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DEVELOPMENT OF INQUIRY-BASED E-LKPD ON PLANT GROWTH AND DEVELOPMENT TO TRAIN CRITICAL THINKING SKILLS

Pengembangan E-LKPD berbasis Inkuiri Materi Pertumbuhan dan Perkembangan Tumbuhan untuk melatih keterampilan berpikir kritis

Alfina Siti Khofifah

Biology Education, Faculty of Mathematics and Natural Sciences, Surabaya State University
e-mail : alfinasiti.20006@mhs.unesa.ac.id

Rinie Pratiwi Puspitawati

Biology Education, Faculty of Mathematics and Natural Sciences, Surabaya State University
e-mail : rinniepratiwipuspitawati@unesa.ac.id

Novita Kartika Indah

Biology Education, Faculty of Mathematics and Natural Sciences, Surabaya State University
e-mail : novitakartika@unesa.ac.id

Abstract

The development of inquiry-based E-LKPD was developed to fulfil the demands of education in mastering technology and 4C skills. This research has successfully developed inquiry-based E-LKPD to train students' critical thinking skills that are valid, practical, and effective. The methods used were validation sheet, response questionnaire, and test sheet. The validity of the E-LKPD was assessed by two validators, namely media expert lecturers and material expert lecturers. The practicality of E-LKPD was measured based on the observation data of the implementation of learning activities, while effectiveness is measured through data on learning outcomes of XII grade students obtained from the E-LKPD final assessment test and the achievement of critical thinking indicators.The trial phase was conducted on 20 students of class XII MIPA at SMA Ta'miriyah Surabaya. Based on the results of the study, it shows that the E-LKPD developed is very valid with a validity score from both validators of 97.33%, the practicality of E-LKPD is declared very practical with the observation score of the implementation of learning activities reaching 97.15% and student responses reaching 97.6%, the effectiveness of E-LKPD is declared very effective with the percentage of completeness of the E-LKPD final assessment reaching 100%. Thus the E-LKPD is declared feasible to be implemented in students.
Keywords: E-LKPD, critical thinking, inquiry.

Abstrak

Pengembangan E-LKPD inkuiri dikembangkan untuk memenuhi tuntutan pendidikan dalam menguasai teknologi dan keterampilan 4C. Penelitian ini telah berhasil mengembangkan E-LKPD berbasis inkuiri untuk melatih kemampuan berpikir kritis siswa yang valid, praktis, dan efektif. Metode yang digunakan yaitu lembar validasi, angket respons, dan lembar tes. Validitas E-LKPD dinilai oleh dua validator ,yakni dosen ahli media dan dosen ahli materi. Kepraktisan E-LKPD diukur berdasarkan data hasil pengamatan keterlaksanaan aktivitas pembelajaran, sedangkan keefektivan diukur melalui data hasil belajar siswa kelas XII yang diperoleh dari tes penilaian akhir E-LKPD dan ketercapaian indikator berpikir kritis. Tahap uji coba dilakukan terhadap 20 siswa kelas XII MIPA di SMA Ta'miriyah Surabaya. Berdasarkan hasil penelitian menunjukkan bahwa E-LKPD yang dikembangkan sangat valid dengan skor validitas dari kedua validator 97,33%, kepraktisan E-LKPD dinyatakan sangat praktis dengan skor pengamatan keterlaksanaan aktivitas pembelajaran mencapai 97,15% dan respons siswa mencapai 97,6%, keefektivan E-LKPD dinyatakan sangat efektif dengan persentase ketuntasan penilaian akhir E-LKPD mencapai 100%. Dengan demikian E-LKPD dinyatakan layak diimplementasikan pada siswa.
Kata Kunci: *E-LKPD, berpikir kritis, Inkuiri.*

INTRODUCTION

Critical thinking is an essential 21st century skill that involves analysing, evaluating and interpreting information to reach logical conclusions. This critical thinking ability helps students analyse information, evaluate the accuracy of sources, and find effective solutions, so that they can process information actively and reflectively. However, based on PISA 2022 data, Indonesian students' critical thinking skills are still low, with a rank of 71 out of 79 countries in the Science category and an average score of 396, below the international average of 500. To overcome this problem, the application of appropriate learning models in schools is needed.

According to Hallatu (2017), a good learning model is student-centered, so that student gain direct

learning experience. One of the models that can improve critical thinking skills is guided inquiry. Lila (2019) mentioned that this model trains critical thinking skills through learning syntax, from formulating problems to drawing conclusions, by encouraging students to solve problems based on data.

Guided inquiry, according to Anam (2016), places students as the subject of learning, so they are actively involved in learning activities. This model is often used in experimental or discovery-based learning (Aisyah, 2015). Islah (2021) added that the guided inquiry syntax can measure critical thinking skills. One of the subjects suitable for training this ability is biology.

One of the biological materials in the Merdeka Curriculum in phase F is plant growth and development, which includes internal and external factors that affect the process. Based on Hasanah's research (2023), 75% of students find it difficult to understand this material only through theory, and 55% need special methods to learn this material. Therefore, the application of the guided inquiry model is expected to improve students' critical thinking skills through practical activities, so that they are more active in understanding the factors that affect plant growth and development through practical activities.

The results of observations in Class XII showed that the average test score of students was only 55, classified as low. The learning process that is still teacher-centred, especially in class XII, makes students passive and only receive material without developing it independently, so their critical thinking skills and experimental skills are not optimal. In addition, the implementation of the Pancasila learner profile is also less than optimal due to the teacher's limitations in using varied learning media. One solution to overcome this problem is the use of digital learning media such as E-LKPD, which can be accessed through smartphones and laptops with a more attractive appearance to increase students' interest and participation in learning.

E-LKPD teaching materials are information and communication technology (ICT) based learning tools that help teachers create interactive and fun learning at school (Ningtyas, 2022). Students only use books and powerpoints as biology teaching materials, which are considered less efficient and interesting because books can only be used at school. Therefore, the development of E-LKPD learning media is needed.

E-LKPD based on guided inquiry is suitable to be developed for plant growth and development material because this material is considered abstract and rarely associated with daily life phenomena. Many natural phenomena related to growth and development are influenced by internal and external factors, but students have difficulty applying the scientific method and understanding the concepts because there are no practical E-LKPDs that contain the stages of inquiry. With E-LKPD, students are expected to be more skilled in discovering concepts independently and connecting them to the phenomena around them (Hasanah,2023).

Based on the background of the existing problems, the researchers tried to develop E-LKPD based on guided inquiry which is feasible to train critical thinking skills based on validity, practicality, and effectiveness.

METHODS

This research uses the 4D model, namely Define, Design, Development, Disseminate. At the definition stage, the curriculum, learners, concepts, learning objectives, and tasks were analysed, with reference to the independent curriculum of high school biology. In the design stage, the main elements of the E-LKPD were prepared, including aspects of appearance, content, and language. In the develop stage, the E-LKPD product was created using the canva application and uploaded to the liveworksheet platform after being revised according to the input from the validators. The disseminate stage involved the publication of scientific articles on the BioEdu website to expand the reach of the research results.

This research was conducted at the Biology Education S1 Study Program FMIPA UNESA and Ta'miriyah Surabaya High School in July - August 2024 with the research target of XII MIPA 1 class students totalling 20 students with the aim of knowing the feasibility of the E-LKPD produced.

Determining the feasibility of guided inquiry-based ELKPD using a validation sheet filled in by two expert validators, namely media expert lecturers and material expert lecturers in accordance with the components of presentation, content, language, conformity with guided inquiry syntax, and achievement of critical thinking skills indicators. The assessment criteria used is a Likert scale with a score of 1 - 4 (less good-very good). The scores obtained from each validator were then calculated using the following formula:

$$\text{Validity (\%)} = \frac{Total\ score}{Total\ maximum\ score} \text{ x } 100\% \quad ...(1)$$

The resulting calculation is interpreted in accordance with the validity criteria sourced from Riduwan (2016) by being declared valid if it gets a score >70%.

Analysing the practicality of the E-LKPD was carried out offline in the XII IPA 1 classroom of Ta'miriyah Surabaya High School, where three observers saw and paid attention to each learner activity during learning activities using guided inquiry-based E-LKPD to train

critical thinking skills. One group consisted of five students and was observed by one observer. The practicality assessment used the Guttman model assessment criteria with the answers 'Yes' and 'No' with a scale value of 0 - 1. The average score percentage was calculated using the following formula:

$$\text{Percentage (\%)} = \frac{\Sigma \text{ Answer "Yes"}}{\text{Maximum score}} \text{ X } 100\% \text{...(2)}$$

The results of the calculations that have been obtained will be interpreted in the E-LKPD practicality criteria from Riduwan (2016) and declared practical if the percentage of practicality getting a positive response reaches ≥ 70% (Riduwan, 2016).

Analysis of students' responses, using data on the results of students' responses after working on guided inquiry-based E-LKPD to train critical thinking skills. The guidelines used to obtain the results of students' responses are the Guttman scale with the answers "Yes" and "No" with a scale value of 0 - 1. The average score percentage is calculated using the following formula:

$$\text{Percentage (\%)} = \frac{\Sigma \text{Answer "Yes"}}{\text{Maximum score}} \text{ X } 100\% \text{...(3)}$$

The calculation results that have been obtained will be interpreted in the E-LKPD practicality criteria from Riduwan (2016) and declared to have a positive and practical response if the percentage of practicality getting a positive response reaches ≥ 76% (Riduwan, 2016).

Determining the effectiveness of E-LKPD is seen from the learning outcomes of students through working on the E-LKPD final assessment questions given after learning activities. The score obtained by students can be calculated by the formula:

$$\text{Percentage (\%)} = \frac{\Sigma \text{ Score obtained}}{\text{Maximum score}} \text{ x } 100\% \text{...(4)}$$

The resulting calculations are interpreted in accordance with the criteria for interpreting critical thinking skills sourced from Fauzan (2021) by being declared good or very good if they get a test score ≥ 76.

RESULTS AND DISCUSSION

This research produces E-LKPD teaching materials based on guided inquiry.The features developed in the E-LKPD to support students in developing their critical thinking skills are four main features which include Bio-Observe, Bio-Think, Bio-Activity, and Bio-Eval. These features are used to train the five critical thinking indicators taken from Facione (2015), namely interpretation, explanation, analysis, inference, and evaluation. The E-LKPD construction developed will then be validated by media experts and material experts to determine the validity level of E-LKPD as a feasible teaching material.

Validation

Validation of the E-LKPD was assessed based on 3 main aspects, namely presentation, content, and language, which are contained in Table 1..

Table 1. E-LKPD Validation Results

No	Aspects	Percentage	Category
1	Presentation	98,75	Very valid
2	Contents	97,50	Very valid
3	Linguistics	95,75	Very valid
Average		97,33	Very valid

Table 1 is a recapitulation of E-LKPD validation in terms of presentation, content, and language aspects which obtained an overall average validity of 97.33% including very valid criteria. The results of the assessment of the presentation component are based on the suitability of learning objectives, material, appearance, titles, images, indicators, and the type of font used with a percentage of 98.75%. The presentation aspect of the E-LKPD is one of the main components to be able to influence learning significantly. Good presentation aspects provide convenience in learning and make it easier to measure learning activities (Surwuy et al., 2023).

The validity of the content aspect of the E-LKPD is assessed based on the suitability of the content to the indicators of critical thinking skills that are trained. The suitability of the indicators can be interpreted that the E-LKPD to train critical thinking indicators is based on the background conditions of students, namely skills and knowledge as well as student needs (Surwuy et al., 2023). The suitability of the content aspects of the E-LKPD can be seen in the features used for the activities provided. Validity as in Table 1 which shows that the overall percentage obtained is 97.50%, which means that the greater the validity of the E-LKPD content, it can be interpreted that E-LKPD can be used as a valid teaching material to train a learning indicator.

The validation of the E-LKPD language component obtained a percentage of 95.75%. The validity of the E-LKPD language aspect is assessed based on several aspects, including readability and the use of foreign terms. The linguistic aspect becomes the main guide in independent learning by students. The language is

straightforward and clear, making the E-LKPD easy to understand, so that good language aspects make the E-LKPD to be used as a guide for independent learning by students (Prastowo, 2015).

Based on the description of the validity level of the E-LKPD developed, the E-LKPD meets the validity requirements to be used in learning. The activities in the PBL E-LKPD are in accordance with the critical thinking indicators, so it is considered feasible to use in learning the material of the respiratory system.

Practicality

The practicality of the E-LKPD based on guided inquiry is assessed through the results of observations of the implementation of student activities and student responses after learning activities. The results of observations of the implementation of student activities are contained in Table 2.

No	Activity	Applicability E-LKPD (%)	
		I	II
1	Learners read the instructions in the E-LKPD	100	100
2	Learners do the activity in groups	100	100
3	Learners read the article and formulate a problem.	100	100
4	Learners write the hypothesis of the problem formulation made	100	100
5	Learners design an experiment	100	100
6	Learners perform practical activities	90	95
7	Learners collect data	90	90
8	Learners analyse lab results in groups	90	95
9	Learners are able to draw conclusions from the practical activities carried out.	100	100
Average		96,66	97,70
Category		Very Practical	Very Practical

Table 2. Implementation Observation Results

Based on the observation of the implementation of learner activities, it was found that the percentage of activity implementation in E-LKPD 1 was 96.66% and E-LKPD 2 was 97.7% with very practical interpretation criteria. When viewed in Table 2, not all components get 100% value, both in E-LKPD 1 and E-LKPD 2, this happens because there are still some students who discuss other things and some are still busy with observing the suitability of the practicum results so that they do not focus on working on E-LKPD. In this activity the teacher must try to make students focus in groups and cooperate with the activities being carried out as stated by Kamilahrohmawati (2018) that guidance is needed so that students do not underestimate small things and are more active again during discussion activities.

In E-LKPD 1 the average score obtained in the implementation of learning is 96.60%. Many students are very enthusiastic in working on E-LKPD 1 so that in each group they have postitive dependence on each other, namely working together and being responsible for the completion of the material studied (Hamdani, 2011). E-LKPD 2 the average score obtained in the implementation of learning is 97.70%. The observation results showed that almost all students did the activities on E-LKPD 2 well. Based on this, there is an increase in the implementation of students' activities in working on E-LKPD 2 compared to E-LKPD 1, this is because students are more enthusiastic about discussing and are more active in working together.

Learners' responses are obtained through questionnaire data filled in by learners to show how practical the E-LKPD developed for learners is. Learner response data is contained in Table 3.

Table 3. Results Learner Response Questionnaire

Based on the results of data analysis of students' responses in Table 4.3, it is known that overall students gave a good response to the E-LKPD that had been developed with a percentage of 97.60% with a positive response category. The response data shows that, of the 15 questions, 12 questions got a percentage of 100% for the answer 'yes', indicating that the guided inquiry-based E-LKPD developed is easy to use as a learning resource that helps students to be actively involved in understanding the material and practising critical thinking skills. This critical thinking ability can provide learners with experience in analysing, and evaluating information to solve problems (Salim, 2019).

In addition to the good responses given by students, there were also some students who gave unfavourable responses to several questions in the response questionnaire. There were 3 questions that showed some students gave unfavourable responses. The three questions are about the time allocation that is in accordance with the length of practicum activities by 3 students, this E-LKPD can help motivate to learn through practicum activities by two students, E-LKPD has an appropriate size of letters or numbers and is easy to read by two students.

Students' unfavourable responses regarding E-LKPD can help motivate to learn through practicum activities because students are lazy to do practicum, so it becomes a burden for students. Students' unfavourable responses regarding E-LKPD have the appropriate size of letters or numbers and are easy to read because there is a font size that is too small, making it difficult for readers to understand the instructions.

The percentage of E-LKPD 1 implementation is 96.60% and E-LKPD 2 is 97.70% which is included in the very practical category and students' responses to E-LKPD based on guided inquiry reached 97.60% with a positive response category. The conclusion that can be drawn is that E-LKPD fulfils the practicality requirements to be used in learning activities. That E-LKPD that has fulfilled the practicality component is categorised as practical and can be used in the learning process to help improve student learning outcomes at school (Kamilahrohmawati, 2018)

Effectiveness

The effectiveness of E-LKPD is assessed based on student learning outcomes and the achievement of critical thinking indicators measured through the final assessment of E-LKPD conducted after the use of E-LKPD, this test is conducted to assess the ability of students after they use E-LKPD. There is one type of test in this study, namely the final assessment of E-LKPD which is used to determine the improvement of learning outcomes, especially indicators of students' critical thinking skills after the use of E-LKPD in learning. A recapitulation of the results of the achievement of critical thinking indicators can be presented in Table 4.

Table 4. Critical thinking indicator results

No	Indicator	Percentage (%)	Category
1	Interpretasi	93,75	Very good
2	Analisis	86,88	Very good
3	Inferensi	98,75	Very good
4	Eksplanasi	97,50	Very good
5	Evaluasi	96,75	Very good
Average		94,72	Very good

No	Question	Percentage (%)	Category
1	Is the cover design of the E-LKPD attractive?	100	Positiv
2	Does this E-LKPD interest you to learn it?	100	Positiv
3	Is this E-LKPD organised systematically and easy to understand?	100	Positiv
4	Are the images presented clearly visible?	100	Positiv
5	Do the activities in this E-LKPD have clear objectives?	100	Positiv
6	Is the work procedure in this E-LKPD easy to understand?	100	Positiv
7	Is the time allocation in this E-LKPD appropriate?	85	Positiv
8	Can this E-LKPD help motivate you to learn through practical activities?	90	Positiv
9	Can this E-LKPD increase knowledge about plant growth and development material?	100	Positiv
10	Is the knowledge orientation in E-LKPD can complete the tasks in the E-LKPD?	100	Positiv
11	Are the activities presented in this E-LKPD able to train critical thinking?	100	Positiv
12	Is the language used in the E-LKPD in accordance with the EYD?	100	Positiv
13	Is the language used in the E-LKPD communicative and easy to understand?	100	Positiv
14	Does the E-LKPD have a font size that is easy to read?	90	Positiv
15	Is the presentation of the E-LKPD interesting?	100	Positiv
Average		97,66	Positiv

The results of indicator achievement are obtained through the results of the final assessment of students' E-LKPD in the learning that has been done to determine the effect of learning in training students' critical thinking skills. The results of indicator achievement based on Table 4. which contains critical thinking indicators obtained a percentage> 76 with a very good category, this indicates that students have mastered critical thinking skills.

There are five indicators of critical thinking skills that are trained in the developed E-LKPD, namely interpretation, analysis, inference, explanation, and evaluation. The first indicator of critical thinking skills is interpretation. The interpretation indicator is the ability to be able to understand and write the meaning of the data information provided (Facione, 2015). The interpretation indicator was trained twice on the E-LKPD through the provision of articles and learning videos supported by the Bio-Observe feature. The results of the interpretation indicator obtained a percentage of 93.75% in the very good category. These results show that activities with the provision of articles and learning videos on E-LKPD can train students' interpretation skills in learning.

The analysis indicator is the ability to find and conclude inferential relationships between statements, questions, and concepts, as well as identify problems associated with existing concepts or theories (Facione, 2015). The analysis indicator in the E-LKPD is trained twice through the provision of articles supported in the Bio-Think feature and in simple experiments in the Bio-Activity feature. The results of the analysis indicator obtained a percentage of 86.88%. The analysis indicator is the indicator with the lowest percentage compared to the other four indicators as shown in Table 4. This is because in learning at school students are very rarely trained to analyse so that students are less observant and thorough in reading tables and are too focused on their logic so that they cannot answer correctly according to the data displayed.

The inference indicator is the ability to find and collect important parts needed to draw conclusions (Facione, 2015). The inference indicator is trained through the Bio-Eval feature, which is the inference of experimental data connected to the problem to be solved. The results of the inference indicator obtained a percentage of 98.75%. These results show that students can indirectly use their knowledge explicitly to be able to infer something that shows the ability to understand what they get (Benedetti et al., 2021).

Explanation indicators are the ability to determine or provide logical reasons based on phenomena or information provided (Facione, 2015). Explanation indicators are trained through giving problems through videos and images on the Bio-Think feature. The results of the explanation indicator obtained a percentage of 97.50%. These results show that students are helped to be able to train their explanation skills. Explanation indicators in E-LKPD ask students to be able to communicate their opinions based on the concepts they have learned about the images or videos given. The presentation of images and videos in the E-LKPD towards explanation skills as an effort to facilitate the visualisation of their thoughts through the use of technology (Bozkurt, 2022).

The last indicator is evaluation which is an activity to assess credibility, or test the truth of concepts, statements, and questions logically (Facione, 2015). Evaluation is trained on the E-LKPD through the Bio-Eval feature. The results of the evaluation indicator obtained a percentage of 96.75%. These results indicate that students can provide solutions to the problems given and authentic problems used in learning make it easy for students to provide solutions to problems (Sakti et al., 2023).

Based on this description, learning with the guided inquiry approach can influence students to train their critical thinking skills in learning. E-LKPD based on guided inquiry on plant growth and development material developed based on these results, it becomes one of the teaching materials that can be used to train students' critical thinking skills and at the same time become valid, practical, and effective teaching materials to be used.

CLOSING

Conclusion

The guided inquiry-based E-LKPD developed is suitable for use as teaching material based on the acquisition of a validity value with a percentage of 97.33% which is included in the very valid category, a practicality value with a percentage of learning implementation reaching 97.15% and student responses reaching 97.6% which is classified as very practical, and effectiveness which is reviewed through the percentage of completeness of the E-LKPD final assessment reaching 100% which is classified as very effective.

Suggestion

Further research is needed regarding the development of E-LKPD based on guided inquiry using modified types of practicum in supporting learning.

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