JURNAL EDUKASI BIOLOGI
Volume 10 No 1, March, 2025, 52-62
ISSN: 2986-5484 E-ISSN: 2986-4828
DOI: 10.21831/edubio.v11i1.22902

EFEKTIFITAS PENGEMBANGAN LEMBAR KERJA PESERTA DIDIK (LKPD) BERBASIS EKSPERIMEN PADA MATERI SISTEM PERNAPASAN DALAM MENINGKATKAN HASIL BELAJAR PESERTA DIDIK KELAS XI SMA

THE EFFECTIVENESS OF STUDENT WORKSHEETS (LKPD) ON RESPIRATORY SYSTEM IN IMPROVING THE LEARNING OUTCOMES OF 11th GRADE HIGH SCHOOL STUDENTS

Muthia Akmala[1*], Rizka Rifaatul Hidayah[1], Indah Zaliani[1], Aida Rahma Aulia[1], Ade Suryanda[1], Dini Safitri[1], Fitria Pusparini[1]

[1]Department of Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Jakarta, Indonesia
*E-mail: muthiakml12@gmail.com

Abstract. 21st-century learning outcomes are important in preparing individuals to face the challenges of the modern world, especially in science learning. Factors influencing learning outcomes include learning media, such as Student Worksheets (LKPD), which help students understand the material better. This study used the Research and Development (R&D) method with the 4D model from Thiagarajan and Semmel, including the Define, Design, Develop, and Disseminate stages. The sampling technique used is purposive sampling. A small-scale trial was conducted on 30 grade XI students of SMAN 70 Jakarta. The results of the expert feasibility assessment showed that the material aspect scored 82%, the media aspect 84%, and the language aspect 80%, so the LKPD was declared feasible to use. The assessment of the practicality of the LKPD was measured using a response questionnaire sheet, which obtained very practical results. In addition, the results showed an average pre-test score of 76.6 and a post-test of 95.6, which showed a significant increase in student understanding. The development of LKPD based on experiments on the respiratory system material has proven effective in improving student learning outcomes. This study confirms that using experiment-based LKPD can support learning optimally, combining theory and practice to improve student understanding.
Keywords: Biology, LKPD, Learning, Practicum, Respiratory system

Received: 24 December 2024 Revised: 10 January 2025 Accepted: 15 January 2025 Published: 30 March 2025

INTRODUCTION

Learning outcomes in the 21st century play an important role in shaping individuals ready to face the challenges of the ever-evolving modern world. In addition, learning outcomes in the 21st century have strong relevance in science learning. In this era, science learning focuses on mastering academic knowledge and developing 21st-century skills such as critical thinking, creativity, collaboration, and communication (Arifin et al., 2024). These skills are essential to adapt to technological advances, social change, and global economic dynamics. In addition, 21st-century learning outcomes also include character building, such as a sense of responsibility, integrity, and empathy, which are needed to build an inclusive and sustainable society (Imtinan et al., 2023; Krisgiyanti & Pratama, 2023). By emphasizing the importance of lifelong learning, learning outcomes in this century prepare individuals who make positive contributions to the world (Şentürk, 2019).

Observations of student learning outcomes at SMAN 70 Jakarta show that practical activities are important in improving students' understanding of the subject matter, especially in science subjects. In practical sessions, students learn theoretical concepts and develop

critical thinking skills and data analysis through direct observation and experiments. This activity allows students to understand the theory's application better while improving their collaboration skills through group work. In addition, according to Ramdhani et al. (2024), student involvement in practical work also increases their learning motivation because learning becomes more interesting and applicable. This result shows the importance of integrating interactive learning methods into the educational process.

Factors influencing student learning outcomes can be analyzed, including learning media, facilities, infrastructure, laboratories, and other learning resources (Zakiyawati et al., 2021). Learning media, such as modules or Student Worksheets (LKPD), play an important role in helping students understand the material in a more structured way. Well-designed LKPD, for example, allows students to explore concepts through practical tasks relevant to everyday life (Cahyana et al., 2024). In addition, facilities such as complete laboratories and modern learning tools make it easier for students to conduct experiments so that they can learn through direct experience.

Based on the results of interviews with teachers at SMAN 70 Jakarta, several factors influence student learning outcomes, including the availability of learning facilities such as laboratories, teaching aids, and learning media. Teachers said that the laboratory facilities at the school were sufficient to support practical learning. In addition, teachers also highlighted the importance of interactive learning media, such as Student Worksheets (LKPD), which can help students understand the material more systematically. However, implementing this learning media depends on the readiness of teachers and the availability of time to create teaching materials under the curriculum.

Student Worksheets (LKPD) are one of the learning tools containing topics, summaries, and instructions to help students complete learning activities to master the basic skills taught (Cahyani & Pertiwi, 2024). LKPD functions as a tool that facilitates students' exploration and experimentation to help all students understand the concept of the respiratory system in more depth. Research by Hulu and Anas (2024) shows that practicum-based learning supported by LKPD can significantly improve students' understanding of concepts and encourage them to develop creativity and critical thinking. The Biology teacher said during the interview that SMAN 70 Jakarta had used LKPD as one of the learning tools, especially for materials that require deeper understanding, such as biology. However, teachers revealed that not all LKPDs used were under standards due to time constraints in compiling comprehensive and interesting LKPDs. Some teachers also still use LKPDs downloaded from external sources, which are sometimes less relevant to the needs of students.

Based on previous research, experiment-based LKPD has been proven to improve student learning outcomes. Research conducted by Hamidah et al. (2018), Nida (2021), and Wulansari et al. (2024) shows that LKPD developed with an experimental approach can improve student understanding, reduce misconceptions, and increase learning motivation, especially in materials that require in-depth understanding, such as the respiratory system.

The respiratory system is a biology material requiring in-depth understanding because it involves complex concepts. Unfortunately, many students often experience misconceptions, such as understanding that the lungs are the only organs responsible for respiration or misinterpreting the difference between aerobic and anaerobic respiration (Suwarno & Suratsih, 2018). These misconceptions can affect their understanding of advanced concepts, such as energy metabolism or diseases related to the respiratory system. Therefore, a learning approach is needed that can explain concepts systematically and interactively, one of which is through the use of experiment-based Student Worksheets (LKPD), allowing students to connect theory with practice directly. Thus, using this LKPD is very relevant in improving student learning outcomes. Therefore, this study aims to determine the effectiveness of developing LKPD for respiratory system practicum in improving the learning achievement of class XI students.

METHOD

This study applies the Research and Development (R&D) method using the 4D development model from Thiagarajan and Semmel, which includes the stages of Define, Design, Develop, and Disseminate. A needs analysis is conducted at the Define stage to identify students' learning needs. The design stage involves designing LKPD based on the analysis results by integrating relevant learning instruments. Furthermore, at the development stage, LKPD validation tests are conducted by material experts, media experts, and language experts using assessment instruments. Finally, the developed LKPD is disseminated to a broader learning environment at the Disseminate stage. However, this study's development of this LKPD was limited to a small-scale trial conducted at SMAN 70 Jakarta. This process is due to the limited time and scope of the study.

The small-scale trial stage of the LKPD was conducted by involving samples selected by purposive sampling, totalling 30 grade XI students at SMAN 70 Jakarta. The small-scale trial was conducted to collect responses and feedback regarding its practicality and effectiveness. The feasibility analysis of LKPD by material experts, media experts, and language experts, as well as the practicality analysis by students, were carried out using quantitative descriptive methods. To assess the effectiveness of the LKPD, the pre-test and post-test scores were compared. The feasibility value of LKPD was calculated using the following percentage formula.

$$\text{Percentage (\%)} = \frac{\Sigma\, total\ score}{\Sigma\, maximum\ score} \text{ x } 100\%$$

Next, the percentage of feasibility and practicality obtained is interpreted into qualitative categories based on Table 1. This table presents the criteria for the effectiveness test results formulated by Riduwan (2016).

Table 1. Eligibility score categories

% Scale Percent	Category
0-20	Very not feasible
21-40	Not feasible
41-60	Less feasible
61-80	feasible
81-100	Highly feasible

(Source: Riduwan, 2016)

The percentage of practicality is interpreted into qualitative categories based on Table 2.

Tablel 2. Categories of practicality scores

% Scale Percent	**Category**
0-20	Very impractical
21-40	Impractical
41-60	Less practical
61-80	Practical
81-100	Very practical

(Source: Riduwan, 2016)

According to the score interpretation criteria, LKPD is declared practical and worthy of limited trials if it obtains a score of ≥ 61%. An expert test complements this assessment to ensure the overall quality of LKPD. The material expert test evaluates design and readability, the media expert test ensures the suitability of the content with basic competencies, and the language expert test assesses the clarity and suitability of language use. With these three tests, LKPD is expected to meet quality standards to support effective learning. The effectiveness of LKPD is evaluated through the analysis of learning test results and improvements in student learning outcomes. The evaluation process involves giving a pre-test before learning begins and a post-test after learning is completed. This study uses a trial as a sample to assess the ability of LKPD to support improvements in student learning outcomes. The data obtained were analyzed using the N-gain score <g> calculation, as explained by (Komarudin et al., 2017).

$$<g>= \frac{Skor\ posttest - skor\ pretest}{Skor\ maksimal - skor\ pretest}$$

The normalized N-gain scores are then interpreted into the criteria contained in Table 3.

Table 3. *Normalized N-Gain* category

Value	Category
0.00<(<g>)<0.30	Low
0.30<(<g>)<0.70	Moderate
0.70<(<g>)<1.00	High

(Source: Komarudin et al., 2017)

Based on the criteria, improving student learning outcomes is considered effective if the gain score reaches or exceeds 0.30, which is included in the medium or high category.

RESULTS AND DISCUSSION

LKPD Development Process

The LKPD was designed using the Canva application on A4 paper size with Open Sans font size 24, which aims to provide visual comfort and ease of reading for students. The blue theme was chosen because this colour psychologically provides a calming effect and can increase students' concentration while studying (Sany et al., 2018). In addition, blue can also be associated with the respiratory system because this colour is often associated with fresh air, oxygen, and the sky—elements closely related to the respiratory process. On the cover is a picture of the respiratory organs, such as the lungs, trachea, and bronchi, used to provide a visual identity relevant to the material to be studied. This image also functions as an initial introduction for students to the focus of learning in the LKPD so that they can immediately understand the context of the respiratory system material before starting learning activities, as shown in the cover in Figure 1.

The LKPD developed in this study has characteristics such as containing instructions for use, learning outcomes, learning achievement indicators, learning objectives, material summaries, and LKPD sheets (containing identity, practicum objectives, tools and materials), working methods, observation result tables, questions and conclusions). This LKPD was developed following the independent curriculum. As a requirement for developing LKPD following the independent curriculum, it focuses on the analytical, evaluation, and creative skills (Sumilat & Pangalo, 2024).

The LKPD sheet is designed to contain all information that supports the implementation of practicums in a structured and systematic manner. This LKPD contains important components such as student identity, practicum objectives, tools and materials needed, working

methods, observation tables to record practicum data and analytical questions that direct students to conclusions. In addition, to improve student learning outcomes, LKPD has special features designed to encourage critical thinking, creativity, and problem-solving skills. These features include data analysis-based questions and reflections to link the practicum results to broader biological concepts shown in Figure 2.

Figure 1. Front cover of LKPD

This LKPD is designed as a tool to support the implementation of practicums and as a medium to improve student learning outcomes through an approach that emphasizes in-depth understanding and application of concepts. By including observation tables and analysis questions, students are trained to process data and draw conclusions based on evidence obtained during the practicum (Atiqoh & Suhandoyo, 2022). This approach is expected to improve not only the cognitive aspects of students but also their critical thinking skills (Manurung & Anazifa, 2024).

Validity of LKPD

To ensure its quality and effectiveness, the developed LKPD went through a feasibility test process that included three main aspects: material, media, and language. This assessment involved experts in each field intending to ensure that the LKPD was relevant to basic competencies and could optimally meet students' learning needs. The material aspect was evaluated to ensure the suitability of the content with the learning objectives, the accuracy of the concept, and the relevance to everyday life. The media aspect included an assessment of the layout, visual design, and readability to attract students' interest and make it easier for them to understand the material. Meanwhile, the language aspect was assessed to ensure clarity, grammar suitability, and students' level of understanding. This process was carried out thoroughly to ensure that the LKPD produced could be used as an effective, interesting learning medium that followed the needs of students. The results of the expert assessment are shown in Table 4.

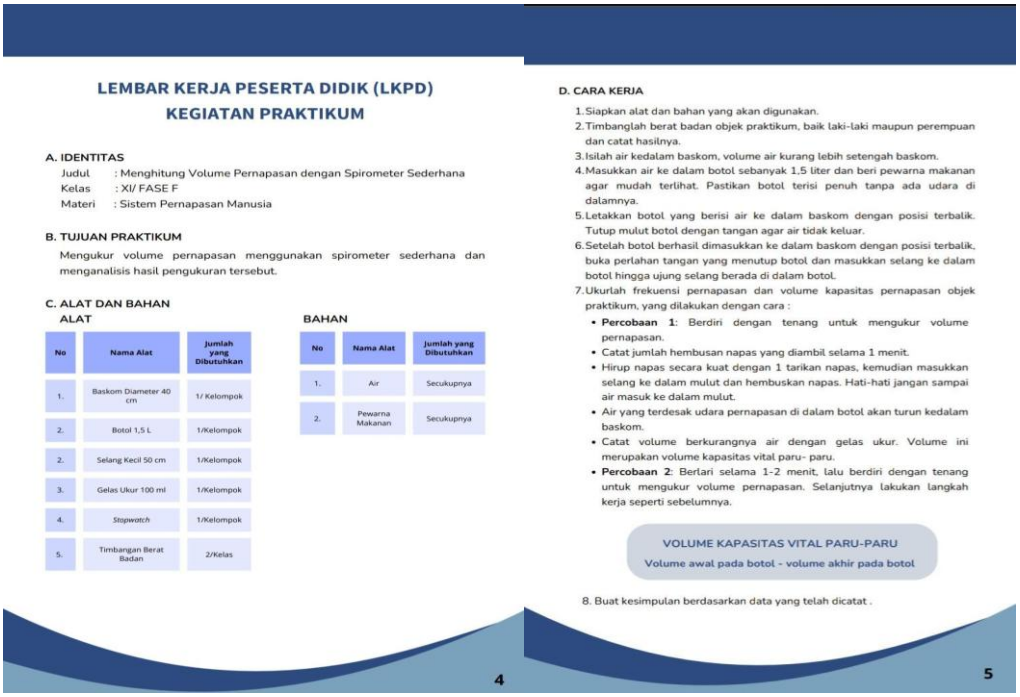

Figure 2. Contents of the LKPD

Table 4. Results of expert ratings

Aspects	Percentage	Category
Material	82%	Highly feasible
Media	84%	Highly feasible
Language	80%	Feasible

Based on Table 4., the results of expert assessments of the feasibility of LKPD show that the material aspect obtained a score of 82%, the media aspect reached 84%, and the language aspect obtained 80%. Based on these results, this LKPD can be categorized as feasible for use in learning. The score on the material aspect reflects that the contents of the LKPD are relevant to students' basic competencies and learning needs. The assessment of the media aspect shows that the design and visual presentation of the LKPD can attract students' attention and support their understanding of the material. Meanwhile, the score on the language aspect shows that the use of language in the LKPD is clear, easy to understand, and under the level of student ability. With high scores on these three aspects, this LKPD meets the criteria as an effective learning media and is feasible to implement.

Practicality of LKPD

This study examines how using experiment-based LKPD in respiratory system practicum activities improves student learning outcomes. The LKPD is designed to encourage more active and participatory learning. The main components of the LKPD include learning objectives, instructions for use, material summaries, and practicum steps that are arranged systematically so that students can understand concepts and develop analytical skills through direct practice.

The practicality of the LKPD is measured using a response questionnaire sheet, which aims to identify the level of student interest in the LKPD developed (Nida, 2021). In addition, this questionnaire also includes questions related to the effectiveness of the LKPD in improving student understanding. The questionnaire was given to 30 grade XI students after they had completed the learning process, which included a pre-test and a post-test. After the entire

learning series is completed, students are asked to fill out a questionnaire with a Likert scale consisting of five choices: Strongly Disagree (STS), Disagree (TS), Undecided (RR), Agree (S), and Strongly Agree (SS). The results of student responses are then analyzed and presented in Table 5.

Table 5. Recapitulation of the practicality of the LKPD

Aspects	Percentage	Category
Fill	88%	Very practical
Language	87%	Very practical
Penyajian	89%	Very practical
Graphics	86%	Very practical

Based on the data in Table 5, the content aspect in the experimental-based LKPD through respiratory system practicum obtained an average percentage of 88%. This percentage shows that the material presented in the LKPD follows the basic competency criteria related to the respiratory system. Thus, this LKPD meets the standards of effective learning tools BSNP (2014) set. In addition, the suitability of the material to basic competencies shows that the LKPD can optimally support the biology learning process. As a tool that supports active learning, experiment-based LKPD can increase student involvement in the learning process, strengthening their understanding of the material (Irwansyah, 2022). Thus, this LKPD is expected to improve student learning outcomes in the respiratory system material.

Language is an important element in communication to ensure that learning objectives are conveyed clearly without causing misinterpretation (Day et al., 2022). Therefore, the linguistic aspect of the LKPD must meet very practical criteria to support the achievement of learning objectives. The evaluation results show that the linguistic aspect has an average practicality percentage of 87%, with a very practical category. This result indicates that students can understand the instructions and explanations in the LKPD well.

In the presentation aspect, the average practicality percentage obtained was 89%, which is included in the very practical category. The assessment of this aspect includes several important factors, such as the order and systematics of compiling the LKPD, which includes the introduction, introduction to skills, table of contents, and bibliography. Each section in the LKPD is arranged neatly and systematically to make it easier for students to follow the learning stages. This LKPD is designed with an orderly structure, where each element has a role that supports each other in delivering material about the respiratory system. According to Astiwi and Siswanto (2024), the structured packaging of the LKPD allows students to access relevant information easily, utilize the guidance provided, and follow the experimental steps effectively. Overall, this LKPD makes it easy to understand the respiratory system concept through a well-organized presentation.

The graphic aspect also plays an important role in attracting students' interest in using LKPD. Based on the results, this aspect obtained an average percentage of 86% with a very practical category. The graphic assessment includes cover design relevant to the content, clear font and size choices, image harmony, colour selection, and the overall design of LKPD (BSNP, 2014). However, the linguistic aspect recorded the lowest score compared to other aspects.

Effectiveness of LKPD

The effectiveness of LKPD is also measured by the results of the LKPD work completed by students. The assessment of argumentative skills is used to measure the extent to which students' learning experiences have improved using LKPD. The results of argumentative skills are obtained by comparing the pre-test and post-test scores that are completed individually. This data is the main indicator in assessing the improvement of argumentative

skills and the effectiveness of LKPD that has been developed (Mulyasari et al., 2020).

Table 6. Average *pre-test* and *post-test scores*

Aspects	Percentage
Pre-test	76.6
Post-test	95.6

Based on Table 6, students' average pre-test and post-test scores show that the average pre-test score is lower than the post-test score. This result reflects a significant increase, with an average pre-test score of 76.6 and a post-test score of 95.6. This increase confirms that LKPD effectively improves students' understanding and abilities. In addition, the graph showing the difference in pre-test and post-test scores shows a positive trend, indicating clear growth or improvement in students' abilities.

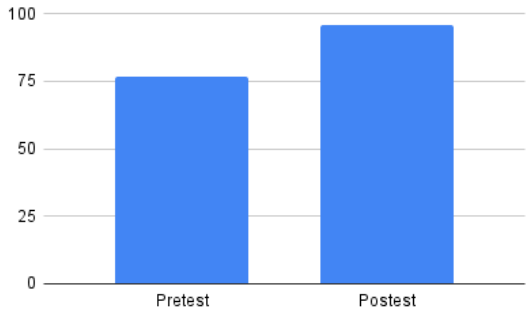

Figure 3. Pretest and posttest mean diagram

Based on the data shown in Figure 3, the average pre-test score of 76.6 and the average post-test score of 95.6 indicate an increase after learning activities using LKPD. The effectiveness of LKPD is analyzed by calculating N-gain, the results of which are listed in Table 7.

Table 7. Recapitulation of *students' pre-test* and *post-test* scores

N Gain	N Gain Score
0.6	60

The improvement in learning outcomes was analyzed using the N-gain method to measure the effectiveness of learning in improving student understanding. Based on the data in Table 7, the N-gain analysis shows an average score of 0.6 or 60% of the maximum improvement that can be achieved, which is included in the moderate effectiveness category according to the N-gain classification criteria. Similar research by Widya et al. (2019) also found that N-gain scores in the range of $0.3 \leq$ N-gain < 0.7 are included in the moderate improvement category, indicating significant improvements in the cognitive aspects of students. This value is calculated based on the difference between students' pre-test and post-test scores. In this context, the N-gain value of 0.6 confirms that using LKPD effectively improves students' understanding of the material being studied.

The significant difference between the pre-test and post-test scores reflects the success of LKPD in supporting the improvement of student learning outcomes. The effectiveness of LKPD is in line with previous research, such as that conducted by Indriani (2020) in physics subjects. The study also used N-gain to evaluate the effectiveness of LKPD and found that the use of LKPD significantly improved students' conceptual understanding. Research by Hamidah (2018) showed that using LKPD based on guided inquiry can significantly improve students'

learning outcomes, with an average pre-test score of 23.97, a post-test score of 81.47, and an N-gain score ≥ 0.70. In addition, research by Wulansari et al. (2024) also found that using LKPD based on the inquiry model effectively improved students' learning outcomes, with a significant difference between the pre-test and post-test scores. This result supports the findings in Table 7 that the LKPD used was able to have a positive impact on students' learning outcomes.

CONCLUSION

This study revealed that developing Student Worksheets (LKPD) based on experiments on the respiratory system material significantly improved the learning outcomes of grade XI high school students. This statement was based on the average final score obtained from the LKPD assessment results by a team of experts, including material experts, media experts, and language experts, which showed that the LKPD was in the valid category or suitable for use overall. The assessment from material experts indicated that the contents of the LKPD followed basic competencies, were scientifically accurate, and were relevant to students' needs. The evaluation by media experts showed that the design and layout of the LKPD were well-designed to facilitate student use. In contrast, language experts assessed that the language used in the LKPD was clear, easy to understand, and appropriate to students' development levels. In addition, the results of the student response questionnaire on the LKPD showed that they felt that this LKPD was very practical to use in learning. The positive response from students reflects that the LKPD not only meets academic eligibility standards but also effectively increases their interest in learning. This combination of validity and practicality shows that LKPD is worthy of being implemented widely as an interactive learning medium.

REFERENCES

Arifin, B., & Mu'id, A. (2024). Pengembangan kurikulum berbasis keterampilan dalam menghadapi tuntutan kompetensi abad 21. *Daarus Tsaqofah: Jurnal Pendidikan Pascasarjana Universitas Qomaruddin*, *1*(2), 118–128. https://doi.org/10.62740/jppuqg.v1i2.23

Astiwi, W., & Siswanto, D. H. (2024). Pengembangan e-LKPD pada materi relasi dan fungsi dengan model PAKEM untuk meningkatkan kemampuan berpikir kreatif. *Jurnal Praktik Baik Pembelajaran Sekolah dan Pesantren*, *3*(3), 118–132. https://doi.org/10.56741/pbpsp.v3i03.684

Atiqoh, A. A., & Suhandoyo, S. (2022). PENYUSUNAN MODUL ELEKTRONIK PENYAKIT SISTEM PENCERNAAN PADA MANUSIA SEBAGAI BAHAN PENGAYAAN BAGI SISWA KELAS XI. *Jurnal Edukasi Biologi*, 8(1), 46–56. https://doi.org/10.21831/edubio.v8i1.18174

BSNP. (2014). *Instrumen penilaian buku teks pelajaran kimia untuk peserta didik SMA/MA*. Jakarta: BSNP.

Cahyana, N., Rustiani, S., Djafar, S., & Nurdin, N. (2024). Literature review: Lembar kerja peserta didik (LKPD) matematika berbasis Geogebra. *Journal of Education Research, 5*(4), 4391–4399. https://doi.org/10.37985/jer.v5i4.1574

Cahyani, D. N., & Pertiwi, K. R. (2024). DEVELOPMENT OF E-LKPD BASED ON PBL IN REPRODUCTIVE HORMONE MATERIAL TO INCREASE REPRODUCTIVE HEALTH LITERACY Danisa. *Jurnal Edukasi Biologi*, 10(2), 191–203. http://dx.doi.org/10.21831/edubio.v10i2.21810

Day, S. P., Webster, C., & Killen, A. (2022). Exploring initial teacher education student teachers' beliefs about reflective practice using a modified reflective practice questionnaire. *Reflective Practice*, 23(4), 437–451. https://doi.org/10.1080/14623943.2022.2048260

Hamidah, N., Haryani, S., & Wardani, S. (2018). Efektivitas lembar kerja peserta didik berbasis inkuiri terbimbing untuk meningkatkan hasil belajar siswa. *Jurnal Inovasi Pendidikan Kimia, 12*(2), 1–12. https://journal.unnes.ac.id/nju/JIPK/article/view/7460

Hulu, S. & Anas, N. (2024). Pengembangan LKPD Berbasis Inkuiri Terbimbing pada Materi Sistem Respirasi Manusia Siswa Kelas XI SMA/MA. *Didaktika: Jurnal Kependidikan*, 13(1), 231-250. https://doi.org/10.58230/27454312.499

Imtinan, A. N. V., Diniyyah, M., Sudrajat, A. K., Susilo, H., & Balqis. (2023). Application of digital mindmap through the process-oriented guided inquiry learning (POGIL) model to improve high school students' collaboration skills and biology concepts understandings during the online learning period. *AIP Conference Proceedings*, 2614(1), 20018. https://doi.org/10.1063/5.0126995

Indriani, I. S. (2020). Pengaruh model pembelajaran Double Loop Problem Solving (DLPS) terhadap kemampuan berpikir kritis siswa pada konsep termodinamika (Kuasi eksperimen di SMA Negeri 105 Jakarta tahun ajaran 2019/2020) (Bachelor's thesis, UIN Syarif Hidayatullah Jakarta). https://repository.uinjkt.ac.id/dspace/handle/123456789/52112

Irwansyah, M., & Perkasa, M. (2022). *Scientific approach dalam pembelajaran abad 21*. Pekalongan: Penerbit NEM.

Komarudin, U., Rustaman, N. Y., & Hasanah, L. (2017). Promoting students' conceptual understanding using STEM-based e-book. *AIP Conference Proceedings*, 1848(November). https://doi.org/10.1063/1.4983976

Krisgiyanti, N. A., & Pratama, A. T. (2023). Pengembangan Lembar Kegiatan Peserta Didik (Lkpd) Berbasis Problem Based Learning (Pbl) Pada Materi Sistem Regulasi Dengan Orientasi Hasil Belajar Peserta Didik Sma N 1 Kroya. *Jurnal Edukasi Biologi*, 9(2), 153–176. https://doi.org/10.21831/edubio.v9i2.19490

Manurung, H. P. O., & Anazifa, R. D. (2024). Development of Interactive E-LKPD Based on Guided Discovery Learning on Cell Material to Improve The Cognitive Understanding of Grade XI Students. *Jurnal Edukasi Biologi*, 10(2), 212–227. http://dx.doi.org/10.21831/edubio.v10i2.22417

Mulyasari, E., Yuliani, Y., & Dewi, S. K. (2020). Keefektifan lembar kegiatan peserta didik (LKPD) berbasis guided inquiry pada materi pertumbuhan dan perkembangan untuk melatihkan keterampilan argumentasi. *Berkala Ilmiah Pendidikan Biologi (BioEdu), 9*(2), 186–192. http://dx.doi.org/10.26740/bioedu.v9n2.p186-192

Nida, R., Salam, A., & Haryandi, S. (2021). Pengembangan bahan ajar elektronik berbasis multimodel pada materi alat-alat optik untuk melatihkan kemampuan analisis peserta didik. *Jurnal Ilmiah Pendidikan Fisika, 5*(2), 107–122. https://doi.org/10.20527/jipf.v5i2.2871

Ramdhani, R. A., Rojabi, M. N., Mubarok, M. C., & Kholis, N. (2024). Eksplorasi implementasi laboratorium fisika berbasis inquiry di SMAN 1 Kejayan. *Magneton: Jurnal Inovasi Pembelajaran Fisika, 2*(2), 91–101. https://doi.org/10.30822/magneton.v2i2.3450

Riduwan. (2016). *Skala pengukuran variabel-variabel penelitian*. Bandung: Alfabeta.

Sany, Y. K., & Isfiaty, T. (2018). Peran warna dalam interior yang bertema futuristik (Studi kasus: Interior Maxxi Museum karya Zaha Hadid). *Waca Cipta Ruang*, *4*(1), 275–281. https://doi.org/10.34010/wcr.v4i1.2041

Şentürk, Ş. (2019). Investigation of pre-service teachers' techno-pedagogical skills and lifelong learning tendencies. *Participatory Educational Research*, 6(2), 78–92. https://doi.org/10.17275/per.19.14.6.2

Sumilat, J. M., & Pangalo, L. C. (2024). Pengaruh Kurikulum Merdeka terhadap Pendidikan Karakter di Sekolah Dasar, *Journal on Education*, 6(4), 21326-21333. https://doi.org/10.31004/joe.v6i4.6282

Suwarno, R. N., & Suratsih. (2018). Pengembangan Media Educational Game "Bio-Monopoli" Sebagai Media Pembelajaran Submateri Rangka Dan Tulang, Materi Sistem Gerak Untuk Siswa Sma/Ma Kelas Xi Ipa. *Jurnal Edukasi Biologi*, 7(2), 102–113. https://doi.org/10.21831/edubio.v7i2.13705

Widya, W., Saptaningrum, E., & Untari, M. F. A. (2019). Pengaruh model Project-Based Learning berbantu lembar kerja peserta didik (LKPD) terhadap kreativitas siswa sekolah dasar. *Jurnal Guru Kita*, *3*(3), 261–270. https://doi.org/10.24114/jgk.v3i3.14599

Wulansari, S. D. W., Andini, D., Pramudiyanti, P., & Dewi, P. S. (2024). Efektifitas LKPD IPAS untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Sekolah Dasar. Lentera: Jurnal Ilmiah Kependidikan, 17(1), 81–88. https://doi.org/10.52217/lentera.v17i1.1437

Zakiyawati, S. W., & Trihantoyo, S. (2021). Urgensi sarana dan prasarana dalam meningkatkan prestasi belajar pada jenjang sekolah menengah kejuruan. *Universitas*, *5*, 73. https://ejournal.unesa.ac.id/index.php/inspirasi-manajemen-pendidikan/article/view/38660