Jurnal Phi

Jenis Artikel: *orginial research/review article*

Development of E-LKPD Assisted by the Flip Builder Application with a Discovery Learning Approach on Business and Energy Materials

Mulki Aris[1], Halimatus Sakdiah[2], Syafrizal Idris[3], Fajrul Wahdi Ginting[4], Safriana[5]

[1,2,3,4,5]Physics Education, FKIP, Melikussaleh University, North Aceh

Corresponding e-mail: mulki.190730001@mhs.unimal.ac.id

KATA KUNCI: E-LKPD, discovery learning, effort and energy

Submitted/Received: 23 July 2024
Revised: 24 December 2024
Accepted: 02 January 2025
Published: 27 January 2025
First Available Online: 27 January 2025

ABSTRACT. The learning process in general still uses books and conventional learning models that make students feel bored and bored. The objectives of the study were to: (1) determine the feasibility of E-LKPD, (2) find out the response of students to E-LKPD, (3) find out the improvement of student learning outcomes to E-LKPD based on discovery learning. The method used in the research is the research method of research and development (R & D) development with a 4-D model. The results showed that: (1) the feasibility of developing discovery learning-based E-LKPD assessed by media experts with a feasibility of 0.79 with the feasible category and material experts were in the feasibility of 0.89 with the very feasible category and teacher assessment with a feasibility of 0.94 with the very feasible category, (2) the response of students to the discovery learning-based E-LKPD was 0.99 with the very interesting category, (3) E-LKPD based on discovery learning is stated to be able to improve student learning outcomes by obtaining an N-Gain Score of 0.78 with a high category and a percentage of 77.61 in the "Very Effective" category. It can be concluded that discovery learning-based E-LKPD can be used in the learning process.

1. Introduction

In general, the development of Science and Technology has a significant influence on education in the 21st century. Education is important for every individual in facing an increasingly modern era (Yunianto et al., 2019). Science and technology has had a positive impact on human thinking skills in various aspects of life, including in the learning process. In Indonesia, the curriculum applied is the 2013 Curriculum. The 2013 curriculum aims to produce the next generation who have productivity, creativity, and innovation through strengthening integrated attitudes, skills, and knowledge (Yanuarti, 2017). Generally, physics learning is more teacher-centered without actively involving students in the learning process. Students only receive information completely from the teacher, so students only focus on the information provided by the teacher without knowing the meaning of each mathematical equation that exists in the physics learning taught (Zulfa et al., 2023).

Electronic LKPD or E-LKPD is an LKPD presented in digital form, which allows learners to fill it using digital devices. Access to E-LKPD can be done by students through digital devices connected to the internet, so it can be accessed from anywhere (Maulana, 2020). E -LKPD has several advantages compared to printed LKPD, such as the ability to be accessed electronically, color displays, and the availability of interactive learning videos. In addition, E-LKPD can also be an interesting means to increase students' interest in learning (Ariani, 2020).

Based on the results of observations and interviews that have been conducted with one of the physics teachers at MAS Ulumuddin Lhokseumawe, information is obtained that the process of teaching physics at MAS Ulumuddin Uteunkot has not been implemented optimally, still uses lecture and group discussion methods and has not implemented an active learning model, still uses Passive learning is taking notes on the material contained in textbooks which makes students feel bored and bored. In addition, in the learning process students lack concentration and students' understanding of concepts is low. This results in many students getting low grades, namely below the KKM (Minimum Completeness criteria). Where students' scores are low, especially in work and energy material, this material is material that is quite difficult and confusing because it requires understanding of the concepts used. Average score of class X MIPA 1 students on Business and Energy material namely 60, while students are said to have completed classically if they have achieved KKM (Minimum Completeness criteria) with a score of 75 (Ginting et al., 2023).

Based on these problems, one of the efforts that can be done is to develop E-LKPD based on Discovery Learning which can help student learning outcomes. E-LKPD can be developed through approaches that lead to discovery or problem solving. With the approach, learning objectives can be planned clearly and purposefully (Ulfa, 2022). The discovery learning model involves learners in the process of discovering concepts through the collection of various information or data obtained through observation or experimentation (Cintia et al., 2018). In the development of E-LKPD-based discovery learning, no initial explanation is given to students, but they are asked to seek the information through the instructions presented in the E-LKPD. The goal is that students can find answers to questions they still don't know for themselves (Rizki et al., 2023).

Based on a previous study conducted by Lestari, et al regarding the development of Student Worksheets (LKPD) based on discovery learning on acid and base materials, the subtopics used in the development of this LKPD include the concept of acid-base, acid-base properties, and acid-base indicators. The results showed that the teacher's response to LKPD was very good with a success rate of 86.6%. Therefore, discovery learning-based LKPD is very effective as learning material for acid and base materials (Lestari et al., 2021). The study conducted by Lubis and Sukmawarti on the development of discovery learning-based LKPD on the theme of heat and locking, temperature and heat subthemes, in grade V of Elementary School, showed the results that discovery learning-based LKPD developed through expert validation tests and validators obtained a success percentage of 90.67%, was included in the criteria of "Very Good", and was assessed "Very Feasible" for use (Lubis & Sukmawarti, 2022). The purpose of this study is to determine the feasibility,

response of students and learning outcomes to E-LKPD based on discovery learning on business and energy materials that have been developed.

2. Method

This research uses a research and development model with a 4-D model developed by Thiagarajan. 4-D Models consists of four stages, namely the define stage, design stage, development stage, and dissemination stage (Putri et al., 2020).

The data collection techniques used in this study were validation sheets for validators, student response questionnaires and pretest-posttest question sheets. This validator sheet uses a questionnaire consisting of four rating scales, which include: 1 (invalid), 2 (quite valid), 3 (valid) and 4 (very valid) while for the student response sheet also used a response questionnaire with assessment criteria 1 = (less), 2 = (enough), 3 = (good), 4 = (very good) and the pretest-posttest question sheet was used to measure the ability of learners before and after learning using discovery learning-based E-LKPD. The data used in the validation of E-LKPD is quantitative data with reference to 4 assessment criteria.

Table 1. Judging Criteria (Rosalina, 2017)

No.	score	Judging Criteria
1.	1	If the judgment is very poor / very inappropriate (invalid)
2.	2	If the assessment is good enough / appropriate enough (valid enough)
3.	3	If the appraiser is good / appropriate (valid)
4.	4	If the assessment is very good / very appropriate (very Valid)

After that, the data collected through data collection instruments are analyzed using analysis and presentation techniques according to a predetermined formula. To calculate the average score of each component or aspect, equation 1 is used.

$$\bar{x} = \frac{\Sigma X}{N} \quad (1)$$

With $\bar{x}$ is the average score of the assessment by experts, ΣX is the number of scores the expert gets, N is the amount of data (Rosalina, 2017). To determine the eligibility of the E-LKPD that has been developed, the average score obtained is converted into a value using certain criteria. This is done to convert the data from the development of E-LKPD which was originally in the form of scores into qualitative data. The formula used to calculate the feasibility index is as follows:

$$Eligibility\ Index = \frac{Average\ of\ all\ facets}{The\ highest\ scale\ of\ assessment} \quad (2)$$

So that the discovery learning-based E-LKPD assessment category is obtained in table 2.

Table 2. E-LKPD Quality Criteria (Rosalina, 2017)

No.	Eligibility Index	Criterion	Decision
1.	$0{,}81 < x \leq 1{,}00$	Very Worth It	If all items on the elements assessed are very suitable and there are no shortcomings with E-LKPD so that it can be used as E-LKPD.
2.	$0{,}62 < x \leq 0{,}81$	Proper	If all items are considered appropriate, although there are slight shortcomings and there needs to be justification with E-LKPD products, they can still be used as E-LKPD sheets.
3.	$0{,}43 < x \leq 0{,}62$	Less Decent	If all items in the assessed element are appropriate, there is a slight deficiency

			and/or a lot with this product, so it needs justification in order to be used as E-LKPD.
4.	$0{,}25 < x \leq 0{,}43$	Not Worth It	If each item in the element is considered inappropriate and there are shortcomings with this product, so justification is needed so that it can be used as E-LKPD.

Student response data is obtained through filling out the E-LKPD sheet which is given to all students after completing using E-LKPD. The purpose of this is to determine the response of students to the use of E-LKPD in the learning process. The formula used is as follows:

$$Student\ Response\ Index = \frac{A}{B} \quad (3)$$

Where A is the number of learners who voted and B is the overall number of learners (Rosalina, 2017).

Improvement in learning outcomes was measured using pretest and posttest given to students before and after using E-LKPD based on discovery learning. The formula used to calculate the improvement in learning outcomes is as follows:

$$Normalitas\ Gain = \frac{nilai\ prostest - nilai\ pretest}{nilai\ maksimum - nilai\ pretest} \quad (4)$$

Table 3. N-Gain score category (Meltzer & David, 2002)

Limitation (G)	Criterion
g>0,7	Tall
0,3<g≤0,7	Keep
g≤0,3	Low

The category of N-gain gain in the form of percent (%) may refer to the following table.

Tabel 3. N-Gain score category (Hake, R.R, 1999)

Present (%)	Interpretation
< 40	Ineffective
40 - 55	Less Effective
56 - 75	Quite Effective
> 76	Effective

3. Results and Discussion

The results of this development research are in the form of e-LKPD teaching materials based on discovery learning on business and energy material. The e-LKPD teaching material media was developed using the professional flip PDF application at MAS Ulumuddin. The assessment results from validation were carried out by 3 media experts and 3 material experts while product trials were carried out by 3 teachers and 20 students, namely class X MIPA 1. The development model used was the 4D model. This model consists of 4 main stages, namely the definition stage, design stage, development stage and disseminate stage.

E-LKPD is very effective in the physics learning process for several reasons:

(1) Advantages of E-LKPD, namely (a) Interactive: E-LKPD can contain interactive content such as simulations, animations and videos that help students understand physics concepts better. (b) Accessibility: E-LKPD can be accessed online, so students can study anytime and anywhere. (c) Customization: E-LKPD can be adjusted to students' needs and abilities, so that the learning process becomes more effective. (d) Feedback: E-LKPD can provide instant feedback to students, so they can understand their strengths and weaknesses. (e) Collaboration: E-LKPD can facilitate collaboration between students, so they can learn from each other (Wudda et al., 2024).

(2) Benefits in Learning Physics, namely (a) Improve Understanding: E-LKPD can help students understand complex physics concepts better. (b) Increasing Motivation: E-LKPD can increase students' motivation to learn physics in a more interesting and interactive way. (c) Improve Skills: E-LKPD can help students

develop practical and analytical skills in physics. (d) Increasing Efficiency: E-LKPD can help teachers save time and increase efficiency in the learning process (Maharani et al., 2024).

So, E-LKPD can be a very effective tool in the physics learning process, because it can help students understand physics concepts better, increase motivation and skills, and increase efficiency in the learning process.

3.1 Material expert assessment

The following graph shows the total index of material expert validation results against discovery learning-based E-LKPD that has been developed:

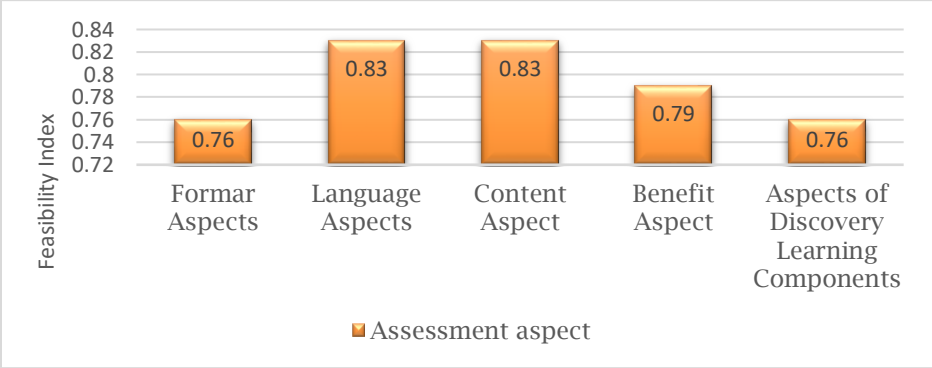


Figure 1. Graph of the total feasibility index of E-LKPD validation results by material experts.

Based on the results of the analysis of material expert assessments regarding E-LKPD as a whole, the average value per aspect is 0.79 with the decent category.

Thus, expert assessments of material substance on the feasibility of E-LKPD developed by researchers show that E-LKPD is feasible to use. This is in accordance with the eligibility criteria of E-LKPD Table 2, if the E-LKPD obtained with the criteria is very feasible if all items in the elements assessed are appropriate and there are no deficiencies with E-LKPD so that it can be used as E-LKPD.

3.2 Evaluation of media members

The total index of material expert validation results against discovery learning-based E-LKPD that has been developed can be expressed with the following graph:

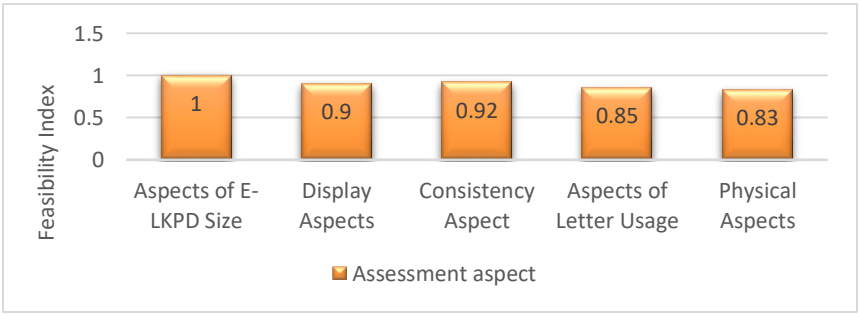


Figure 2. Graph of the total feasibility index of E-LKPD validation results by media experts

Based on the results of the analysis of material expert assessment regarding E-LKPD as a whole, the average value per aspect is 0.89 which is included in the very feasible criteria.

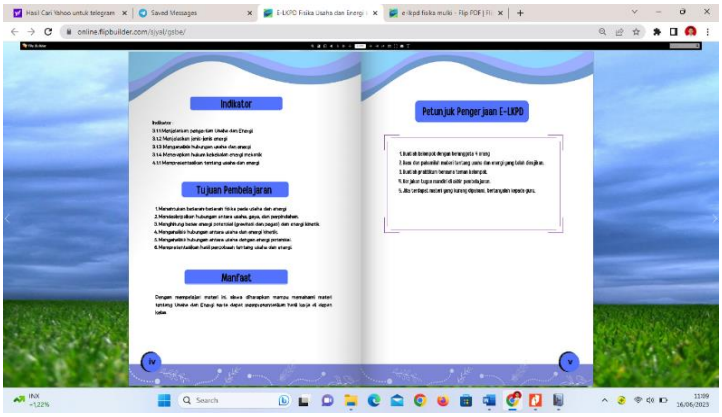
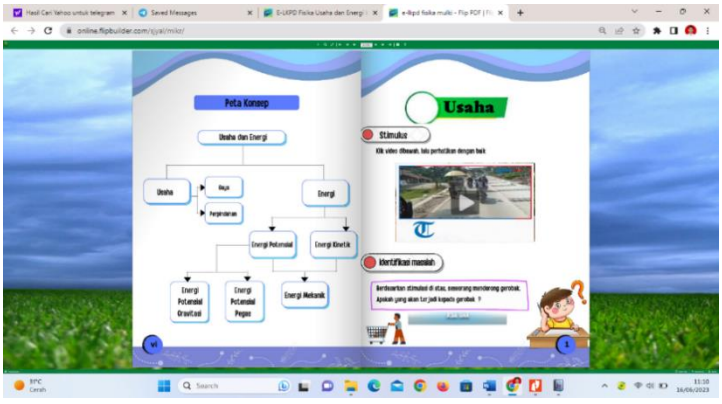
Thus, the media substance expert's assessment of the feasibility of E-LKPD developed by researchers shows that learners' worksheets are worth using. This is in accordance with the eligibility criteria for student worksheets Table 2, if the student worksheets obtained with the criteria are very feasible if all items in the

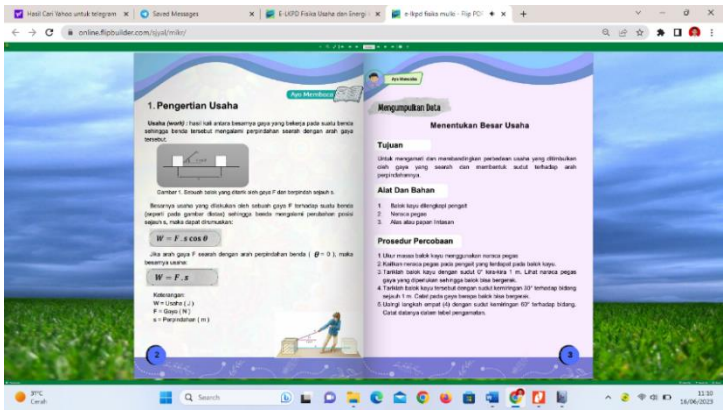
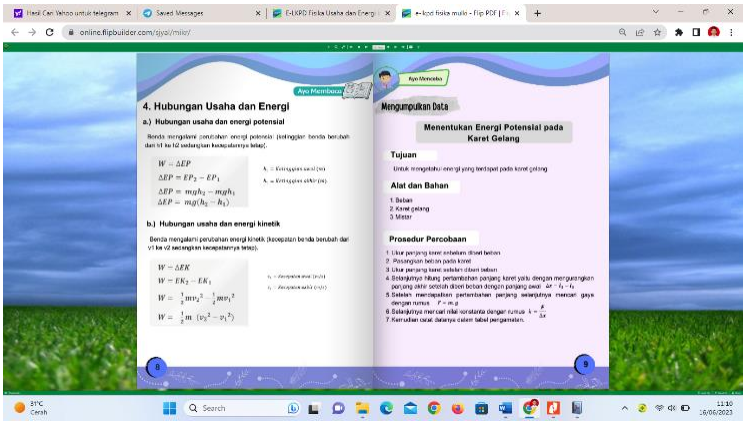
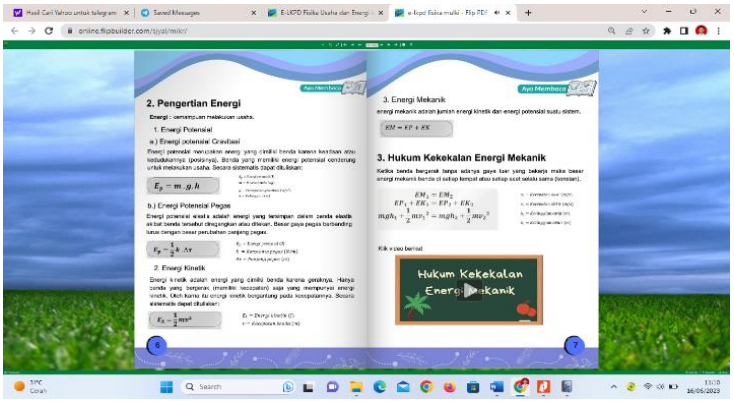
elements assessed are appropriate and there are no shortcomings with E-LKPD so that it can be used as E-LKPD.

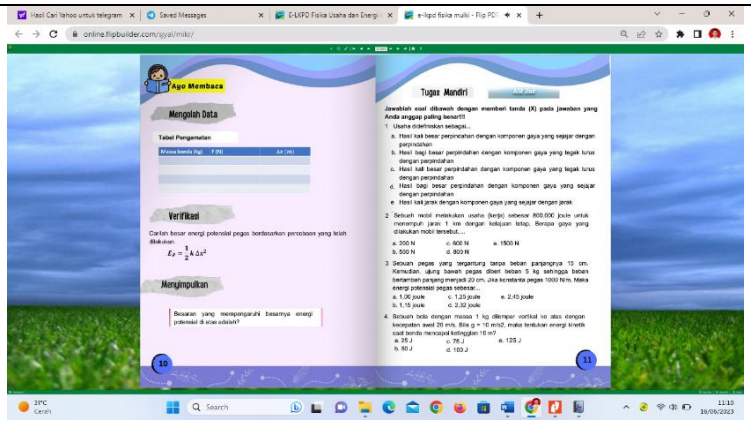
3.3 Product Revision

After validating the E-LKPD, the next process is revising the E-LKPD product according to suggestions and responses from expert validators. The E-LKPD revision activity aims to carry out comprehensive finalization or final improvements to the E-LKPD being developed. The following displays several parts of the E-LKPD that were revised based on suggestions from expert validators.

Table 4. Revised E-LKPD based on discovery learning

No.	Before Revision	After Revision
1.	Suggestion: The cover has been made more attractive.	
2.	Suggestion: Add instructions for working on E-LKPD.	
3.	Suggestion: Revise the concept map according to its division and add instructional sentences to each discovery learning component.	

4.	Suggestion: It is best to make the image in a square shape and make the formula the same size.	
5.	Suggestion: Add formula description.	
6.	Suggestion: Add an interactive simulation video.	

7.	Suggestion: it would be best to add a link to answer the questions so that they are digitally based.	

3.4 E-LKPD Feasibility Trial Phase by Teachers

The results of data analysis of teacher responses showed that the average score per aspect as a whole was 3.77 with a feasibility index of 0.94, which is included in the "very feasible" criterion. When viewed from the four aspects of assessment, namely the quality of E-LKPD content, the quality of E-LKPD presenters, the language quality of E-LKPD, and the quality of E-LKPD display, the average value per aspect is different. In the aspect of quality of E-LKPD content, an average value per aspect of 3.75 was obtained with a feasibility index of 0.94, which is included in the "very feasible" category. The quality aspect of E-LKPD presenters received an average value per aspect of 3.44 with a feasibility index of 0.86, also included in the "very feasible" category. The language quality aspect of E-LKPD received an average value per aspect of 4.00 with a feasibility index of 1.00, which is included in the "very feasible" category. While the display quality aspect of E-LKPD gets an average value per aspect of 3.86 with a feasibility index of 0.96, which is also included in the "very feasible" category.

The total index of teacher validation results against discovery learning-based E-LKPD that has been developed can be expressed with the following graph:

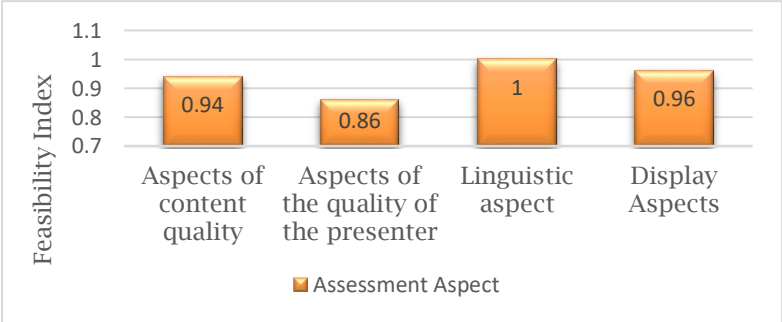


Figure 3. Graph of the total feasibility index of E-LKPD validation results by teachers

3.5 Student response

The results of the data analysis returned by the participants showed that the overall average score of each aspect was 3.96, and the feasibility index was 0.99, which is a very attractive standard. Meanwhile, when viewed from the four assessment aspects, namely the material aspects in E-LKPD, the average value of each aspect is 3.96, and the feasibility index is 0.99 which is included in the very attractive category, while the linguistic aspect of E-LKPD Then the average score of each aspect is 3.97, the feasibility index is 0.99 which is included in the very attractive category, and the average score of each aspect of the presenter aspect is 3.93,

the feasibility score of the index is 0.98 which is included in the very attractive category, and the E-LKPD Interest Aspect obtained an average score of 3.93 per aspect in the 'very attractive' category, with a feasibility index of 0.98.

As for E-LKPD which was developed based on discovery learning, the total student response index can be represented graphically as follows:

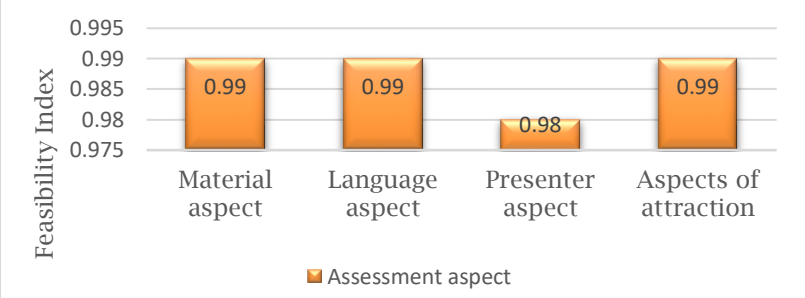


Figure 4. Graph of the appropriateness index for student responses

3.6 Pretest and Postest

Based on pretest and posttest scores, the average N-Gain Score was 0.78 for the "High" category and a percentage of 77.61 for the "Very Effective" category. Thus, it can be said that E-LKPD physics based on discovery learning can improve the learning outcomes of participants in the "high" category in the "very effective" category.

4. Conclusion

Based on the research that has been done, it can be concluded as follows:

1. The feasibility results of E-LKPD based on discovery learning on business and energy mathematics that have been developed based on assessments by media experts as a whole get an average score of 3.17 with a feasibility index of 0.79 which is included in the feasible criteria and based on the overall material expert assessment get an average score of 3.56 with a feasibility index of 0.89 which is included in the very feasible criteria while based on the assessment of the results of teacher responses Overall, it received an average score of 3.77 with a feasibility index of 0.94 which is included in the very decent criteria.
2. The response of students to E-LKPD based on discovery learning on business and energy materials at MAS Ulumuddin which has been developed as a whole gets a score of 3.96 with a feasibility index of 0.99 which is included in the very interesting category.
3. E-LKPD based on discovery learning on business and energy materials that have been developed can effectively improve the learning outcomes of students at MAS Ulumuddin, this is evidenced by the results of the N-gain test getting an average value of 0.78 in the "High" category, with a percentage of 77.61 in the "Very Effective" category.

Pronunciation Thank you

The researcher would like to thank the validators who have helped and directed the author in completing this E-LKPD product.

Involvement Writer

MA collects data, designs E-LKPD and writes original manuscripts. HS and S are supervisors in conducting this research. FWG and S as validators who provide criticism and suggestions to obtain products that are suitable for use.

Bibliography

Ariani, D. 2020. *Pengembangan Lembar Kerja Peserta Didik (Lkpd) Berbasis Discovery Learning Pada Materi Kalor Di Smp*.

Cintia, N. I., Kristin, F., & Anugrahaeni, I. 2018. Penerapan Model Pembelajaran Discovery Learning untuk Meningkatkan Kemampuan Berpikir Kreatif dan Hasil Belajar Siswa. *Perspektif Ilmu Pendidikan,* 32(1), 69-77.

Ginting, F. W., Sakdiah, H., Rose, J., & Febrianty, N. 2023. Pengembangan Four-Tier Diagnostic Test Untuk Menganalisis Kemampuan Konsepsi Siswa Pada Fluida Statis. *Jurnal Dedikasi Pendidikan*, *7*(1), 51-60. https://doi.org/10.30601/dedikasi.v7i1.3442

Lestari, A., Hairida, & Lestari, I. 2021. Pengembangan Lembar Lembar Kerja Peserta Didik (LKPD) Berbasis Discocery Learning pada Materi Asam dan Basa. *Jurnal Zarah, 9(2), 117-124.*

Lubis, A., & Sukmawarti. 2022. Pengembangan Lkpd Berbasis Discovery Learning Pada Tema Panas Dan Perpindahannya Subtema Suhu Dan Kalor Kelas V Sekolah Dasar. *Penelitian Pendidikan MIPA,* 6(2), 1-*7.*

Maharani, P. A., Risdianto, E., & Setiawan, I. 2024. Pengembangan Media Pembelajaran Interaktif Berbantuan Google Sites untuk Meningkatkan Hasil Belajar Siswa pada Materi Momentum dan Impuls. Jurnal Penelitian Pembelajaran Fisika, 15(1), 31-42.

Maulana, I. 2020. Pengembangan E-Modul Flipbook Berbantuan Flip Pdf Professional Dengan Pendekatan Situation Based Learning (SBL) pada Pokok Bahasan Sistem Persamaan Linear Dua Variabel (SPLDV) Kelas VIII Di SMP Negeri 12 Bandar Lampung *(Doctoral dissertation, UIN Raden Intan Lampung).*

Putri, A., Roza, Y., & Maimunah, M. 2020. Development of learning tools with the discovery learning model to improve the critical thinking ability of mathematics. Journal of Educational Sciences, 83-92.

Rizki, M. P., Sakdiah, H., Ginting, F. W., Zahara, S. R., Muliani, & Damanik, B. P. P. 2023. Pengembangan Lembar Kerja Peserta Didik (Lkpd) Berbasis Guided Discovery Learning Menggunakan Simulasi Physics Education Technology (Phet) Pada Materi Listrik Dinamis. *Relativitas: Jurnal Riset Inovasi Pembelajaran Fisika*, *6*(1), 31. https://doi.org/10.29103/relativitas.v6i1.7305

Rosalina, A. M. 2017. *Pengembangan Bahan Ajar Biologi Berbasis STEM (Science Technology Engineering And Mathematics) Pada Pokok Bahasan Bioteknologi Kelas XII SMA (Sekolah Menengah Atas)*. Universitas Jember.

Sari, R. R., Ariani, T., & Lovisia, E. 2022. Pengembangan E-Modul Fisika Berbasis Contextual Teaching and Learning (CTL) Untuk Mengukur Hasil Belajar Fisika Materi Gerak Lurus Kelas X SMA Negeri 2 Lubuklinggau. *3(1), 42-60.*

Ulfa, N. F. 2022. Pengembangan e-lkpd (elektronik–lembar kerja peserta didik) interaktif menggunakan google slide with pear deck dengan pendekatan kontruktivisme (Doctoral dissertation, UIN RADEN INTAN LAMPUNG).

Wudda, A. A., Hufri, H., Gusnedi, G., & Dewi, W. S. 2024. Validasi E-LKPD Interaktif Berbasis Model Pembelajaran Contextual Teaching and Learning pada Materi Hukum Termodinamika. Jurnal Pendidikan Tambusai, 8(1), 7543-7552.

Yanuarti, E. 2017. Pemikiran pendidikan ki. Hajar dewantara dan relevansinya dengan kurikulum 13. *Jurnal Penelitian*, 11(2), 237-265

Yunianto, T., Negara, H. S., & Suherman, S. 2019. Flip builder: Pengembangan pada Media Pembelajaran Matematika. *Jurnal Pendidikan dan Pembelajaran Dasar*, 6(2), 155-127

Zulfa, M., Muliani, Sakdiah, H., Idris, S., & Ginting, F. W. 2023. Development Of Powtoon-Based Audio-Visual Learning Media to Improve Students ' Creative Thinking Ability on Straight-Motion Materials. *Jurnal Eduscience (JES)*, *10*(1), 8-18.