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THE DEVELOPMENT OF STUDENT WORKSHEET BASED ON VIRTUAL LABORATORY TO TRAIN SCIENTIFIC ATTITUDE ON PHOTOSYNTHESIS CONCEPTS

PENGEMBANGAN LKPD BERBASIS LABORATORIUM VIRTUAL UNTUK MELATIHKAN SIKAP ILMIAH PADA MATERI FOTOSINTESIS

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Abstract

Photosynthesis is a material that can be verified so it becomes the right concept to have a practical activities. Based on a survey on class XI MIPA and XII MIPA at SMAN 8 Surabaya, it was found that 89.5% of them had never carried out real practicum activities. One of the factors causing the low of practicum activities is because teachers having difficulties in compiling practicum guides. This causes the scientific attitude of students getting low. Therefore, an alternative form is needed in developing student worksheet based on virtual laboratory to train scientific attitudes as learning media as well as pre-lab facilities for students before starting practicum. This study aims to make LKPD based on virtual laboratory on photosynthetis concepts that is feasible in terms of validity, practicality, and effectiveness to train students' scientific attitudes. This research uses the 4D method (Define, Design, Develop, and Dissaminate) which has been tested on 25 class XII MIPA 7 of SMAN 1 Sampang. The results on validity aspect have 83.33% with the appropriate category, the practicality aspect based on the implementation of the LKPD was 85.58% and the readability was at level 12, and the effectiveness aspect based on student learning outcomes have a N-Gain score of 0.7472, activity observation results have 93%, and scientific attitude questionnaire have 84.21% with each category being very practical, high and very effective. Thus, the developed LKPD is considered feasible and effective for increasing scientific attitudes towards photosynthesis material.
Keywords: photosynthesis, student worksheet, scientific attitude,virtual laboratory,

Abstrak

Fotosintesis merupakan salah satu materi yang dapat dibuktikan kebenarannya sehingga menjadi pilihan materi yang tepat untuk melaksanakan kegiatan praktikum. Berdasarkan survei yang dilakukan pada peserta didik kelas XI MIPA dan XII MIPA di SMAN 8 Surabaya diperoleh hasil bahwa 89,5% dari mereka belum pernah melaksanakan kegiatan praktikum riil. Selain itu, salah satu faktor penyebab rendahnya kegiatan praktikum adalah karena guru mengalami kesulitan dalam menyusun penuntun praktikum. Hal ini menyebabkan sikap ilmiah peserta didik menjadi rendah. Oleh karena itu, dibutuhkan suatu bentuk alternatif berupa pengembangan LKPD berbasis laboratorium virtual untuk melatihkan sikap ilmiah sebagai media pembelajaran sekaligus sarana pralab bagi peserta didik sebelum memulai praktikum. Penelitian ini bertujuan untuk menghasilkan LKPD berbasis laboratorium virtual untuk melatihkan sikap ilmiah pada materi fotosintesis yang layak dalam aspek validitas, kepraktisan, dan keefektifan untuk melatihkan sikap ilmiah peserta didik. Penelitian ini menggunakan metode 4D (Define, Design, Develop, dan Dissaminate) yang telah dilakukan uji coba pada 25 peserta didik kelas XII SMAN 1 Sampang. Hasil penelitian pada aspek validitas memperoleh memperoleh presentase 83,33%, dengan kategori layak, aspek kepraktisan berdasarkan keterlaksanaan LKPD 85,58% dan keterbacaan LKPD berada pada level 12, serta aspek keefektifan berdasarkan hasil belajar peserta didik memperoleh skor N-Gain 0,7472, hasil pengamatan aktivitas 93%, dan hasil angket sikap ilmiah 84,21% dengan kategori masing-masing sangat praktis, tinggi dan sangat efektif. Dengan demikian, LKPD yang dikembangkan dinilai layak digunakan serta efektif untuk meningkatkan sikap ilmiah pada materi fotosintesis.
Kata Kunci: *fotosintesis, LKPD, laboratorium virtual, sikap ilmiah,*

INTRODUCTION

Education is one of the most important supporting factors in human life. Education can also be an indicator in measuring the level of progress of a country. Efforts to improve the quality of education have been carried out both conventionally and innovatively because basically one of the goals of national education is to lead students towards changes in behavior, moral, intellectual and social so they can live as good individuals and social beings (Kemendikbud, 2011).

An important aspect in education is affective or attitude aspect or in science learning it is often known as the scientific attitude. In the aspect of a scientific attitude, students are taught to compare the facts encountered against the possible impact on learning outcomes. According to Hunaepi (2016), scientific attitude is a thinking disposition that has become a research trend that is integrated into high-level thinking skills such as critical, creative thinking, metacognition, problem solving and decision making and really determines the quality of individual students. Scientific attitudes such as: 1) curiosity; 2) concern; 3) alertness; 4) trust; 5) self-confidence; 6) open thinking; 7) flexibility; 8) respect the opinions of others; 9) think fairly; `10) honest; 11) caution; 12) a willingness to reconsider and revise views where honest reflection indicates a need for change; into thinking dispositions that characterize the quality of one's thinking (Facione, 2011). A learning activity that can improve students cognitive, affective and spiritual abilities is urgently needed to support the achievement of improving the quality of education. One of way is by providing practicum activities so their learning activities provide concrete experiences (Wahidah et al., 2018).

One material that can verified is photosynthesis process. Photosynthesis is a biochemical process for the formation of food substances such as carbohydrates carried out by plants, especially plants that contain green leaf substances or chlorophyll. (Wiraatmaja, 2017). By practicum on photosynthesis material, students will have opportunity to discover the concept of their understanding of photosynthesis material, implementing something, processing, following an object, analyzing, proving and drawing their own conclusions on certain objects, conditions or processes. Thus, students will be more confident about something rather than just receiving information from teachers and books (Nurussaniah and Nurhayati, 2016).

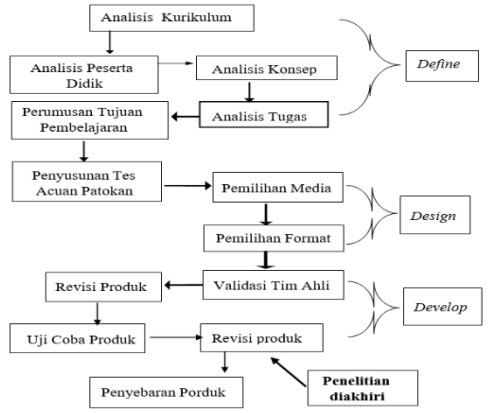
Based on a survey conducted on students in class XI MIPA and XII MIPA at SMAN 8 Surabaya, it was found that 89.5 percent of them had never carried out real practicum activities so they having difficulties in using practicum tools in the laboratory. In addition, from Syamsu (2017), based on the results of interviews with teachers IPA, one of the reasons for not carrying out practicum activities is the teacher's limitations in designing practicum guides. The same thing has also been researched by Yennita (2010) which states that the factors causing the low practicum activities are because teachers having difficulties in compiling practicum guidelines so that practicums are not carried out optimally.

One of alternative to overcome this problem is the development of a guide in carrying out a practicum in the form of Student Worksheets that can be used by teachers and students to make it easier for them to carry out the practicum process. The existence of student worksheet as a printed learning media (hand out) plays a role in helping students learn in a directed manner so as to support students to learn independently, train process skills to train students' thinking abilities (Rohaeti et al., 2009).

Based on this, researchers want to develop a Student Worksheet based on virtual laboratory as a guideline for the steps and thought processes of students when doing practical work using a virtual laboratory to train students' scientific attitudes on photosynthesis material. It is hoped that this research can be a motivation and a means of increasing students' scientific attitudes, as well as being a reference for teachers and schools in an effort to improve the quality of teaching and learning, especially biology material.

METHODS

This research includes development research or often called R&D (research and development). Research and Development. The stages of 4-D development, namely the definition stage (Define), design stage (Design), development stage (Develop), without stage (Desseminates).



Picture 1. Model Development Scheme 4D

The first 4-D development stage aims to define and identify material in the learning process. The defining stage consists of five stages of the analysis process, that is the curriculum analysis process which refers to the K-13 curriculums in order to determine the characteristics of the curriculum and basic competencies to be developed. Students' analysis to find out the background of students so it can arrange student worksheet according to the needs of subject in a limited testing process, that is 25 students of class XII MIPA 7 SMAN 1 Sampang who have heterogeneous abilities with age of range 17-18 years. Concept analysis aims to avoid mistakes or mistakes in understanding the learning concepts given. And a task analysis was created to explain tasks that are aligned with Main competencies and basic competencies in K-13.

The second stage aims to design or compile the student worksheet. At this stage, two worksheets were prepared, that is *LKPD berbasis laboratorium virtual uji Ingenhousz* and *LKPD berbasis laboratorium virtual uji Sachs*. The two worksheet were combined into one unit with the title "LKPD Berbasis Laboratorium Virtual Uji Ingenhousz dan Uji Sachs".

The third stage in the product development process intends to produce proper worksheet through a process of review and validation by two lecturers based on the criticisms and suggestions given. The develop stage includes a review of drafts I and II that have been prepared, validation to determine the feasibility of the worksheet, and limited trials to students. worksheet development was carried out at the Department of Biology, State University of Surabaya in January-February 2023. In March 2023 product validation was carried out by material expert lecturers and education expert lecturers. The limited trial phase for students was carried out in March 2023 to obtain data on students' responses to the developed worksheet. Data collection activities were carried out on 25 class XII high school students at SMAN 1 Sampang.

There are six instruments used in this study that is validation sheets, LKPD assessment sheet, LKPD readability test sheet, scientific attitude questionnaires, observation sheets of student activities and pre-test and post-test question sheets. The validation sheet is in the form of a validation questionnaire which contains a number of statements regarding materiality and presentation to obtain data regarding ratings and opinions of the validator in the learning environment which is compiled into guidelines and references in media reviews. There are 30 statement items with a score range of 1-5 and there is a comments/suggestions column regarding the product. LKPD assessment sheet is a guide prepared as a reference for assessing the results of LKPD implementation during learning. LKPD readability test sheet is a guide prepared as a reference for measuring LKPD readability results using Fry diagrams. The LKPD contains instructions for the stages in measuring the readability of the LKPD with the aim of making it easier for researchers and readers to know the stages in measuring the readability of the LKPD and the cognitive level of reading in the LKPD. The scientific attitude questionnaire is in the form of several statements whose contents relate to scientific attitudes during the learning process which are filled in by the participants as objects. There were 15 statements to be given responses by the students *sangat setuju (SS), setuju (S), ragu-ragu (RR), tidak setuju (TS), dan sangat tidak setuju (STS).* The student activity observation sheets are in the form of several statements whose contents relate to students' scientific attitudes which can be observed during the learning process. Student activity sheets in this study consisted of 10 activity codes which were filled out by observers as 3 observers with each observer supervising 2 groups. The pre-test and post-test questions are photosynthesis sub-chapter questions to measure the increase in students' scientific attitudes. The pre-test and post-test questions in this study consisted of 5 questions that measured 3 dimensions of scientific attitude, namely objectivity, openness and cooperation, respect for data and facts, and critical thinking skills.

Worksheet validity data was then analyzed using a Likert scale. According to Ratumanan and Laurens (2003), the resulting worksheet can be declared valid if it gets a score of 3.00 and is interpreted as $63 \leq$ score ≤ 81 with good criteria or $82 \leq$ score ≤ 100 with very good criteria.

Table 1. Likert Scale

Scale Value	Category
1	Very bad
2	Bad
3	Enough
4	Good
5	Very good

After analyzing the validation results and revising them, the LKPD was tested in a limited way on 25 high school class XII students at SMAN 1 Sampang to find out the practicality of the LKPD. LKPD results are assessed by referring to the LKPD answer key.

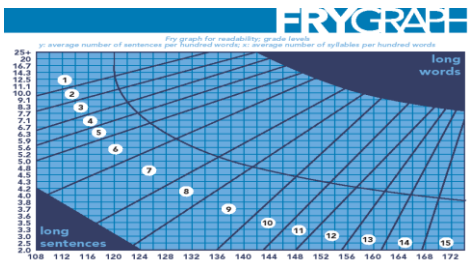
To determine the practicality index category based on the LKPD assessment results, see the following table.

Table 2 Criteria for Interpretation of Practicality Scores

Average Score (n)	Criteria
81% ≤ n ≤ 100%	Very Practical
61% ≤ n ≤ 80%	Practical
41% ≤ n ≤ 60%	Enough
21% ≤ n ≤ 40%	Less Practical
0% ≤ n ≤ 20%	Not Practical

Source: Adapted from Riduwan (2013)

Furthermore, the Fry graph method was used to analyse the readability test results. The readability test technique involves picking 100-word discourse fragments from the beginning, middle, and conclusion of the passage, then counting the number of sentences and syllables multiplied by 0.6.



Picture 2. Fry Readability Graph
(Source: Kurnia, 2015)

The data is then evaluated using the Fry graph, which is seen in Figure 2 below.Pre-test and post-test results were carried out using the Normalized Gain (N-Gain) formula then analyzed to determine the category of student scientific attitude index according to the classification in the table below:

Table 3. Indeks N-Gain

N-Gain (g)	Kriteria
g < 0,70	Tinggi
0,30 ≤ g ≤ 0,70	Sedang
g < 0,30	Rendah

Source: Meltzer (2002)

To determine the effectiveness category of the LKPD based on the results of the scientific attitude questionnaire and the results of observing participant activities, use the index categories below

Tabel 4 Criteria for Interpretation of Effectiveness Score

Average Score (n)	Criteria
81% ≤ n ≤ 100%	Very Effective
61% ≤ n ≤ 80%	Effective
41% ≤ n ≤ 60%	Enough
21% ≤ n ≤ 40%	Less Effective
0% ≤ n ≤ 20%	Not Effective

RESULTS AND DISCUSSION

This research is the development of Worksheets based virtual laboratory to train scientific attitudes on photosynthesis material using the 4-D development model. The results of this study are LKPD based on the Ingenhousz virtual laboratory test and the Sachs test. The aim of this research is to produce LKPD that is theoretically feasible based on the validity of the LKPD which is tested by assessing media expert lecturers and material experts and is empirically feasible based on the practicality of the LKPD based on the workability of the LKPD and the readability test of the LKPD as well as the effectiveness of the LKPD based on the results of the scientific attitude questionnaire, observation of student activities and student learning outcomes.

The LKPD cover contains the title and other identification such as the author's name, class and an image that reflects the material. The following is a virtual laboratory-based LKPD cover to practice scientific attitudes regarding photosynthesis material.

Picture 3. Front Cover of LKPD

The contents of the worksheet include the cover; study instructions; feature explanation; content standards that contain core competencies, basic competencies, indicators, learning objectives, core materials and bibliography. The worksheet material is summarized into 3 features, that is Let's Think, Let's Do and Let's Discuss, containing the steps of the scientific method where students are given a stimulus and then asked to formulate a problem, create a hypothesis, collect data in the form of

facts and process the data by doing virtual practicum. Let's Do contains practical procedures equipped with analysis questions related to the stages in the practicum to train students' scientific attitudes including the ability to think critically, objectively, openly and cooperatively, and Let's Think contains discourse and questions that require students to collaborate between groups so that train students to be able to work together, critically and openly.

The feasibility assessment of the LKPD based on the virtual laboratory of the Ingenhousz test and Sachs test was carried out by two expert lecturers. LKPD validation includes the content, construct and design of the LKPD. The virtual laboratory-based LKPD validation results of the Ingenhousz test and Sachs test are presented in table 5 below.

Table 5. Recapitulation of LKPD Validation Results

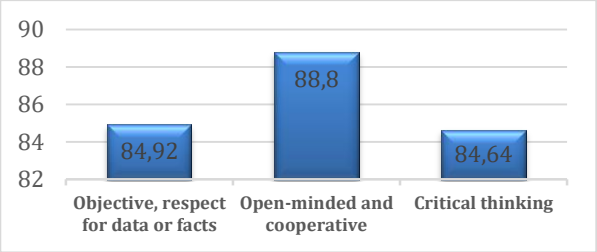
No.	Aspects	Score		Percentage (%)	Category
		V1	V2		
Content of LKPD					
1	Suitability of the virtual laboratory used with the material and aspects of the scientific attitude being trained	4	4	80%	Valid
2	Suitability of material with core competency standards and basic competencies	5	4	90%	Very Valid
3	Suitability of the material with the needs of teaching materials	4	4	80%	Valid
4	Suitability of the material with the development of students	4	4	80%	Valid
5	Ease of understanding the material listed in the LKPD	5	4	90%	Very Valid
6	The truth of the substance of the learning material	4	4	80%	Valid
7	The questions presented support students to explore curiosity	3	3	60%	Enough
8	The questions presented support students to explore an objective and respectful attitude towards data	3	4	70%	Valid
9	The questions presented support students to explore attitudes of cooperation and open thinking	3	4	70%	Valid
10	The questions presented support students to explore critical thinking skills	5	4	90%	Very Valid
Construct of LKPD					
11	Clarity of goals (indicators) to be achieved	5	4	90%	Very Valid
12	The language used is communicative and easy to understand	4	4	80%	Valid
13	The material is presented systematically and logically	5	4	90%	Very Valid
14	The material is presented simply and clearly	5	5	100%	Very Valid
15	Completeness and clarity of information in LKPD	5	5	100%	Very Valid
16	Provide enough space on the LKPD so that students can write or describe something on the LKPD	5	4	90%	Very Valid
17	Can be used by children with varying learning speeds	5	4	90%	Very Valid
18	LKPD readability	4	2	60%	Enough
19	The language used is in accordance with good and correct Indonesian rules	4	4	80%	Valid
20	Use effectively and efficiently language	5	4	90%	Very Valid
21	Use appropriate language to the child's maturity level	5	3	80%	Valid
22	Sentences do not have a double meaning	5	4	90%	Very Valid
Design of LKPD					
23	Use of type and size of letters	5	4	90%	Very Valid
24	Writing color combination	5	4	90%	Very Valid
25	Use of frames to differentiate command sentences and students' answers	4	4	80%	Valid
26	Layout of images on LKPD	3	4	70%	Valid
27	The format and	5	4	90%	Very

	consistency of LKPD is good				Valid
28	LKPD attractiveness	4	4	90%	Very Valid
29	Page density	4	4	80%	Valid
30	Comparison of the size of the letters with matching pictures	4	4	80%	Valid
Theoretical validity of LKPD		83,33			Valid

The theoretical feasibility of the LKPD being developed was obtained based on the validation results of two expert lecturers. Based on the results of the validation carried out, the feasibility of the content aspect was obtained with a percentage of 79%, the feasibility of the construction aspect with a percentage of 87%, and the feasibility of the design aspect with a percentage of 84%.

Feasibility in the content aspect was the lowest 79%, because there were several points that really needed improvement, that is questions presented were deemed less capable of supporting students to explore curiosity and the readability of the LKPD was deemed less appropriate to the cognitive level of the target reader. Therefore, after going through the validation process, researchers focused on improving the quality of the LKPD based on suggestions from the validator, especially on the content aspect of the LKPD to support students' curiosity, cognitive level of reading on the LKPD and other aspects. This assessment has also provided improvements after the validation process. Improvements are made according to suggestions from the validator in order to produce better quality LKPD for trials on students.

The implementation of the LKPD was carried out to determine the feasibility of the LKPD based on the Ingenhousz virtual laboratory test and the Sachs test when conducting limited trials. LKPD implementation can be used as a reference whether LKPD is feasible to be applied in student learning. The application of the LKPD is carried out by giving a score to each question which contains the aspects assessed based on the developed LKPD. The results of the implementation of LKPD are as follows.



Picture 4. Percentage of LKPD Implementation

Based on the three dimensions of scientific attitude observed in terms of the results of LKPD implementation, indicators of open-mindedness and cooperation have the highest achievement of 88.8%. This is evident when students carry out activities on LKPD and experience difficulties or obstacles when doing virtual practicums, students actively work together and discuss both in groups and between groups. An important character that must be built so that students can achieve success, both at school and after graduation, is the ability to cooperate with their friends or other people. This ability to establish cooperation can be trained to students by frequently doing group work during the teaching and learning process. Even in group work, a teacher must make efforts so that each student can be actively involved in the activities being carried out. In this way, students will learn to be able to work together with one another (Azzet, 2013).

The second highest dimension is an objective attitude, respect for data or facts with a percentage of 84.92%. This is proven through the assessment of the implementation of LKPD where students try to be as objective as possible in writing the results obtained during virtual practicum into the results table of practicum activities and write conclusions according to what they get is supported by data based on reference sources. Meanwhile, the dimension of scientific attitude with the lowest results was critical thinking attitude which obtained a result of 84.64%. This was proven when students carried out the first activity, namely Let's Think. Some students have not shown a critical thinking attitude to understand the stimulated discourse given so that they have difficulty identifying problems based on stimulated discourse because they have not followed the steps in critical thinking. Several steps of critical thinking according to Ennis (1996) that is: focus in critical thinking, have reasons, draw conclusions, read situations, see clarity and overall examination. If all of these elements are not considered carefully then students will not be able to make the right decisions or answers.

Thus, the critical thinking attitude of class XII IPA 7 SMAN 1 Sampang still needs to be improved considering that critical thinking is one of the important

skills needed as a student or in the world of work. Critical thinking is an important factor in solving problems both in education and other areas of life. In fact, in recent years, the use of critical thinking constructs as a predictor of success in the world of education and in the world of work has been increasingly being carried out. (Winarti, et al., 2018).

Measuring LKPD readability test, the paragraphs used as sample references are 2 paragraphs at the beginning of the LKPD, 2 paragraphs in the middle of the LKPD, and 2 paragraphs at the end of the LKPD. The results of the description of the number of sentences and syllables in the LKPD are presented in table 6 below.

Table 6. Samples of LKPD Readability

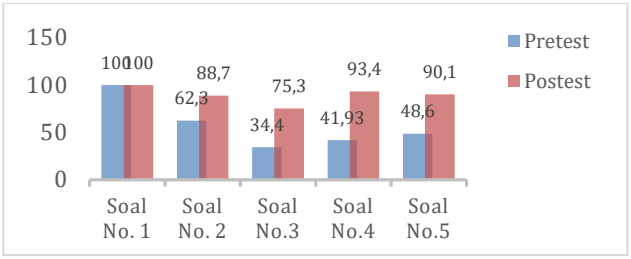
Sample	∑ Sentence	∑ Syllables x 0,6	level
1	2,45	259 x 0,6 = 155,4	12
2	3 x 1,25 = 3,75	208 x 0,6 x 1,25 = 156	12
3	2 x 2,5 = 5	107 x 0,6 x 2,5 = 160,5	12
4	3 x 2,5 = 7,5	14 x 0,6 x 2,5 = 171	13
5	3 x 1,1 = 3,3	219 x 0,6 x 1,1= 144,54	10
6	3 x 1,1 = 3,1	242 x 0,6 x 159,72	12

Based on the results obtained from the 6 sample paragraphs, the average cognitive level of reading sentences in the Ingenhousz Test and Sachs Virtual Laboratory-Based Worksheets is at level 12. This proves that the LKPD based Virtual Laboratory Ingenhousz Test and Sachs Test are feasible and appropriate to be applied to 12th grade high school students are based on the use of the fray graph formula. The appropriate cognitive level for grade 12 is 11, 12 or 13. This is based on the statement of Harjasujana and Yeti (1997). Readability has an approximate nature, so there may be deviations both upward and downward. Therefore, the discourse readability rating should be increased by one level and reduced by one level.

The results of assessing media effectiveness were obtained from student's cognitive abilities which were measured using pre-test and post-test question sheets. The next step is to test the analysis of pretest and posttest scores using the N-gain test to then analyze the increase in students' scientific attitudes. The average results of pre-test and post-test question sheets is presented in the following table.

Table 7.Student Learning Outcomes Using N-Gain Formula

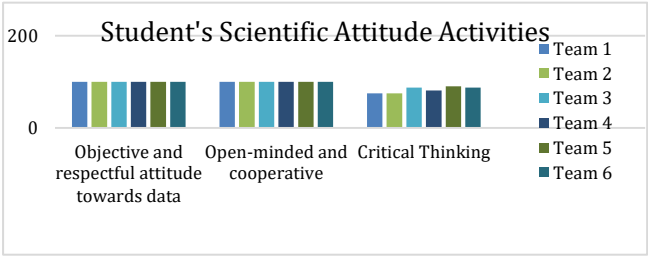
Average of Pre-Test score	Average of Pos-Test score	N-Gain Score	Category
57.446	89.5	0.7472	High



Picture 5.Percentage of indicator achievement. Indicators (1) Report results objectively; (2) Critical when analyzing a problem; (3) Critical when analyzing new facts; (4) Be skeptical; (5) Critical when analyzing information.

The highest average indicator achievement is indicator 1, namely 100, then indicators 4 and 5, namely 93.4 and 90.1. Meanwhile, the lowest indicator achievement was in indicator 3, namely critical in analyzing new facts, which obtained an assessment result of 75.3. Based on research conducted by Anisa (2021), one of the factors that causes a person's lack of ability to analyze new facts is the lack of literacy and interest in reading that students and people in Indonesia have, which influences their critical thinking skills. The results of the effectiveness of LKPD are measured based on the learning outcomes of students using the N-gain test obtaining a value of 0.7472 in the high category proves that the Ingenhousz Test and Sachs Virtual Laboratory-Based Worksheets are able to improve the scientific attitude of students which refers to improving learning outcomes. According to Haryono (2009) Assessment of learning outcomes can ideally reveal all aspects of the learning domain, namely aspects of knowledge, attitudes and skills. Because students who have good cognitive abilities when tested with tests are not necessarily able to properly apply their knowledge in overcoming life's problems.

The results of observing students' activities during learning using the Ingenhousz Test and Sachs Test virtual laboratory-based LKPD for 6 groups observed by 3 observers obtained a very effective assessment with a percentage of 93%. The following is a description of the percentage of students' scientific attitudes based on observer observations.

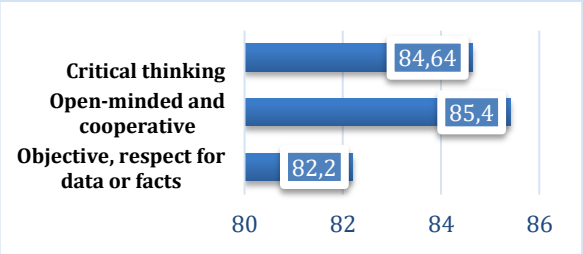


Picture 6. Student Activity Observation Chart

Based on this graph, it can be seen that all groups showed an objective attitude and high level of cooperation during the teaching and learning process

using LKPD Based Virtual Laboratory Ingenhousz Test and Sachs Test. This indicates that students have written the results of practicum objectively in accordance with the results of the virtual practicum that have been carried out and always include citations in writing opinions or theories from sources both books and the internet, active in expressing opinions when discussing in groups, open to receiving suggestions and respect the opinions of friends both within groups and between groups. In the critical thinking indicator, each group has a different percentage and has the lowest average percentage, namely 79% in the effective category. This was because some of the students in the group initially did not show a critical attitude when answering questions given by the researcher, but after several times the researcher asked questions by pointing directly at the students to answer, the students began to be responsive even though there were still some answers that were not appropriate. This happened because the concept reinforcement was not carried out on the same day as the LKPD implementation, so some material was forgotten. However, other indicators of critical thinking attitudes such as trying to critically analyze problems in the activity steps in the LKPD and looking for and showing relevant evidence before drawing conclusions have been implemented.

The effectiveness of the LKPD developed in training scientific attitudes requires user student responses to be measured and analyzed based on the achievement of each scientific indicator. The results of the recapitulation of student responses through the scientific attitude questionnaire are presented in the following graph.



Picture 7. Scientific Attitude Questionnaire Results

The feasibility of the Ingenhousz Test and Sachs Test Virtual Laboratory Based LKPD based on the results of the scientific attitude questionnaire obtained a percentage of 84.21% in the very effective category. Based on these results it can be seen that during the teaching and learning process using LKPD students feel they have worked well together, are ready to accept criticism and suggestions, and feel the need to collaborate in order to achieve maximum results during the teaching and learning process using LKPD. They also try to be skeptical in accepting new information by looking for evidence first, trying to think critically in analyzing problems and always considering and showing reliable evidence when drawing conclusions. Students have also shown an objective attitude by including sources when writing a theory that comes from reference sources in the form of articles or books as an effort to respect other people's ideas or opinions and always compares between hypotheses and conclusions in practicum with adequate evidence and references. In the second aspect, namely treating ideas and conclusions that are temporary and challenged with new evidence, many students answered *Ragu-ragu* (RR) and *Tidak Setuju* (TS) to the point "I always include citations to the information obtained to appreciate other people's ideas or work" and "I always compare my hypothesis and conclusions in experiments based on sufficient evidence". This indicates that students still need to get used to always including citations when writing other people's ideas as a form of respect for other people's data and ideas as well as practicing literacy and interest in reading so that the evidence provided when drawing conclusions is not only based on one source but from several. sources from which conclusions can then be drawn.

In general, based on the results of the analysis that has been carried out, the Ingenhousz Test and Sachs Test Virtual Laboratory Based LKPD is considered suitable for use and effective in improving the 3 dimensions of scientific attitude, namely objective attitude, respect for data or facts, open-minded attitude and cooperation and the ability to think critically in photosynthesis material. However, there is still a need to improve learning methods and take more time to train students in critical thinking indicators. This is in line with Rachmawati (2018) statement that the very short learning time in learning causes students to not be optimal in providing ideas and ideas for solving problems. So it takes longer to train critical thinking attitudes, starting with training students' focus, interest in reading and literacy, drawing conclusions, reading situations, seeing clarity and overall examination.

CLOSING

Conclusion

Based on the results of the data obtained, it can be concluded that the validity of LKPD obtained a percentage of 83.33% with a feasible category covering content aspects with a percentage of 79%, feasibility in construction aspects with a percentage of 87%, and feasibility in design aspects with a percentage of 84%. The practicality of the LKPD gets a percentage of 85.58% in the very practical category and the legibility of the LKPD is at level 12. The effectiveness of the

LKPD gets an N-Gain score of 0.7472 in the high category, the results of observing student activity during learning get a percentage of 93% in the very effective category, and the results of the scientific attitude questionnaire obtained a percentage of 84.21% in the very effective category.

Suggestion

Based on the research results, several suggestions that can be recommended are: Before the practicum activity takes place, the teacher should provide a good understanding of the concept and conduct questions and answers to train students' abilities in critical thinking. Apart from that, training scientific attitudes in students requires quite a long period of time, especially critical thinking skills, so further research is needed with special learning models so that students' critical thinking abilities can be improved.

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