

## IMPLEMENTATION OF HANDS ON MINDS ON INTEGRATED ELECTRONIC STUDENT WORKSHEETS ON ENVIRONMENTAL CHANGE MATERIAL TO IMPROVE CRITICAL THINKING SKILLS OF 10TH GRADE STUDENTS AT NATION STAR ACADEMY SURABAYA

*Penerapan Lembar Kerja Peserta Didik Elektronik Terintegrasi Hands On Minds On Pada Materi Perubahan Lingkungan Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas X SMA Nation Star Academy Surabaya*

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### Abstract

The current curriculum requires students to not only master knowledge, but also be able to solve real-world problems through the development of 21st-century skills, particularly the 4Cs (Critical Thinking, Communication, Collaboration, and Creativity). Indonesian students' critical thinking skills are still relatively low, according to the 2022 Programme for International Student Assessment (PISA) results. Therefore, there is a need for innovative learning media that can optimally train critical thinking skills. This study aims to describe learning completeness, consistency in the application of the integrated Hands On Minds On E-LKPD, and student responses to its use in the learning process. This study uses a quantitative descriptive approach with a Pre-Experimental One Group Pre-test and Post-test Design method. The research subjects involved 50 tenth-grade students from two classes at Nation Star Academy (NSA) Surabaya who use the Cambridge curriculum. The research was conducted in October 2025 during three meetings. The research instruments were pre-tests and post-tests to measure learning completeness and improvement, as well as student response questionnaires. The average post-test score reached 94% above the minimum passing grade with an N-Gain value of 0.88, which is categorized as high. Student responses to the use of E-LKPD were very positive at 92%. Thus, it can be concluded that the implementation of E-LKPD integrated with Hands On Minds On, carried out in accordance with the Problem Based Learning syntax, is effective in improving students' critical thinking skills.

**Keywords:** E-LKPD, Hands On Minds On, Critical Thinking, Environmental Change

### Abstrak

Kurikulum saat ini menuntut peserta didik tidak hanya menguasai pengetahuan, tetapi juga mampu menyelesaikan permasalahan nyata melalui pengembangan keterampilan abad ke-21, khususnya keterampilan 4C (Critical Thinking, Communication, Collaboration, dan Creativity). Keterampilan berpikir kritis peserta didik Indonesia masih tergolong rendah, hasil Programme for International Student Assessment (PISA) 2022. Oleh karena itu, diperlukan inovasi media pembelajaran yang mampu melatih keterampilan berpikir kritis secara optimal. Penelitian ini bertujuan untuk mendeskripsikan ketuntasan pembelajaran, konsistensi penerapan E-LKPD terintegrasi Hands On Minds On, serta respons peserta didik terhadap penggunaannya dalam proses pembelajaran. Penelitian ini menggunakan pendekatan deskriptif kuantitatif dengan metode Pre-Experimental One Group Pre-test and Post-test Design. Subjek penelitian melibatkan 50 peserta didik kelas X dari dua kelas di Nation Star Academy (NSA) Surabaya yang menggunakan kurikulum Cambridge. Penelitian dilaksanakan pada bulan Oktober 2025 selama 3 kali pertemuan. Instrumen penelitian berupa tes pre-test dan post-test untuk mengukur ketuntasan dan peningkatan hasil belajar, serta angket respons peserta didik. Nilai rata-rata post-test mencapai 94% di atas KKM dengan nilai N-Gain sebesar 0,88 berkategori tinggi. Respons peserta didik terhadap penggunaan E-LKPD sangat positif sebesar 92%. Dengan demikian, dapat disimpulkan bahwa penerapan E-LKPD terintegrasi Hands On Minds On yang dilaksanakan sesuai sintaks Problem Based Learning efektif dalam meningkatkan keterampilan berpikir kritis peserta didik

**Kata Kunci:** E-LKPD, Hands On Minds On, Berpikir Kritis, Perubahan Lingkungan



## INTRODUCTION

21st-century education requires a paradigm shift in the learning process. In this digital era, students are not only expected to master subject matter knowledge but also to develop 4C skills (Critical Thinking, Communication, Collaboration, and Creativity). According to Widodo and Kusuma Wardani (2020), teaching 21st-century skills to students can help them communicate more effectively across diverse differences and collaborate in achieving shared goals. In the field of education, the curriculum is a crucial component within educational institutions. The curriculum consists of a set of plans and instruments related to objectives, content, and instructional materials, and it serves as a guideline for managing learning activities to achieve academic goals (Sopiansyah et al., 2022).

At present, education that emphasizes global competencies and technology-based learning has become a fundamental pillar of the Indonesian education system as an effort to improve educational quality. Several schools have adopted the Cambridge curriculum, which is recognized for its strengths in developing students' understanding, knowledge, and skills (Hasanah et al., 2024). A number of schools in Indonesia have implemented international curricula to enhance school quality. The Cambridge International Examination (CIE) curriculum, more commonly known as the Cambridge Curriculum, is the most widely adopted international curriculum in Indonesia (Ramadianti, 2023). One of the schools implementing the Cambridge Curriculum is the international high school Nation Star Academy Surabaya. Based on observations and interviews with biology teachers at the international high school Nation Star Academy, it was found that the instructional media used in learning activities have not been optimal in developing students' critical thinking skills, particularly in the topic of environmental pollution. In addition, the available E-LKPD often merely represent a digitalized version of printed LKPD without utilizing interactive or multimedia features that can effectively stimulate the stages of students' critical thinking. E-LKPD have significant potential as learning instruments that can guide students through the learning process, facilitate exploration, and encourage problem-solving.

According to Widjanarko and Budiyo (2018), the Cambridge Curriculum emphasizes students' understanding, knowledge, and critical thinking skills, which encompass mental strategies and problem-based learning. The majority of students in Indonesia demonstrate a low level of critical thinking ability. This low level of skill is reflected in the results of the Student Assessment (PISA) 2022 study, in which Indonesia ranked relatively low in critical thinking skills, placing 72nd out of 77 participating countries. Therefore, it is important for students to improve their critical thinking abilities so that they are able to analyze, discuss, and evaluate the information they receive (Indriani et al., 2023).

The integrated hands-on minds-on learning method is an instructional approach in which students are not only required to observe and listen to the teacher's explanations but are also directly involved in the processes of observing, performing, and identifying the objects being studied (Mulyaningsih et al., 2025). In biology learning, it is essential to guide students to study real natural objects. Therefore, learning models that can foster students' potential and creativity are needed so that the learning process emphasizes biological realities (Illahi et al., 2022). This is also supported by Putra and Fitrihidajati (2024), who stated that hands-on minds-on activities, which involve physical activities (experiments or practical work) and psychological activities (thinking in problem solving), can help students achieve a deeper understanding of the subject matter.

In the era of globalization and the rapid advancement of information technology, one of the emerging trends is the use of technology in the learning process, including the implementation of Electronic Student Worksheets (E-LKPD). E-LKPD represent an innovation of conventional student worksheets designed to support the learning process through digital and electronic media (Astiwi, 2024). E-LKPD must be designed in a way that enhances students' creative thinking. Moreover, E-LKPD need to be optimally developed to effectively improve students' critical thinking skills (Rawanda, 2024). E-LKPD offer advantages by reducing limitations of space and time in learning activities, thereby promoting more efficient learning. In addition, E-LKPD serve as an engaging learning method, particularly when students' learning motivation declines (Syafitri & Tressyalina, 2020).

## METHODS

This study employed a quantitative descriptive approach using a Pre-Experimental Design, specifically the One-Group Pre-test and Post-test Design. This design was applied to determine the improvement in students' critical thinking skills before and after the implementation of Hands-On Minds-On integrated E-LKPD in the learning process.

O1 X O2



Figure1. Procedure of the One-Group Pre-test Post-test Design

**Notes:**

- O1 : Pre-test administered before the learning intervention
- X : Implementation of learning using Hands-On Minds-On integrated E-LKPD
- O2 : Post-test administered after the learning intervention

The study was conducted at SMA Nation Star Academy Surabaya during the odd semester of the 2025/2026 academic year, from August to February 2025. The research subjects consisted of two classes, namely X Science 1 and X Science 2, with a total of 50 students selected using a simple random sampling technique. All students received the same treatment in the form of learning activities using Hands-On Minds-On integrated E-LKPD on the topic of environmental change.

The research data were collected using two techniques, namely tests and questionnaires. The tests were used to measure the improvement of students' critical thinking skills by comparing pre-test and post-test scores, as well as examining the consistency of students' learning mastery. The questionnaire was used to obtain students' responses to the use of E-LKPD during the learning process. The questionnaire was developed using the Guttman scale with response options of "Yes" (1) and "No" (0).

Cognitive learning outcome mastery was determined based on the improvement in scores from the pre-test to the post-test. Students were considered to have achieved learning mastery if their scores reached  $\geq 80$ .

The pre-test and post-test results were analyzed through individual mastery, which was calculated using the following formula.

$$Percentage = \frac{Score\ obtained}{Maximum\ score} \times 100\%$$

The pre-test and post-test scores obtained were further analyzed to determine the improvement in learning outcomes using the N-gain score calculation. The formula used is as follows

$$N - Gain = \frac{Post - test\ score - Pre - test\ score}{Maximum\ Score - Pre - test\ score}$$

Furthermore, the obtained N-gain scores were interpreted based on low, medium, and high categories, as presented in Table 1.

Intervals	Category
$G > 0,3$	Low
$0,3 \geq g < 0,7$	Moderate
$G < 0,7$	High

Sources: (Nuryani *et al.*, 2022)

The response questionnaire was developed by the researcher using the Guttman scale in the form of statement items accompanied by "Yes" and "No" response options. The aspects of the students' response questionnaire were scored according to the criteria presented in Table 2.

Tabel 2. Guttman Criteria Scale

Statement	Score
Yes	1
No	0

Sources: (Nuryani *et al.*, 2022)

Furthermore, the questionnaire results were analyzed descriptively using the percentage formula as follows.

$Percentage = \frac{Score\ obtained}{Maximum\ score} \times 100\%$  After the response percentages were obtained, they were interpreted using the criteria presented in Table 3.

Tabel 3. Criteria for the Implementation Score of Students' Response Questionnaire

Percentage	Grade	Interpretation
88 – 100	A	Very Positive
75 – 87	B	Positive
62 – 72	C	Fairly Positive
49 - 61	D	Less Positive



0 - 48	E	Not Positive
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Source: (Putra, 2022)

The distributed response questionnaires were categorized as “Good” and “Very Good” if the obtained scores met the specified criteria  $\geq 75$

### RESULT AND DISCUSSION

This study aimed to implement Hands-On Minds-On integrated E-LKPD on the topic of environmental change to foster the critical thinking skills of Grade X senior high school students. The implementation of E-LKPD was evaluated through improvements in students’ learning outcomes, as measured by pre-test and post-test scores, as well as students’ responses to the learning process.

The effectiveness of the Hands-On Minds-On integrated E-LKPD on the topic of environmental change was examined based on the improvement in students’ learning outcomes. Students’ learning outcomes were obtained through the administration of pre-tests and post-tests on the environmental change topic to assess critical thinking skills. The learning outcomes measured in this study were cognitive learning outcomes, consisting of pre-test and post-test scores. The level of students’ critical thinking achievement can be observed across each critical thinking indicator measured in this study. Table 4 presents the learning outcome data of Grade X Science 1 and X Science 2 students.

Tabel 4. N-Gain of Grade X Science 1 and Science 2 Students

No.	X Science 1		X Science 2	
	N-Gain	Criteria	N-Gain	Criteria
1	0.89	High	1.00	High
2	1.00	High	1.00	High
3	0.40	Moderate	0.78	High
4	0.86	High	0.50	Moderate
5	0.88	High	0.80	High
6	1.00	High	1.00	High
7	0.83	High	0.91	High
8	0.89	High	0.78	High
9	0.90	High	1.00	High
10	1.00	High	0.71	High
11	0.80	High	0.91	High
12	0.67	Moderate	0.92	High
13	0.82	High	0.70	Moderate
14	1.00	High	0.78	High
15	1.00	High	1.00	High
16	0.90	High	0.92	High
17	0.73	High	0.82	High
18	0.92	High	1.00	High
19	1.00	High	1.00	High
20	0.83	High	0.91	High
21	1.00	High	1.00	High
22	0.50	Moderate	0.85	High
23	0.92	High	1.00	High
24	0.80	High	0.78	High
25	0.82	High	0.91	High
Mean	0.87	High	0.88	High

Based on the data presented in Table 4, it can be observed that all students in Grade X Science 1 experienced an improvement in learning outcomes after participating in learning activities using Hands-On Minds-On integrated E-LKPD. The average N-gain score of 0.87 falls within the high category, indicating that most students demonstrated a



significant improvement in concept mastery. Meanwhile, students in Grade X Science 2 obtained an average N-gain score of 0.88, which is also categorized as high. This result indicates that learning using Hands-On Minds-On integrated E-LKPD was effective in improving students' concept mastery.

Overall, the N-gain score for both classes was 0.88, which falls within the high category. Based on this average value, it can be inferred that students experienced an improvement from the pre-test on the subtopic of environmental change, specifically the eutrophication topic in the Cambridge curriculum. The students' learning outcomes indicate a relationship between post-test mastery and students' activeness during learning activities, as observed throughout the instructional process. The achievement of students' learning outcomes can be attained when students participate actively in learning activities (Syafriza & Junaidi, 2022).

The E-LKPD media utilized in this study also include features such as Bio Think, Bio Fact, Bio Concept, Bio Activity, Bio Link, and Bio Exercise. Based on the development results reported by Ardyagarani and Fitrihidajati (2025), these features directly contribute to improved learning outcomes by stimulating critical thinking processes, strengthening conceptual understanding, and encouraging students' independence in exploring learning materials.

The improvement in students' learning outcomes is further supported by the N-gain achievement, which falls within the high category with an average score of 0.88. This N-gain value indicates that the use of Hands-On Minds-On integrated E-LKPD is effective in enhancing students' understanding from the pre-test to the post-test.

The mastery of pre-test and post-test results as well as the achievement criteria of Grade X Science 1 students are presented in Table 5.

Table 5. Pre-test Mastery of Grade X Science 1 and Science 2 Students

No.	X Science 1		X Science 2	
	Percentage (%)	Criteria	Percentage (%)	Criteria
1	55.00	Not Complete	60.00	Not Complete
2	60.00	Not Complete	65.00	Not Complete
3	75.00	Not Complete	55.00	Not Complete
4	65.00	Not Complete	70.00	Not Complete
5	60.00	Not Complete	50.00	Not Complete
6	50.00	Not Complete	50.00	Not Complete
7	40.00	Not Complete	45.00	Not Complete
8	55.00	Not Complete	55.00	Not Complete
9	50.00	Not Complete	60.00	Not Complete
10	55.00	Not Complete	65.00	Not Complete
11	50.00	Not Complete	45.00	Not Complete
12	55.00	Not Complete	40.00	Not Complete
13	45.00	Not Complete	50.00	Not Complete
14	65.00	Not Complete	55.00	Not Complete
15	60.00	Not Complete	45.00	Not Complete
16	50.00	Not Complete	40.00	Not Complete
17	45.00	Not Complete	45.00	Not Complete
18	40.00	Not Complete	50.00	Not Complete
19	50.00	Not Complete	50.00	Not Complete
20	40.00	Not Complete	45.00	Not Complete
21	50.00	Not Complete	40.00	Not Complete
22	70.00	Not Complete	35.00	Not Complete
23	40.00	Not Complete	50.00	Not Complete
24	50.00	Not Complete	55.00	Not Complete
25	45.00	Not Complete	45.00	Not Complete
Mean	50.00	Not Complete	50.60	Not Complete



Table 6. Post-test Mastery of Grade X Science 1 and Science 2 Students

No.	X Science 1		X Science 2	
	Percentage (%)	Criteria	Percentage (%)	Criteria
1	95.00	Complete	100.00	Complete
2	100.00	Complete	100.00	Complete
3	85.00	Complete	90.00	Complete
4	95.00	Complete	85.00	Complete
5	95.00	Complete	90.00	Complete
6	100.00	Complete	100.00	Complete
7	90.00	Complete	95.00	Complete
8	95.00	Complete	90.00	Complete
9	95.00	Complete	100.00	Complete
10	100.00	Complete	90.00	Complete
11	90.00	Complete	95.00	Complete
12	85.00	Complete	95.00	Complete
13	90.00	Complete	85.00	Complete
14	100.00	Complete	90.00	Complete
15	100.00	Complete	100.00	Complete
16	95.00	Complete	95.00	Complete
17	85.00	Complete	90.00	Complete
18	95.00	Complete	100.00	Complete
19	100.00	Complete	100.00	Complete
20	90.00	Complete	95.00	Complete
21	100.00	Complete	100.00	Complete
22	85.00	Complete	90.00	Complete
23	95.00	Complete	100.00	Complete
24	90.00	Complete	90.00	Complete
25	90.00	Complete	95.00	Complete
Mean	93.60	Complete	94.40	Complete

Based on the obtained data, it can be observed that students' post-test scores increased significantly. The average pre-test score was 50%, indicating that most students were in the non-passing category. After the implementation of Hands-On Minds-On integrated E-LKPD, the average post-test score increased to 93.60%, and all students achieved the passing category. In Grade X Science 2, the average pre-test score was 51%, which also placed most students in the non-passing category. Following the implementation of Hands-On Minds-On integrated E-LKPD, the average post-test score increased to 95.00%, and all students reached the passing category.

The improvement in learning outcomes cannot be separated from the role of the teacher as a facilitator. The teacher's role is essential in creating a supportive classroom learning environment, guiding students to reflect on the learning process, and assisting students in developing critical thinking through guiding questions and group discussions. By providing opportunities for students to engage in discussion, collaborate in groups, and apply critical thinking strategies in authentic contexts, teachers are able to foster students' independence and analytical abilities (Fakhri, 2023).

The results of students' responses to learning activities using Hands-On Minds-On integrated E-LKPD on the topic of environmental change in Grade X Science 1 and Science 2 are presented in Table 7.

Tabel 7. Students Responses

No	Criteria	Yes (%)	No (%)	Grade
1.	The learning objectives presented in this E-LKPD are clearly formulated.	100%	0%	A



2.	The allotted time is adequate for completing the E-LKPD activities.	90%	10%	A
3.	The instructions provided for working on the E-LKPD are clear and easy to understand.	98%	2%	A
4.	The activity procedures presented in this E-LKPD are clearly structured and feasible to implement.	90%	10%	A
5.	The exercise on formulating problem statements in this E-LKPD is clearly structured and manageable.	94%	6%	A
6.	The exercise on formulating hypotheses in this E-LKPD is clearly structured and manageable.	90%	10%	A
7.	The exercise on designing experiments in this E-LKPD is clearly structured and manageable.	94%	6%	A
8.	The exercise on conducting experiments in this E-LKPD is clearly structured and manageable	92%	8%	B
9.	The exercise on data collection in this E-LKPD is clearly structured and manageable.	82%	18%	B
10.	The exercise on data analysis in this E-LKPD is clearly structured and manageable.	90%	10%	A
11.	The exercise on drawing conclusions in this E-LKPD is clearly structured and manageable.	94%	6%	A
12.	This E-LKPD facilitates student conceptual understanding of the subject matter.	94%	6%	A
13.	The visual presentation of this E-LKPD is engaging.	88%	12%	A
14.	The images presented in this E-LKPD are clear and contribute to improved understanding.	84%	16%	B
Overall average percentage students positive respons (%)		92%		A

Descriptions:

A: Very Positive, B: Positive

The implementation of Hands-On Minds-On integrated E-LKPD reflects a learning process that incorporates critical thinking strategies employed by students. This is evidenced by the positive responses obtained from the student response questionnaires of Grade X Science 1 and Science 2, which reached 92% and were categorized as very positive. These findings indicate that Hands-On Minds-On integrated E-LKPD are highly practical to use based on students' responses and are also highly practical in terms of their implementation in training students' critical thinking skills in both Grade X classes.

The high level of positive student responses indicates that students favor the activities embedded in the E-LKPD. The electronic student worksheets are perceived to support conceptual understanding, train data analysis skills, enhance students' ability to draw conclusions, formulate problem statements, develop hypotheses, and collect data through experimental activities. Furthermore, E-LKPD help students better comprehend the instructional material delivered during the learning process.

These positive responses are consistent with the results of the implementation of the instructional module, which also fell within the very high category. All stages of the learning process—from the introductory, core, to the closing activities—were successfully implemented in both classes. This optimal level of implementation strengthens the questionnaire findings, indicating that students felt comfortable, found it easy to follow the learning activities, and were supported in understanding the material. Thus, the positive student responses did not stand alone but were aligned with the quality of the instructional implementation. This consistency is also reflected in students' learning outcomes. The average post-test scores and N-gain values were categorized as high, indicating that the E-LKPD were not only well received by students but also effective in enhancing conceptual understanding and fostering critical thinking skills.

The use of the Hands-On Minds-On approach in instructional materials enables students to optimally comprehend the learning content. This is supported by the statement of Yanita et al. (2020), who asserted that learning using the Hands-On Minds-On approach requires maximum student engagement, thereby providing students with opportunities to think independently, collaborate in groups, and solve problems autonomously.



## CLOSING

### Conclusion

The findings of this study indicate that the implementation of Hands-On Minds-On integrated E-LKPD on the topic of environmental change yields consistently positive effects on the critical thinking skills of Grade X students. This is evidenced by the increase in post-test scores, with an achievement level of 94%, which exceeds the school's minimum mastery criterion of 80 and falls within the very high category, as well as an N-gain score of 0.88 categorized as high, indicating that students achieved learning mastery. In addition, students from both classes provided positive responses to the use of E-LKPD, with a response rate of 92%. These findings confirm that the integration of the Hands-On Minds-On approach into E-LKPD can serve as an effective alternative for enhancing students' critical thinking skills on the topic of environmental change.

### Suggestion

The research recommendations are formulated based on the findings discussed in this study. Future research may apply Hands-On Minds-On integrated E-LKPD as an alternative instructional tool for other topics that require critical thinking skills. In addition, subsequent studies are recommended to involve a larger number of classes as research subjects to obtain more representative results.

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