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# Teacher and Student Perceptions on the Use of Differentiated e-LKPD in Project-Based Learning on Organic Waste Processing to Improve Critical Thinking Skills

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**Abstract:** The purpose of this study was to determine the perception of science teachers towards differentiated electronic student worksheets based on organic waste processing projects to improve critical thinking skills. The research method used is a qualitative method. Data collection techniques through questionnaires and interviews, then analyzed using descriptive analysis. The questionnaire was distributed to 10 science teacher respondents and 96 junior high school students in South Lampung Regency. The results showed that 80% of teachers had not used differentiated electronic student worksheets based on projects and had not trained critical thinking skills; according to students, no teachers implemented project-based learning. Based on the results of the study, it can be concluded that differentiated e-LKPD based on organic waste processing projects is needed to improve students' critical thinking skills.

**Keywords:** Critical thinking skills; Differentiated e-LKPD; Project-based learning

## Introduction

In 2045, Indonesia is heading towards its golden age of exactly 100 years with the target of becoming a developed country. One of the factors towards Golden Indonesia is human resources. The current era of development requires humans to have skills and abilities that must be mastered, namely 21st century life skills. Life skills in the 21st century include Creativity, Critical Thinking, Communication, Collaboration or better known as 4C. According to Pancawati & Widaswara (2023) in business development in the creative economy sector, it requires business actors to have the ability to think critically, creatively, and innovatively in developing their businesses.

To achieve qualified human resource quality, one important aspect in the process is critical thinking (Mastan & Sukendro, 2023). Currently and in the future, jobs that will continue to be relevant are those that require critical thinking involvement in the decision-making process (Rahardhian, 2022). Without critical thinking, society is vulnerable to exploitation not only politically, but also economically (Facione, 2015).

Critical thinking is a form of reflective and rational thinking in determining the right beliefs or actions (Ennis, 2011). Thus, critical thinking is a reasoning process that has a specific purpose such as proving a statement, interpreting the meaning of something, or making decisions in solving problems based on information obtained by thinking reflectively (Alharbi et al., 2022; Facione, 2015; Van Laar et al., 2020).

It should be noted that some Indonesian citizens have not adopted a critical mindset, this phenomenon is influenced by several factors such as the tendency to adapt and the way the media presents information (Mastan & Sukendro, 2023). In addition, based on data from the 2022 Program for International Student Assessment (PISA) research, Indonesia is ranked 68th

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with a score; mathematics (379), science (398), and reading (371). These data show that Indonesian students are below the OECD average, which should be at level 5 or level 6 but in reality Indonesian students have only reached level 1 or level 2. The PISA science literacy assessment tests how well students can solve complex problems, think critically, and communicate effectively. From these data, it can be concluded that the critical thinking skills of students in Indonesia are very low (PISA, 2022).

The cause of the low critical thinking skills of students in Indonesia is due to ineffective learning in improving students' talents, potential, and interests with teachers dominating learning (Anisa et al., 2021; Hairida, 2016). Therefore, Indonesian students need to be trained in learning that has the opportunity to improve critical thinking skills, considering that there is still capacity and potential that has not been fully utilized (Lidiawati & Aurelia, 2023).

One of the efforts that can be made to improve critical thinking skills is through learning by presenting problems that occur in the surrounding environment (Milatti & Fitrihidajati, 2024; Solikhin et al., 2023). In the context of learning in the 21st century, it is not only expected that students are able to memorize or understand the material, but also be able to apply the knowledge gained so that learning has greater relevance. The ability to think critically is very important so that students can analyze, synthesize, and construct the concepts learned. In the environment of students, both at home and in the surrounding environment, there are real problems that can be used as media in learning. The problem that occurs is the large amount of organic waste from leaf litter, vegetable and fruit waste at home which has an impact on environmental pollution because it produces greenhouse gases (Febrianti et al., 2023)

The learning model that can provide real problems is project-based learning. According to Barrows & Tamblyn (1980), project-based learning uses problems as a focal point or stimulus for the use of skills in solving problems or thinking logically, as well as to find and obtain the information needed to understand how to solve the problem. This is in line with research by Hulu & Sinaga (2020) that the application of project-based learning models can improve critical thinking skills in science subjects through meaningful experiences because it allows students to master a concept in depth, providing opportunities to generate ideas or ideas to solve problems.

Several studies that have been conducted on the development of project-based e-LKPD include the development of e-LKPD based on chicken manure waste processing projects, the development of e-LKPD based on projects on used cooking oil waste problems (Anggraini, 2023), the development of e-LKPD based on tapioca flour waste utilization projects (Alifiani, 2023) and the development of e-LKPD based on plastic waste recycling projects (Febriyanti, 2023).

Differentiated learning is learning where teachers use various teaching methods to meet the individual needs of each student according to their needs (Purnawanto, 2023). Differentiated learning includes aspects of content, process, and product differentiation implemented by paying attention to individuals in meeting learning needs (Tomlinson, 2014). Differentiated learning supports innovative learning according to the interests and abilities of students (Suwandi et al., 2023). In differentiated learning, teachers have the freedom to choose various teaching tools so that learning can be adjusted to the learning needs and interests of students, in this case by developing differentiated teaching materials.

In differentiated teaching materials, it provides an opportunity for each individual to learn effectively according to their preferences, so that students can be more involved and also understand the learning material better (Pertiwi et al., 2023). Herwina (2021), it was stated that differentiated learning can help students achieve optimal learning outcomes, because the products that will be produced are according to their interests.

Based on the explanation above, it can be concluded that there has been no research on the development of differentiated e-LKPD in project-based learning that considers the fulfillment of students' learning needs. This study aims to determine the perceptions of science teachers and junior high school students regarding the use of differentiated e-LKPD in project-based learning for processing organic waste to improve critical thinking skills.

## Method

This research uses qualitative research methods adapted from (Creswell & Creswell, 2017). The instruments in this study used interview and questionnaire guidelines. Participants in this study were 10 science teacher respondents and 96 junior high school student respondents. Before the study, the researcher conducted a literature study by analyzing the results of recent research on e-LKPD, project-based learning, differentiated learning, and critical thinking skills. Furthermore, the researcher developed an instrument to analyze the need for e-LKPD in science learning, then the instrument was distributed in two ways, namely direct questionnaire administration and via Google Form. The indicators of the questionnaire questions for the need for

e-LKPD according to teachers and students and the interview guidelines consist of: to determine the use of e-LKPD in science learning, differentiated learning, project-based learning based on real problem solving, and critical thinking skills.

The data analysis techniques used in this study are data collection, data reduction, data presentation and verification. The data collection process begins with the researcher visiting the research location, namely junior high schools in South Lampung Regency and collecting data from respondents. The data collected is then reduced by focusing on information that is relevant to the core of the research problem. At this stage, the researcher carries out the process of determining and eliminating unnecessary data, then summarizing and compiling it comprehensively and systematically, so that the research data obtained is accurate. After that, it is continued with the final stage, namely data presentation and drawing conclusions. At this stage, the researcher describes the data from beginning to end to obtain clear conclusions and to verify (Miles et al., 2014).

After the data is presented, the information can be strengthened by the results of the interview. The interview procedure includes answers about the learning process at his school. In addition, interviews are conducted to explore the reasons for using LKPD in class, project learning models in science education, differentiated learning, and critical thinking skills.

Quantitative data analysis and qualitative analysis are carried out in an integrated and triangulated manner. The data of this study were obtained from questionnaires given to teachers and students, which were analyzed by grouping the answers to questions in the questionnaire, giving points to each answer according to the assessment criteria and calculating the overall score for each question. This study uses the Guttman scale, which is choosing answers according to the contents of the question, namely: "Yes" and "No" with a score of "1" and "0". Then calculate the percentage score and interpret it qualitatively. The formula for calculating the percentage score for each item is as follows Formula 1.

$$\% \, J_{in} = \frac{\Sigma Ji}{N} x \, 100\% \quad (1)$$

Where, %Jin is the percentage of answer choice i, ΣJi is the number of respondents who answered, and N is the total number of respondents (Sudjana, 2013).

## Result and Discussion

This section describes the discussion and results of the study based on data collection and analysis. The results of distributing questionnaires to 10 science teachers in South Lampung Regency are presented in Table 1.

**Table 1.** Results of interpretation of teacher perception questionnaire

| Question | Percentage (%) | |
|---|---|---|
| | Yes | No |
| Do you know about project-based learning? | 100 | 0 |
| If yes, have you ever implemented project-based learning with students? | 60 | 40 |
| If yes, do you apply real problems in the project-based learning you apply? | 10 | 90 |
| Has the problem of organic waste in the environment ever been used in the project-based learning that you implement?? | 30 | 70 |
| Have you ever developed LKPD with Project Based Learning? | 40 | 60 |
| Do you know about critical thinking skills? | 90 | 10 |
| Have you ever conducted a critical thinking skills measurement test on students? | 30 | 70 |
| Is the LKPD you use able to help students practice critical thinking skills? | 50 | 50 |
| Do you know about differentiated learning? | 80 | 20 |
| Do you know about differentiated LKPD in project-based learning? | 50 | 50 |
| Is the LKPD you use a differentiated LKPD in project-based learning? | 20 | 80 |
| Is it necessary to have teaching materials in the form of differentiated e-LKPD in project-based learning? | 100 | 0 |

Table 1 shows that all science teacher respondents know about project-based learning, and as many as 60% of respondents have implemented it in their learning. However, in practice, teachers do not raise topics based on real problems. This is supported by the results of the survey where only 10% of teachers raised topics based on real problems that occur in the surrounding environment in project-based learning. Based on the results of the interviews conducted, teachers only gave project assignments to make previously determined products, such as making tape products which are food biotechnology, making simple water purifiers, and making cell replicas.

The use of project-based learning models ideally raises real problems that exist in the surrounding environment, and provides students with the freedom to determine for themselves the products they will make to solve these real problems (Diawati et al., 2017). Project-

based learning (PBL) places authentic projects or assignments at the center of students' learning attention. This concept encourages students to develop a deeper understanding of the subject matter by focusing on solving real-world problems (Ginanjar et al., 2021). Colley (2008) explains that project-based learning is project identification, finding information, making project plans, running projects, documenting, reporting and evaluating projects.

Along with the advancement of technology, LKPD has now been converted into a digital format that can be accessed via computers or smartphones. However, survey results show that as many as 60% of teachers have not used e-LKPD in implementing project-based learning. Based on the interview results, information was obtained that the reason teachers have not used e-LKPD in learning is due to the lack of adequate facilities and teachers do not yet have the skills to make e-LKPD and there are regulations in several schools that prohibit students from bringing smartphones to school so that this becomes an obstacle for teachers to carry out learning effectively using e-LKPD. In fact, e-LKPD using live worksheets has advantages including; more practical, easily accessible, and free; can be accessed via laptop, computer, or smartphone; can be used for online assignments; and does not take up storage space because it is accessed via the website (Amalia et al., 2022).

Then the survey showed that 90% of respondents knew about critical thinking skills, but the indicators of critical thinking skills understood by teachers were different from the indicators of critical thinking skills that should be measured. Based on the interview results, teachers stated that students are said to think critically if they are able to solve problems, provide statements based on existing facts, and draw conclusions. The indicators understood by teachers are not as they should be.

According to Stiggins (1997) suggest that we can capture the essence of "critical thinking" in five steps: clarifying the issue by asking critical questions; gathering important information about the issue; starting to think logically from various sides or perspectives; gathering clarifying information and conducting further analysis if necessary; and making and communicating decisions.

As many as 70% of teacher respondents stated that they had never taken a test to measure critical thinking skills. Based on the interview results, teachers argued that "students' problem-solving skills have not developed optimally, so they still need to be given learning that trains these skills."

As many as 50% of teacher respondents stated that the LKPD that is usually used can help students in practicing critical thinking skills. However, based on the interview results, teachers are of the opinion that the LKPD used has not been implemented optimally to train students' critical thinking skills. One way to develop critical thinking skills is through learning that involves presenting real problems from the surrounding environment (Nurcahyani, 2024). The learning model that can provide real problems is project-based learning.

As many as 80% of teacher respondents know differentiated learning and 50% know differentiated LKPD in project-based learning, but only 20% stated that the LKPD used is differentiated LKPD in project-based learning. In differentiated teaching materials, it provides an opportunity for each individual to learn effectively according to their preferences, so that students can be more involved and also understand the learning material better (Pertiwi et al., 2023). The substance of differentiated learning is learning that facilitates all the differences that students have openly with the needs that they will achieve (Maryam, 2021).

From several things, it can be concluded that it is necessary to develop differentiated e-LKPD in project-based learning that considers fulfilling students' interests and learning needs with various learning activities. In addition, all respondents gave positive responses considering the need for the development of teaching materials in the form of differentiated e-LKPD in project-based learning for processing organic waste to improve critical thinking skills.

The results of filling out the questionnaire by 96 junior high school students are shown in Table 2. Based on Table 2, as many as 87% of students stated that they had not carried out problem-solving activities in learning. As many as 20% of student respondents stated that the problem-solving activities they had carried out in project-based learning were on real problems that occurred in the surrounding environment. Based on the interview results, students answered that the problem-solving activities carried out included distinguishing acid and base solutions, identifying the characteristics of living things, or making animal and plant cell demonstration tools. The tools and materials used in their problem-solving activities did not come from real problems. This is in line with the responses of teachers who have not implemented real problems in the project-based activities they carry out.

**Table 2.** Results of interpretation of student perception questionnaire

| Question | Percentage (%) | |
|---|---|---|
| | Yes | No |
| Has your teacher ever asked you to do problem-solving activities in learning? | 13 | 87 |
| If yes, are the issues raised based on real problems that occur in the surrounding environment? | 20 | 80 |
| Has your teacher ever used LKPD as a guide to solving real problems in learning? | 10 | 90 |
| Have you ever used electronic LKPD? (LKPD that can be accessed using a smartphone/laptop) | 33 | 67 |
| Have you ever used electronic LKPD in learning to solve real problems? | 10 | 90 |
| Has your teacher ever asked you to solve an organic waste problem? | 5 | 95 |
| Have you ever chosen a problem-solving method in learning that suits your interests? | 29 | 71 |

Only 10% of student respondents stated that teachers have provided LKPD as a guide in solving problems. However, as many as 78% of student respondents stated that they had never used e-LKPD in learning. In addition, the results of the study also showed that as many as 95% of student respondents stated that they had never carried out activities to solve organic waste problems. In fact, this problem can be used in project-based learning. Organic waste has a high water content so it rots quickly. The unpleasant odor of organic waste can pollute the environment and cause disease outbreaks (Azmin et al., 2022). Soemarwoto (1992) stated that global warming is a symptom of rising earth's surface temperatures due to increasing greenhouse effect intensity. One of the greenhouse gases that can act as a greenhouse gas from organic waste is methane (CH4) (Puger, 2018). Learning media is needed to provide students with direct experience in solving problems that occur in their environment.

Next, 71% of student respondents stated that they had never chosen a problem-solving method in learning according to their interests, meaning that differentiated learning in the process or product aspects of students has not been optimally implemented. This is also in accordance with the responses of 80% of teachers who stated that they had not used differentiated e-LKPD in project-based learning.

## Conclusion

Based on the results and discussion, it is known that the perceptions of science teachers and junior high school students towards e-LKPD, differentiated learning, project-based learning, and students' critical thinking skills are not as expected. Teachers have not fully implemented project-based learning on real problems such as organic waste in the surrounding environment to improve critical thinking skills by using differentiated e-LKPD that can accommodate students' needs in learning. Therefore, there needs to be a differentiated e-LKPD based on organic waste processing projects that can improve students' critical thinking skills.

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**Author Contributions**

All authors in this article contributed to the process of completing the research. U.A. collecting initial research data, processing data, and writing draft of article. C.D. directing research flow, validating data collection instruments, methodology, and reviewing article. M.S. directing research flow, methodology, reviewing article. All authors have read and agreed to the published version of the manuscript.

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**Conflicts of Interest**

No conflict of interest.

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