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Development of PBL-Based Student Worksheets to Improve Students' Critical Thinking Skills in Biology Subjects

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Abstract: The purpose of this research is to develop Biology Student Worksheets (LKPD) based on Problem Based Learning (PBL) to improve students' critical thinking skills on valid, efficient and efficient respiratory and excretory system materials. This type of study is a 4-D form development study consisting of 4 steps, namely define, design, develop, and disseminate. The study points are students of class XI MAN 02 Sijunjung in the 2023-2024 academic year. Validity trial information is obtained through the approval sheet by the lecturer as the validator. Practicality trial information is obtained from the results of the analysis of teacher and student reaction questionnaires. Success trial information is obtained from the multiple-option question sheet to assess students' critical thinking skills. The validation results by the validator on the PBL-based Biology LKPD show a validity value of 84.1% with a very valid category. The practicality results by the Biology teacher show a value of 86.9% with a very practical category, and students 82.81% with a very practical category. The results of the effectiveness test of students' critical thinking skills showed that the PBL-based Biology LKPD was effective, as seen through the critical thinking skills test which showed higher critical thinking skills in the experimental class (83.5%) compared to the control class (74.5%). Thus, it can be concluded that the PBL-based Biology LKPD developed is valid, practical, effective, and can improve students' critical thinking skills.

Abstrak: *Tujuan dari penelitian ini adalah untuk mengembangkan Lembar Kerja Peserta Didik (LKPD) Biologi berbasis Problem Based Learning (PBL) guna meningkatkan kemampuan berpikir kritis siswa pada materi sistem pernapasan dan ekskresi yang valid, praktis, dan efektif. Jenis penelitian ini adalah penelitian pengembangan dengan model 4-D yang terdiri dari 4 tahap, yaitu define (pendefinisian), design (perancangan), develop (pengembangan), dan disseminate (penyebaran). Subjek penelitian adalah siswa kelas XI MAN 02 Sijunjung pada tahun ajaran 2023–2024. Informasi uji validitas diperoleh melalui lembar penilaian oleh dosen sebagai validator. Informasi uji kepraktisan diperoleh dari hasil analisis angket tanggapan guru dan siswa. Informasi uji keefektifan diperoleh dari lembar soal pilihan ganda untuk menilai kemampuan berpikir kritis siswa. Hasil validasi oleh validator terhadap LKPD Biologi berbasis PBL menunjukkan nilai validitas sebesar 84,1% dengan kategori*

sangat valid. Hasil kepraktisan oleh guru Biologi menunjukkan nilai sebesar 86,9% dengan kategori sangat praktis, dan dari siswa sebesar 82,81% juga dengan kategori sangat praktis. Hasil uji efektivitas terhadap kemampuan berpikir kritis siswa menunjukkan bahwa LKPD Biologi berbasis PBL efektif, yang terlihat dari hasil tes berpikir kritis siswa yang lebih tinggi pada kelas eksperimen (83,5%) dibandingkan dengan kelas kontrol (74,5%). Dengan demikian, dapat disimpulkan bahwa LKPD Biologi berbasis PBL yang dikembangkan adalah valid, praktis, efektif, dan mampu meningkatkan kemampuan berpikir kritis siswa.

Keywords: *LKPD, PBL Model, Critical Thinking Skills*

INTRODUCTION

Critical thinking is a core competency that students must have to face the challenges of the current era and the future. Critical thinking is one part of the ability to assume a large amount. The ability to assume critically is also needed in the 21st century to create the latest innovations in people's lives. Critical thinking means to be raised because it can improve the quality of people's energy sources and improve students' mindsets in solving cases and providing solutions to existing problems that are very important in everyday life. These abilities support each other and must be applied in training, especially Biology training (Lestari & Della, 2021).

Participant Activity Sheets (LKPD) can train participants' critical thinking skills, because each participant can share inspiration and opinions in criticizing a problem through activities and guidance in LKPD. LKPD was developed based on the form of PBL training to improve participants' critical thinking skills, because the form of PBL is a form of case-based training, where with the form of PBL, students are given a case, where the case encountered by the student must be solved by the student. Therefore, the form of PBL is a form of training that can improve students' critical thinking skills. One of the learning materials that is reasonable to use to overcome cases related to small critical thinking skills is LKPD. The Student Activity Sheets (LKPD) that were developed are LKPD Biology based on PBL and are made by observing the syntax of PBL and matching it with critical thinking skill markers. PBL is a form of training that is tried to improve students' critical thinking skills, helping to improve problem-solving skills. PBL requires prospective teachers to recognize the cases presented by the rules of the most data-mining method, then analyze and find a way out of the existing case. Candidate teachers are expected to be people with great insight and are able to see the relationship between training and the area (Lestari & Della, 2021).

Based on a study conducted by (Maghfiroh, Ducha & Purnama, 2020) it is known that the PBL-based LKS in this study obtained a validity score of 3.95 with a very good type. Based on the results of the validity experiment, it can be concluded that the PBL-based LKS developed in this study can be used in a guided learning method to train students' critical assumption skills. However, the study conducted by (Maghfiroh, Ducha & Purnama, 2020) is different from the research conducted by the researcher, namely in terms of the research object and materials used by the researcher, which are different from the research conducted by (Maghfiroh, Ducha & Purnama, 2020) , in addition, the research conducted by (Maghfiroh, Ducha & Purnama, 2020) was only carried out up to the validation stage, while the research conducted by this

researcher has reached the validity, practicality, and effectiveness stages.

The LKPD used in this research is the Applicative-Integrative LKPD. The Applicative-Integrative LKPD is a student activity sheet that helps students to apply and implement designs in everyday life in the form of problems, and can also help students relate the modules studied to natural events or life that students experience every day. The Applicative-Integrative LKPD is combined with the PBL format. This PBL format is a problem-based training form, where at each meeting in the PBL-based Biology LKPD, a problem is presented in the form of an article related to the training module, where students are required to be able to create the main problem in the article, and students are also required to be able to solve the problems that have been presented in the form of questions, this is intended to encourage curiosity in students. The personality of a great curiosity encourages and motivates students to find solutions in solving problems. So by using the PBL-based Biology LKPD, it can help students practice and apply designs in everyday life in the form of problems, as a result it can improve critical thinking skills in students (Arends, 2012).

Based on this framework, observers were interested in conducting a study on the Development of Biology Student Activity Sheets (LKPD) Based on Learning Based Learning (PBL) to improve students' critical thinking skills on the material of the respiratory and excretory systems that are original, effective and efficient.

The case limitation in this study is the Development of Biology Student Activity Sheets Based on Indecisive Based Learning to improve students' critical assumption skills is only tried on the respiratory system and excretory system materials, and the Development of Biology Student Activity Sheets Based on Indecisive Based Learning is tried up to the validity experiment, practicality experiment, and effectiveness experiment.

METHOD

This research is a type of development research or research and development (R&D) which aims to produce Biology Student Worksheets (LKPD) Based on Problem Based Learning (PBL) to improve students' critical thinking skills in the respiratory and excretory system modules that are original, efficient, and efficient. The points in this study are students of class XI MAN 02 Sijunjung in the 2023-2024 academic year.

The form of study development to be used in this study is the 4-D development form. For Trianto, the 4-D development form consists of 4 development steps, namely define, design, develop, and disseminate. The first is the Define step, which is tried in this define step is (a) initial-final analysis (desire analysis), which is tried in this initial-final analysis, namely conducting a question and answer session with the subject teacher of biology, analyzing the reading Biology textbooks grade XI, and analyzing the curriculum and niche objectives of the Biology grade XI training. (b) analysis of teaching participants and. (c) Formulation of training objectives. The second is the Design step, which is tried in this design step is to conceptualize a prototype of the Biology LKPD based on PBL. The third is the Develop step, which is tried in this Develop step is to carry out a validity test with experts/lecturers, after the PBL-based Biology LKPD is declared valid, it is continued with a practicality test with the Biology teacher of class XI and the level of critical thinking skills of class XI students. The next fourth is the *Disseminate stage*, which is carried out at the disseminate stage, namely the dissemination of PBL-based Biology LKPD (Noto, 2014).

The method of collecting information used in this study is a questionnaire and the results of the Q&A. The questionnaire is a record of problems submitted to teachers and students

who share opinions according to customer requests. This research questionnaire means to reveal the validity and practicality of consuming Student Activity Sheets (LKPD) for PBL-based Biology training on the respiratory system and excretory system module category XI at MAN 02 Sijunjung. On the other hand, questions and answers are used to identify opinions, hopes, dreams, results, desires, religion, and others. In this study, questions and answers were tried on Biology subject teachers to reveal the practicality of PBL-based Biology LKPD on the respiratory system and excretory system module developed in.

The research data analysis technique was carried out to determine the validity, practicality, and effectiveness of the PBL-based Biology LKPD that had been created. The research data analysis technique used a validation sheet. The calculation of the final value data from the validation results was analyzed using a scale of 0-100. The validity analysis of the PBL-based Biology LKPD was carried out with the following stages; (a) Scoring using a Likert scale; (b) Adding the scores of each validator for all indicators; and (c) Giving validity values with the formula proposed by Riduwan (2012) in (Siregar, 2018).

$$Validity\ value = \frac{Total\ scores\ obtained}{Highest\ score\ total}\ x\ 100\%$$

The results obtained are interpreted using the following criteria:

Table 1. Validity Categories of PBL Biology LKPD

Percentage Range (%)	Category
0-20%	Invalid
21-40%	Less valid
41-60%	Quite valid
61-80%	Legitimate
81-100%	Very valid

The next data analysis technique is to conduct a practicality test using a practicality sheet. The feasibility of PBL-based Biology LKPD can be seen from the questionnaire that has been filled out by teachers and students. The questionnaire is arranged in the form of a Likert comparison. The calculation of the final control value data is analyzed by a Likert comparison on a comparison of 0-100 using the procedures proposed by Riduwan, (2012) in (Siregar, 2018) .

$$Practicality\ value = \frac{Total\ scores\ obtained}{Highest\ score\ total}\ x\ 100\%$$

The results obtained are interpreted using the following criteria:

Table 2. Practicality Categories of PBL- Biology LKPD

Percentage Range (%)	Category
0-20%	Not Practical
21-40%	Less practical
41-60%	Quite Practical
61-80%	Practical
81-100%	Very Practical

To find out the level of practicality of a product, in addition to being tested using a questionnaire, it is also necessary to try a Q&A with the Biology subject teacher, where the results of the Q&A are analyzed using a narrative story, namely the processing of information formulated in the form of words. The next data analysis technique is to conduct an effectiveness test.

The data analysis of the effectiveness of PBL-based Biology LKPD is observed from the critical assumption skills in the form of student learning outcomes. Before determining the research category and supervision category, it is necessary to first know whether the study population has a similar generality or not. Therefore, a general suitability experiment was conducted, to carry out a general suitability experiment, a normality experiment and a homogeneity experiment were first conducted, and continued by conducting an Assumption experiment (T-Experiment). Next, an analysis of students' critical assumption skills was conducted. Students' learning outcomes were calculated based on the general

figures of the learning outcome tests analyzed from the Guidance Objectives Income Benchmark (KKTP), to determine the completeness of students' learning (individuals) can be calculated using the formula:

$$Effectiveness\ value = \frac{Total\ scores\ obtained}{Highest\ score\ total}\ x\ 100\%$$

The results obtained are interpreted using the following criteria:

Table 3. Critical Thinking Skills Assessment Criteria

Percentage Range (%)	Category
0-20%	Ineffective
21-40%	Less Effective
41-60%	Quite Effective
61-80%	Effective
81-100%	Very Effective

If the individual's completion is greater or uniform with the Training Target Entry Barometer (KKTP), until the student is claimed to have completed. The basis of the KKTP used is the KKTP set by MAN 02 Sijunjung, which is 79. The training that practices the Hayati LKPD based on the PBL that is being developed is said to be efficient if the students who achieve completion are greater or similar to 79 .

RESULTS AND DISCUSSION

1. Validity of PBL-Based Biology LKPD

In the development of PBL-based Biology LKPD, a validation stage must be carried out to assess the design of the product that has been designed, especially the rational use of new products or not through field facts. Data from the analysis of the PBL-based Biology LKPD validation sheet on the material of the respiratory system and excretory system in humans obtained the results as shown in Table 4.

Table 4. Results of Validation of PBL-Based Biology LKPD

Validated aspects	Validity value (%)	Criteria
Construction aspects	93.7%	Very Valid
Content suitability aspects	81.6%	Very Valid
Content presentation aspects	83.3%	Very Valid
Linguistic aspects	83.3%	Very Valid
Graphic aspects	80.5%	Legitimate
Average	84.1%	Very Valid

Based on the validation results of the PBL-based Biology LKPD which have been carried out with expert validators or lecturers consisting of tool expert validators, module expert validators, and language expert validators, where the views estimated by the expert validators or lecturers are the construct view, content feasibility view, content presentation view, language view, and graphic view, and have obtained the percentage results of the five views, namely 84.1% with a very valid category.

Observed from the architectural view that has been estimated by the expert validator or lecturer, it gets a validity score of 93.7% with a very good type, this architectural view is related to how the analysis and concept of the product are developed. Next, observed from the content feasibility view that has been estimated by the expert validator or lecturer, it gets a validity score of 81.6% with a very good type, this content feasibility view is related to the suitability of the module explanation with the Training Objectives and Training Achievements and the modules that are informed carefully. Next, observed from the content presentation view that has been estimated by the expert validator or lecturer, it gets a validity score of 83.3% with a very good type, this content presentation view is related to the presentation of the training objectives to be achieved, the queue rules in describing the

module, the presentation of the module in the LKPD has matched the steps in the form of PBL, and the form of question presentation has matched the module. Next, it is observed from the linguistic perspective that has been estimated by expert validators or lecturers, obtaining a validity value of 83.3% with a very accurate type, this linguistic thinking is related to the consumption of clear and easy-to-understand speech or conversation, and in accordance with good and correct Indonesian language rules. Furthermore, it is observed from the graphical perspective that has been estimated by expert validators or lecturers, obtaining a validity value of 80.5% with an accurate type, this graphical perspective is related to the dimensions of notes in compiling LKPD, as well as the concept in the form of patterned scribbles or presentation of paintings in the Biology LKPD with the PBL platform. Lufri & Ardi (2017) also stated that validation refers to the accuracy, meaningfulness, and benefits of a product that is developed by an observer. Regarding this, it is in accordance with the view of Sugiyono (2019) who stated that validity is the level of accuracy of data that is connected to the research point with the actual data (Afni, et al. 2023).

Darmayanti (2013) stated that validity was obtained because the PBL-based Biology LKPD developed was in accordance with the criteria. Validity comes from validity test data by experts/lecturers. PBL-based Biology LKPD which is in line with the theoretical basis of development and can be used to measure students' critical thinking skills, it can be said that this PBL-based Biology LKPD is valid and in accordance with expectations (Ariana, et al. 2020) .

The factors that influence the validity results of the PBL-based Life Sciences Student Worksheet are because the parts of the PBL-based Life Sciences Student Worksheet have been matched with the evaluation views formalized in the validity instrument, the PBL-based Life Sciences Student Worksheet is validated gradually by carrying out corrections according to recommendations and opinions at each validation step, the development of the PBL-based Life Sciences Student Worksheet uses communicative language and is appropriate to the level of cognitive development of the teaching participants, and meets the standards of content and construct validity (Kurniahtunnisa, & Anggraito, 2019) .

2. Practicality of PBL-based Biology LKPD

Practicality information of PBL-based Biology LKPD comes from the author from the results of teacher and student reaction tests. For student reactions, they were obtained from the distribution of questionnaires that the author conducted on 24 students in category XI MAN 02 Sijunjung. On the other hand, the author's teacher reactions also came from questionnaires that the author distributed to Biology teachers in category XI MAN 02 Sijunjung, and were supplemented with the results of regular Q&A with Biology teachers in category XI MAN 02 Sijunjung. The methods tried to identify the practicality of PBL-based Biology LKPD on the respiratory system and excretory system modules in humans are:

a) Providing practicality questionnaires to teachers

Judging from the questionnaire that the author has given to the Biology teacher of the

PBL class, the PBL-based Biology LKPD also has advantages, namely that it can improve students' critical thinking skills, especially in the material of the respiratory system and excretory system in humans. Data from the analysis of the PBL-based Biology LKPD practical sheet on the material of the respiratory system and excretory system in humans by the Biology subject teacher of class XI MAN 02 Sijunjung obtained the results as seen in Table 5.

Table 5. Results of Data Analysis of Biology LKPD Practical Work Based on PBL

Rated aspect	Practicality Value (%)	Criteria
Ease of use	89.2%	Very Practical
Efficiency of learning time	81.2%	Very Practical
Benefits obtained	87.5%	Very Practical
Average	86.9%	Very Practical

Based on the results of the questionnaire analysis from the subject teachers of Biology type XI MAN 02 Sijunjung, until the results of the questionnaire analysis of the responses of the subject teachers of Biology type XI MAN 02 Sijunjung. Observed from the estimated thinking, namely the convenience in consumption with a practicality value of 89.2% with a very effective type, the expertise of the length of training with a practicality value of 81.2% with a very effective type, the benefits received with a practicality value of 87.5% with a very effective type. From the results of the practicality of the PBL-based Biology LKPD received from the Biology subject type XI MAN 02 Sijunjung, it can be concluded that the PBL-based Biology LKPD is effective for use in the coaching method .

b) Distribution of Practical Worksheets to Students

The distribution of practical sheets to students aims to find out information about students' responses to PBL-based Biology LKPD that has been distributed to students. Students are given a response questionnaire to the practicality of PBL-based Biology LKPD on the material of the respiratory system and excretory system in humans for class XI MAN 02 Sijunjung, where the response questionnaire functions to see students' responses to the practicality of PBL-based Biology LKPD. Data from the analysis of the PBL-based Biology LKPD practical sheets on the material of the respiratory system and excretory system in humans by class XI MAN 02 Sijunjung obtained the results as shown in Table 6.

Table 6. Results of Practical Data Analysis of PBL-Based Biology LKPD by Students

Rated aspect	Practicality value (%)	Criteria
Ease of use	84.67%	Very Practical
Efficiency of learning time	81.25%	Very Practical
Benefits obtained	82.21%	Very Practical
Average	82.81%	Very Practical

Based on the results of the analysis of the practicality questionnaire that was tried in the Observed category from the estimated view is the ease of use with a practicality figure of 84.67% with a very efficient type, the ability of the duration of the training with a practicality figure of 81.25% with a very efficient type, the benefits obtained with a practicality figure of 82.21% with a very efficient type. From the results of the PBL-based Biology LKPD. The practicality obtained from category XI students of MAN 02 Sijunjung with a total of 24 students, it can be concluded that the PBL-based Biology

LKPD is efficient to use in the training method.

In terms of ease of use, PBL-based Biology LKPD is said to be practical because the PBL-based Biology LKPD that was developed has presented the material clearly, simply, the entire contents of the PBL-based Biology LKPD are easy to understand and are arranged based on PBL syntax, the size and type of font are easy to read, practical in size and equipped with clear instructions. This is in accordance with BNSP (2013) which states that language standards or readability in teaching materials include the use of good and correct Indonesian, clarity of language and ease of reading. In terms of learning time efficiency, PBL-based Biology LKPD is said to be practical because the PBL-based Biology LKPD that was developed is efficient for use in learning, learning time is more efficient and students can learn according to their abilities. According to Sumiati & Asra (2007) LKPD can help students to process learning outcomes (find and prove the concepts learned) according to their abilities. In terms of benefits, PBL-based Biology LKPD is said to be practical because PBL-based Biology LKPD can replace the role of teachers as facilitators and help students improve their critical thinking skills. According to Majid (2012), LKPD can make it easier for teachers to prepare and implement learning, help students learn to understand the material and do things in writing (Lestari et al., 2018) .

PBL-based Biology LKPD can be said to be practical if teachers and students assess that this PBL-based Biology LKPD can be used easily based on the aspects assessed. Practicality data is analyzed based on the results of the practicality response questionnaire assessment from students and the practicality response questionnaire from teachers. So the PBL-based Biology LKPD developed is easy to use by students because the syntax of the PBL learning model applied to the LKPD is clear and easy to apply in the learning process, and the language and questions used in the PBL-based Biology LKPD are clear and easy to understand, and the size of the PBL-based Biology LKPD is also practical and easy to carry (Lestari, et al. 2019).

Based on research conducted by (Maghfiroh, et al. 2020), the validity of the LKS is determined based on the validation results by three validators using the validation sheet instrument. The validity aspects assessed include aspects of presentation, content, language, characteristics of LKS to train critical thinking skills, and PBL-oriented LKS. The research results show that the PBL-based LKS in this study obtained a validity value of 3.95 with a very valid category.

The difference in the development of LKPD that the author did is in terms of research objects and research materials, in addition, previous research only conducted research up to the validity stage, different from the research that the author has done. The research that the author has done was carried out up to the validity, practicality, and effectiveness stages so that it is able to complement the shortcomings in previous research.

Critical thinking skills are the ability to think rationally or logically and reflectively that focuses on religion and the decisions to be made (Ennis 2015). Students who are equipped with critical thinking skills can examine other people's opinions that are right

or wrong based on objective evidence or insight, so that students can conclude and calculate which opinions are wrong and which are right without any doubt. Current learning really needs to train students to have critical thinking skills so that students can apply and practice designs in everyday life in the form of problems. Critical thinking skills are skills that are not inherent in people since birth. Critical thinking skills must be trained in a coaching process (Rahmawati et al., 2016) .

3. Effectiveness Test of PBL-Based Biology LKPD

The effectiveness test of PBL-based Biology LKPD was tried in 2 categories, namely, the research category and the supervision category. The experiment on the effectiveness of PBL-based Biology LKPD which was enlarged or not when used as learning material in training activities. The results of the effectiveness experiment were used as a principle in identifying the effectiveness of PBL-based Biology LKPD. Effective data was obtained by assessing students' learning competencies, namely students' critical thinking skills.

Evaluation of students' critical thinking skills can be accepted through a final experiment in the form of two alternative or balanced problems that have been compiled from indicators of critical thinking skills submitted to students in the research type and supervision type. The completion of the final experiment problems is attempted at the end of the training meeting. This evaluation is used to view the success of the Biology LKPD based on PBL. In general, the results of students' critical thinking skills in the research category and supervision category can be observed in Table 7.

Table 7. Average results of critical thinking skills of students in the experimental and control classes

Class	Amount	Average	Information
Experiment	2004	83.5	Complete
Control	1640	74.5	Incomplete

Information in Table 7 proves that the general figure of critical thinking skills of students in the research category is greater than that of the supervision category. The research category is the category that is given treatment in the form of using PBL-based Life Sciences Worksheets, while the supervision category is the category without using PBL-based Life Sciences Worksheets. The general figure for the research category is 83.5 using PBL-based Life Sciences Worksheets, while the general figure for the supervision category is 74.5 not using PBL-based Life Sciences Worksheets.

Success information is obtained by calculating the students' practice competencies observed from the students' critical assumption skills. Evaluation of students' critical assumption skills can be obtained through a final test in the form of multiple-choice or fair questions that have been compiled based on the critical assumption skill markers submitted to students in the research and supervision categories. The final test questions are carried out at the end of the training meeting. This evaluation is used to view the success of the PBL-based Biology LKPD.

The characteristics of multiple-choice question instruments are that multiple-choice questions can make students more focused on the answers. The indicators of critical thinking skills used are in accordance with the form of multiple-choice questions that the researcher made, because seen from the indicators of critical thinking skills that the researcher used where students can determine good and correct

reasons and opinions that have been put forward in the question, and students can also see the possibility of the correct answer that has been put forward in the question, and students can also avoid doubts about the answers that have been put forward in the question. So objective multiple-choice questions are the most widely used and applied questions. Multiple-choice questions consist of statements, alternative answers, and distractors.

In an operational way, the success of developing a learning material in the form of a PBL-based Life Sciences Student Activity Sheet, if the developed Life Sciences Student Activity Sheet can achieve the expected goals, where the goal of developing a PBL-based Life Sciences Student Activity Sheet can improve students' critical thinking skills. The results of the success of the PBL-based Life Sciences Student Activity Sheet are obtained from the results of the final test submitted to students. The success test was tried to measure the level of students' critical thinking skills after using the PBL-based Life Sciences Student Activity Sheet in the training method (Hayyun et al., 2024).

The purpose of developing PBL-based Biology LKPD in the respiratory system and excretory system modules is to recognize the success of PBL-based Biology LKPD in improving students' critical thinking skills. PBL-based Biology LKPD is said to be effective if the learning outcomes provide a meaningful analogy between the level of critical thinking skills of the research type and the type of supervision. The level of success in this research is obtained from the results of calculating the final experimental value submitted to students in the research and supervision types, where the research type is the type that uses PBL-based Biology LKPD in the training method, while the supervision type is the type that does not use PBL-based Biology LKPD in the coaching method (Hulu & Anas 2024).

As a result, it can be explained that the Biology LKPD based on PBL that was developed can improve students' critical thinking skills. This is in accordance with Hosnan's opinion (2014) who reported that the main purpose of PBL is to improve students' critical thinking skills, problem-solving skills, and create their own knowledge. The PBL format can create critical thinking skills and new insights that are useful in the long term. For Yuan, et al. (2011) through the PBL format, students are able to exchange ideas and work together with heterogeneous group bodies to solve problems which in the end can improve students' critical thinking skills. Not only that, Wynn (2010) said that by using the PBL format, teachers function as providers so that students are active in learning (Anesa & Ahda 2021) .

The increase in critical thinking skill income is closely related to the fun learning method experienced by the students, therefore, the success of increasing critical thinking skill income can be triggered by a fun learning atmosphere. This assumption is based on several reasons, as follows: First, the PBL format can strengthen the student's design for the learning module submitted by the teacher. Interestingly, the PBL format can be used as a method to remember data. Thus, it can be said that the use of the PBL format can be used as a method to increase the enjoyment of learning. Second, the PBL format can train students to act critically towards the module. A good bond

between students and teachers makes the learning atmosphere fun (Monalisa & Ahda, 2019) .

CONCLUSION

Based on the results of the research on the development of PBL-based Biology LKPD that the author has conducted up to the stages of validity, practicality, and effectiveness, it can be concluded that:

The PBL-based Biology LKPD on the respiratory system and excretory system modules that have been developed has a validity with a very high level of 84.1%. The PBL-based Biology LKPD on the respiratory system and excretory system modules is estimated to be very efficient by teachers with a percentage of 86.9% and is estimated to be very efficient by students with a percentage of 82.81%. The PBL-based Biology LKPD on the respiratory system and excretory system modules that have been developed has been efficiently recognized through a critical thinking skill test which proves that the critical thinking skills of students in the research category are greater (83.5%) than in the supervision category (74.5%).

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