Education grid[8]. The practicality assessment indicator consists of 4 assessment aspects, namely the attractiveness of Student Worksheet, Ease of use of Student Worksheet, Benefits of Student Worksheet, and Clarity of Student Worksheet content. Assessment of practicality used the following formula in equation (3).

$$P = \frac{f}{N} x\ 100\ \% \quad (3)$$

Description:
P = Final Value
f = Score Gain
N = Maximum Score

There are five criteria for practicality, namely impractical, less practical, practical enough, practical, and very practical [23]. The value content criteria are shown in Table 2 below.

Table 2. Criteria of Product Practicality

Final grade (%)	Criteria
0 – 20	Impractical
21 – 40	Less Practical
41 – 60	Practical enough
61 – 80	Practical
81 – 100	Very Practical

[23]

RESULTS AND DISCUSSION

Results

Validity Analysis

Validity results were acquired using the approved method of analysis, and they were reviewed by three UNP Physics lecturers.In the indicator of validity instruments consists of 4 components, namely the presentation component, graphic component, content feasibility, and language feasibility.

As a result of the evaluation of the presentation component, you can see in Table 3 below which validity tests were valid.

Table 3. The validity analysis Results of the presentation components

Indicator	V' Aiken	Information
Cover	0.92	High
Identity	1.00	High
Instructions for use	1.00	High
learn outcomes	0.92	High
learn objectives	0.92	High
Short material	0.83	High
Practice questions	0.83	High
Work guide	0.83	High
Self-task	0.75	Medium
Bibliography	0.75	Medium
Classifying forms of energy	0.83	High
Analyze the forms of energy and their use in daily life	0.83	High
Analyze the applicability of the Law of Conservation of Mechanical Energy to events that occur in everyday life	0.83	High

Finding the problem of energy availability that exists in the environment around the place of residence	0.83	High
Discovering potential energy sources in the environment around where you live	0.83	High
Planning the design of making simple energy-producing tools or prototypes as a solution to the problem of energy availability	0.92	High
Making tools or producing prototypes making simple energy-producing tools or prototypes	0.92	High
Energy and effort	0.92	High
Forms of energy	0.92	High
Power and energy change	0.83	High
Law of conservation of mechanical energy	0.92	High
Energy efficiency	0.83	High
Renewable and non-renewable energy sources	0.92	High
There are supporting images/ illustrations / videos	0.83	High
Presentation of interactive materials	0.92	High
Linkage between activities	0.83	High
Integrity of material meaning	0.83	High
Sorted question	0.92	High
Bibliography	0.75	Medium
Average	**0.87**	**High**

According to the data in the table above, of the 29 total indicators, there are 3 indicators with moderate criteria with a value of 0.75. the average result the presentation component assessment is 0.87 with high standards, therefore the validity test is pronounced valid.The evaluation results of the graphics component are shown in Table 4 below.

Table 4. The analysis results of the validity of the graphical component

Indicator	V' Aiken	Information
Color	0.92	High
Appropriate picture/illustration	0.92	High
Font usage	0.92	High
Font size	0.92	High
Text & background color contrast	0.92	High
Organized layout	0.92	High
Display design	0.83	High
Average	**0.90**	**High**

According to for the data from the table above, all indicators received high criteria The average result graphic component evaluation 0.90 with high criterion, and the validity test is certified valid.. evaluation results for the content appropriateness component are shown in Table 5.

Table 5. The content validity analysis results

Indicator	V' Aiken	Information
Topic as per CP & TP	0.83	High
TP compliant material	0.83	High
Real-life links	1.00	High
Encourage curiosity	0.83	High
Creating questioning skills	0.75	Medium
Student profile of Pancasila: Believers, devoted to God Almighty,	0.58	Medium
Global diversity	0.75	Medium
Mutual cooperation	0.83	High
Independent	0.75	Medium
Critical reasoning	0.75	Medium
Creative	0.83	High
PjBL Model: Problem presentation	0.83	High
Planning	0.83	High
Scheduling	0.83	High
Project creation	0.83	High

Assessment	0.83	High
Evaluation	0.83	High
Free Flow: Start from yourself	0.83	High
Concept exploration	0.83	High
Collaboration Space	0.83	High
Contextual Demonstration	0.83	High
Elaboration Comprehension	0.83	High
Connection between materials	0.83	High
Real action	0.83	High
learn styles: Visual	0.92	High
Audio	0.92	High
Kinesthetic	0.92	High
Can be connected to everyday life	0.92	High
Accuracy of images with material	0.92	High
Conclusion	0.83	High
Average	**0.83**	**High**

According to the data in the table above, of the 30 total indicators, there are 4 indicators with a value of 0.75 and 1 metric with a value of 0.58 included in the intermediate criteria. The average result of the examination the component's content feasibility is 0.83 with high standards, and the validity test certified valid.

The assessment results of the linguistic feasibility component are shown below (see Table 6).

Table 6. The results of the validity analysis of the linguistic feasibility component

Indicator	**V' Aiken**	**Information**
Communicative	0.92	High
Motivating	0.92	High
No double meaning	0.83	High
In accordance with the rules of Indonesian grammar	0.92	High
Clear	0.92	High

information Spelling according to EYD	0.92	High
Average	**0.90**	**High**

According to for the information in the table above, all indications obtained high ratings. And the average result of the examination of the component of linguistic feasibility is 0.90 with high standards, and the validity test has been pronounced valid. Figure 1 displays the following validity analysis graph.

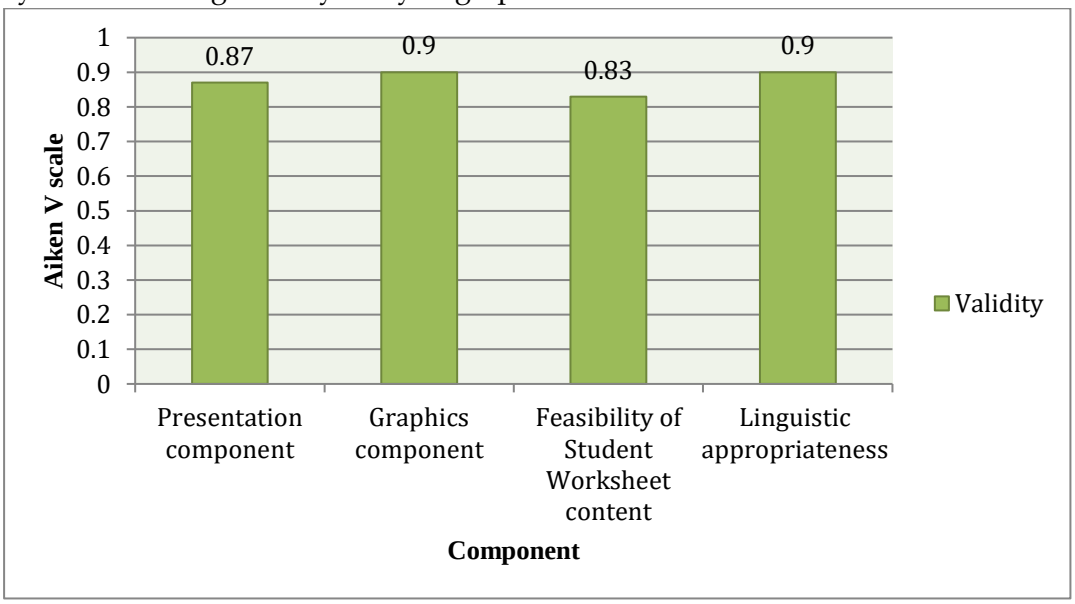

Figure 1: Validity Analysis Chart

It can be seen from Figure 1 above, the value of the content feasibility component is lower than the presentation, graphic, and linguistic feasibility components with a value of 0.83. The components of graphics and content feasibility have a higher value than the presentation and content feasibility components with a value of 0.9. The above validity analysis results indicate that the Student Worksheet renewable energy material according to for PjBL is valid with regard to presentation, grammar, content feasibility and linguistic feasibility, so that it is valid and compliant with the provisions of the independent curriculum.

Practicality Analysis

After the product was validated by 3 validators, a practicality analysis was conducted by 3 physics teachers and 60 Phase E students of SMAN 1 Banuhampu using a practicality instrument. Analysis of the practical results of Student Worksheet on PjBL-according to Renewable Energy material for Phase E have been carried out on 4 aspects of practicality assessment. This aspect includes the components of the attractiveness of the presentation, ease of use, benefits and clarity of content. The practicality test results by each teacher shown in Table 7 below.

Table 7. The teacher's practicality analysis results of the PjBL-according to Student Worksheet

Assessment aspect	Practicality score	Criteria
The attractiveness of Student Worksheet	92.4 %	Very Practical
Ease of use of Student Worksheet	96.2 %	Very Practical
Benefits of Student Worksheet	94.8 %	Very Practical
Clarity of Student Worksheet content	96.7 %	Very Practical
Average	**95 %**	**Very Practical**

According to for the data in the table above, all aspects scored with very practical criteria. The aspect of the attractiveness of Student Worksheet scored 92.4%, the aspect of ease of use of Student Worksheet scored 96.2%, the aspect of the benefits of Student Worksheet scored 94.8%, and the aspect of clarity of Student Worksheet content scored 96.7%. The average results of teachers' analysis on the feasibility of Student Worksheet according to for PjBL are 95% with very practical criteria.

The attractiveness aspect scores lower than the other 3 aspects with a score of 92.4. The content clarity aspect scored higher than the other 3 aspects with a score of 96.7. However, all aspects are included in the same criteria, namely very practical. It shown from the teacher's practicality analysis results above that the PjBL-according to renewable energy material Student Worksheet is practical, starting from the attractiveness aspect, the ease of use aspect, the benefits aspect and the clarity of content aspect, so that it can be used in learn. Therefore, the conclusion that the Student Worksheet on PjBL-according to renewable energy material for phase E is very practical to be used by teachers in learn.

The students' analysis results of the usability of the PjBL-according to Student Worksheet are shown in Table 8.

Table 8. The students' practicality analysis results of PjBL-according to Student Worksheet.

Assessment aspect	Practicality score	Criteria
The attractiveness of Student Worksheet	82.1 %	Very Practical
Ease of use of Student Worksheet	80.5 %	Very Practical
Benefits of Student Worksheet	82.7 %	Very Practical
Clarity of Student Worksheet content	81.3 %	Very Practical
Average	**81.6 %**	**Very Practical**

Table 8 shows, that the practicality analysis value of students regarding PjBL-according to renewable energy material Student Worksheet for each aspect of the assessment is included in the very practical criteria. The attractiveness aspect score of

Student Worksheet is 82.1%, the ease of use aspect of Student Worksheet gets a value of 80.5%, the benefit aspect of Student Worksheet gets a value of 82.7% and for the clarity aspect of Student Worksheet content with a value of 81.3%. From the results of the evaluation of the four aspects of the practicality of Student Worksheet on PjBL-according to renewable energy material for Phase E, an average of 81.6% was obtained with very practical criteria.

The value of the ease of use aspect is lower than the other 3 aspects with a value of 80.5. The benefit aspect gets a higher score than the other 3 aspects with a value of 82.7. The analysis results of the above students' utility are as follows that the PjBL-according to renewable energy material Student Worksheet is practical, starting from the aspect of attractiveness, the aspect of ease of use, the aspect of benefits and the aspect of clarity of content, so that it can be used in learn. Thus, the conclusion that the Student Worksheet of renewable energy materials for teaching according to for PjBL is very practical for use by students in phase E of education.

Discussion

The results of the Student Worksheet validity test on PjBL-according to renewable energy material are good and valid with an average value of the four components of 0.87. From this value, the validity of Student Worksheet on PjBL-according to renewable energy material is categorized as high and it can just concluded that the validation of Student Worksheet on PjBL- according torenewable energy material is very good. This study is consistent with previous research, namely Student Worksheet chemical equilibrium material according to for project- according to learn (PjBL) for phase F SMA which has been tested for validity (Sari & Alizar, 2023). Another study by Wiwek et al (2021) showed that Project-according to learn tools can be utilized in physics classes to help students improve their communication abilities. Thus, Student Worksheet on PjBL- according to renewable energy material is suitable for application in the learn process.

Teachers and students participated in the practicality test of the Student Worksheet on Project-according to learn (PjBL) for renewable energy materials. It received an average score of 95 from teachers and an average score of 81.6 from students. These findings suggest that the Student Worksheet on PjBL-according to renewable energy materials is useful and beneficial to both teachers and students during the learn process. This is consistent with Nurhamida and Andromeda's (2023) research on the usefulness of Project-according to learn-according to teaching modules and fits the standards of the autonomous curriculum. Furthermore, research demonstrates the applicability of the combined STEAM-PjBL Volta Cell Student Worksheet, making it appropriate for application in the lear process. (Yani et al., 2023).

CONCLUSION

From the validity analysis results conducted, the conclusion that the Student Worksheet product is according to for renewable energy material according to for project-according to learn for Phase E is valid with a validity index of 0.87 presentation components, 0.9 graphical components, 0.83 content feasibility components, and 0.9 language feasibility components. according to for the validity assessment results of Student Worksheet renewable energy material according to for project- according to learn for Phase

E, available for study. According to for the feasibility analysis results, the conclusion that the Student Worksheet product for Phase E is practical with an average teacher feasibility index of 95% and very practical criteria. For the practicality value of students, the average index is 81.6% with very practical criteria. According to for the results the practical assessment of Student Worksheet renewable energy material according to for PJBL for Phase E, it is declared practical to be used in learn.

ACKNOWLEDGEMENTS

The authors would like to thank all parties involved in the writing of this article and the professors who guided and supported this research.

REFERENCES

Aini, N. A., Syachruroji, A., & Hendracipta, N. (2019). Pengembangan LKPD berbasis problem based learning pada mata pelajaran IPA materi gaya. Jurnal Pendidikan Dasar, 10(1), 68-76. https://doi.org/10.21009/jpd.v10i1.11183

Aiken, LR 1985. *Tiga Koefisien Untuk Menganalisis Reliabilitas dan Validitas Peringkat* . Pengukuran Pendidikan dan Psikologis. 45, 131–141 .

Amir, I., Nursalam, N., & Mustafa, I. (2022). Tantangan Implementasi Nilai-Nilai Profil Pelajar Pancasila dalam Pembelajaran Bahasa Indonesia pada Kurikulum Merdeka Belajar. GHANCARAN: Jurnal Pendidikan Bahasa dan Sastra Indonesia, 204-215. https://doi.org/10.19105/ghancaran.vi.7587

Algiranto, A. (2021). Pengembangan lembar kerja siswa fisika berbasis problem based learning untuk meningkatkan partisipasi dan hasil belajar siswa sma kelas x. *Jurnal Perspektif Pendidikan*, *15*(1), 69-80. https://doi.org/10.31540/jpp.v15i1.1038

Andriyatin, R., Rosidin, U., & Suana, W. (2016). Pengembangan lembar kerja siswa model problem based learning materi suhu dan kalor. *Jurnal Pembelajaran Fisika*, *4*(3). http://digilib.unila.ac.id/id/eprint/22500

Azmi, N., Prastowo, P., & Maslena, M. (2018). Analisis Kesesuaian Lembar Kerja Peserta Didik (LKPD) Biologi Kelas X yang Digunakan MAN Rantauprapat Kabupaten Labuhan Batu. Jurnal Pelita Pendidikan, 6(2). http://digilib.unimed.ac.id/id/eprint/30341

Azzahra, S., Khasanah, N. I., Kurniawan, D. A., & Maison, M. (2022). Analisis Kebutuhan Media Pembelajaran Fisika Berbasis Teknologi Di Sman 8 Tanjung Jabung Barat Pada Era Merdeka Belajar. *Prosiding Amal Insani Foundation*, *1*(1), 167-176.

Baharuddin, M. R. (2021). Adaptasi kurikulum merdeka belajar kampus merdeka (Fokus: model MBKM program studi). *Jurnal Studi Guru Dan Pembelajaran*, *4*(1), 195-205.

Barlian, U. C., & Solekah, S. (2022). Implementasi kurikulum merdeka dalam meningkatkan mutu pendidikan. *JOEL: Journal of Educational and Language Research*, *1*(12), 2105-2118.

Chulaelah, S. Y. (2017). Penerapan Metode E-learning Berdasarkan Gaya Belajar Siswa Pada Mata Pelajaran Fisika. *Jurnal Komputer Terapan*, *3*(2), 241-250.

Daryanto. (2018). Pembelajaran Abad 21: Revolusi Industri 4.0. Gava Media.

Depdiknas. (2008). Kurikulum Tingkat Satuan Pendidikan. Dikmenum. Depdiknas

Dinantika, H. K., Suyanto, E., & Nyeneng, I. D. P. (2019). Pengaruh penerapan model pembelajaran project based learning terhadap kreativitas siswa pada materi energi terbarukan. *Titian Ilmu: Jurnal Ilmiah Multi Sciences*, *11*(2), 73-80.

Erlinawati, C. E., Bektiarso, S., & Maryani, M. (2019). Model pembelajaran project based learning berbasis STEM pada pembelajaran fisika. Fkip E-Proceeding, 4(1), 1-4.

Hidayah, A. N., Winingsih, P. H., Amalia, A. F., & Fisika, D. (2020). Development of physics e-Student Worksheet (electronic worksheets) using 3d pageflip based for problem based learning on balancing and rotation dynamics. *Jurnal Ilmiah Pendidikan Fisika-COMPTON*, *7*(2), 36-43.

Kemendikbud. (2022). Permendikbud Nomor 56 Tahun 2022 tentang Pedoman Penerapan Kurikulum dalam Rangka Pemulihan Pembelajaran.

Kurniawati, W., Harjono, A., Gunawan, G., Busyairi, A., & Taufik, M. (2021). Pengembangan Perangkat Pembelajaran Fisika Berbasis Proyek untuk Meningkatkan Kemampuan Komunikasi Peserta Didik. *Jurnal Pendidikan Fisika dan Teknologi*, *7*(2), 141-146. http://dx.doi.org/10.29303/jpft.v7i2.3096

Larmer, J., Mergendoller, J. R., & Boss, S. (2015). Setting the Standard for Project Based Learning. ASCD.

Lucas, G. (2005). The George Lucas Educational Foundation: 2005. Instructional Module Project Based Learning.

Marisa, M. (2021). Curriculum innovation "independent learning" In the era of society 5.0. *Jurnal Sejarah, Pendidikan Dan Humaniora*, *5*(1), 66-78.

Markham, T. (2011). Project-Based Learning: A Short History. Edutopia.

Mulyatiningsih, E. (2016). Pengembangan model pembelajaran. Diakses dari http://staff. uny. ac. id/sites/default/files/pengabdian/dra-endang-mulyatiningsih-mpd/7cpengembangan-model-pembelajaran. pdf. pada September.

Nugroho, T., & Narawaty, D. (2022). Kurikulum 2013, kurikulum darurat, dan kurikulum prototipe (2020-2021) atau kurikulum merdeka (2022) mata pelajaran bahasa inggris: suatu kajian bandingan. In *SINASTRA: Prosiding Seminar Nasional Bahasa, Seni, dan Sastra* (Vol. 1, pp. 373-382).

Nurdin, S. (2016). Adriantoni. Kurikulum dan pembelajaran, 67-68.

Nurhamida, N., & Andromeda, A. (2023). Validitas dan Praktikalitas Modul Ajar Berbasis Project Based Learning pada Materi Perubahan Fisika dan Kimia Kelas X SMA/MA. *JURNAL PENDIDIKAN MIPA*, *13*(2), 398-403. https://doi.org/10.37630/jpm.v13i2.965

Putri, S. T. (2019). Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Problem Based Learning pada Materi Reaksi Reduksi Oksidasi untuk SMA/MA Kelas X (Doctoral dissertation, Universitas Negeri Padang).

Retnawati, H. (2016). Analisis Kuantitatif Instrumen Penelitian. Parama Publishing.

Riduwan. 2012. Cara Mudah Menggunakan dan Memaknai Path Analysis (Analisis Jalur). Bandung: Alfabeta.

Riyastiti, P. (2020). PENGEMBANGAN LKPD HOTS OPEN ENDED PADA MATERI BILANGAN CACAH PADA PERKALIAN DAN PEMBAGIAN KELAS IV SEKOLAH DASAR (Doctoral dissertation, Universitas Muhammadiyah Malang).

Rizaldi, D. R., Makhrus, M., & Doyan, A. (2019). Analisis tingkat kemampuan berpikir kritis dengan model perubahan konseptual ditinjau dari gaya belajar siswa. *Jurnal Pendidikan Fisika dan Teknologi*, *5*(1), 74-81.

Sapitri, L. (2022). Studi Literatur Terhadap Kurikulum yang Berlaku di Indonesia saat Pandemi COVID-19. *Inovasi Kurikulum*, *160*.

Sari, F. I., Sunendar, D., & Anshori, D. (2023). Analisis Perbedaan Kurikulum 2013 Dan Kurikulum Merdeka. *Jurnal Pendidikan dan Konseling (JPDK)*, *5*(1), 146-151.

Septiaahmad, L., Sakti, I., & Setiawan, I. (2020). Pengembangan lembar kerja peserta didik (LKPD) fisika berbasis etnosains menggunakan model discovery learning untuk meningkatkan keterampilan berpikir kritis siswa SMA. *Jurnal Kumparan Fisika*, *3*(2), 121-130.

Sugiyono. (2012). Metode Penelitian Kuantitatif, Kualitatif , dan R&D. Bandung. ALFABETA.

Sumantri, B. A. (2019). Pengembangan Kurikulum di Indonesia Menghadapi Tuntutan Kompetensi Abad 21. EL-HIKMAH: Jurnal Kajian Dan Penelitian Pendidikan Islam, 13(2), 146-167.

Suryaman, M. (2020, October). Orientasi pengembangan kurikulum merdeka belajar. In *Seminar Nasional Pendidikan Bahasa Dan Sastra* (pp. 13-28).

Susanty, S. (2020). Inovasi pembelajaran daring dalam merdeka belajar. Jurnal Ilmiah Hospitality, 9(2), 157-166.

Thomas, J. W., & Stewart, A. M. M. (2000). Project-Based Learning: A Handbook for Middle and High School Teachers. Association for Supervision and Curriculum Development.

Trianto. (2011). Model Pembelajaran Terpadu: Konsep, Strategi, dan Implementasinya dalam Kurikulum Tingkat Satuan Pendidikan (KTSP). Prestasi Pustaka.

Vitrianingsih, D., Yuliani, H., Syar, N. I., & Nasir, M. (2021). Analisis kebutuhan pengembangan lembar kerja siswa (lks) berbasis problem based learning pada materi elastisitas dan hukum hooke kelas xi di sma negeri 1 palangka raya. *Karst: JURNAL PENDIDIKAN FISIKA DAN TERAPANNYA*, *4*(1), 1-7.

Yamin, M., & Syahrir, S. (2020). Pembangunan pendidikan merdeka balajar. Jurnal Ilmiah Mandala Education, 6(1).

Yani, F., & Mulia, M. (2023). Pengembangan LKPD terintegrasi STEAM-PjBL pada materi sel volta untuk meningkatkan kemampuan berpikir kritis peserta didik kelas XII SMA/MA. *Jurnal Pendidikan Kimia FKIP Universitas Halu Oleo*, *8*(2), 83-94. : https://doi.org/10.36709/jpkim.v8i2.18