

Development of PBL-Based Biology Students Worksheets with Character Education to Enhance Learning and Critical Thinking Competencies in Class XI High School Students

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Abstract – This study aims to develop a Biology LKPD based on Problem Based Learning with character education to improve students' learning competency and critical thinking. The development model used is Ploom. The study was conducted at SMAN 1 Ranah Pesisir. The test was conducted in class XI IPA 1 and XI IPA 2 as subjects. Testing uses questions in the form of multiple-choice and essay. The LKPD validity results obtained are as follows: subject matter expert 96.66%, learning design expert 92%, and learning media expert 90%. The LKPD practicality results are as follows: individual test results of 90% on very good qualifications, small group test results of 91.6% on very good qualifications, and field test results of 90.5% on very good qualifications. The affectivity of 29 students, 9 grading points are very good and 19 grading points are good enough, on average the affective aspects are categorized pretty well. Two-tailed t test with $\alpha 0.05$ ($0,1164 > 0.05$). Calculation of t-test for $\alpha 0.05$ with df 56 is 1.6730, it turns out $t\text{-count} > t\text{-table}$. Based on the results of the analysis, it was concluded that PBL-Based Biology LKPD loaded with Character Education can improve students' learning competency and critical thinking.

Keywords – R&D, LKPD, PBL, Character Education, Critical Thinking

I. INTRODUCTION

Biology is a branch of science that has an important role in the development of science and technology. In learning Biology, it is necessary to apply the direct application of the knowledge gained to life events. Biology examines the facts and principles that exist in life and provides insight into how to obtain these facts and principles. According to Permendikbud No. 21 of 2016 concerning Basic and Secondary Education Content Standards for Biology content, students must have the competence to be able to apply principles, concepts, and laws in the field of Biology to solve real and environmental problems.

Biology Learning uses a lot of worksheets as a guide for students to practice, the worksheets used are not made by educators in SMA Negeri 1 Ranah Pesisir, and worksheets used are sourced from printed books in the school library. The worksheets that are used have not been able to guide students in investigating knowledge and find learning concepts and worksheets that are used have not been able to improve students' learning and critical thinking competencies in solving questions and practicum. Not yet achieved the learning competencies listed in table 1, due to the use of worksheets that have not guided students to be able to achieve learning competencies in Biology subjects. So that it becomes an obstacle in improving students' critical thinking skills in

learning.

The cause of the problem can originate from the factors of educators and students. From the factors of educators, among others: 1) educators have used good teaching strategies, but have not been optimal in the use of learners' worksheets, 2) the lack of educators' ability to develop learners' worksheets that can improve students' learning and critical thinking competencies, 3) less creative educators create learning that is more meaningful, interesting, and fun, 4) educators have not used appropriate learning media to help students understand abstract concepts in Biology lessons, 5) educators have not found effective student worksheets to deliver subject matter, and 6) educators have not used appropriate student worksheets to provide direct experience to students. While the factors of students, namely: 1) low motivation to learn; (2) the enthusiasm of students to participate in learning tends to be low because of the limited learning resources, 3) the different learning styles of students in the classroom; (4) students' ability to catch lessons is low; and (5) students need a variety of media in learning.

Based on the description above, it can be concluded that the worksheets of students need to be optimized in learning Biology, especially the worksheets of PBL-based Biology students with character education to improve students' learning competency and critical thinking because Biology subject matter cannot be presented using printed books and lecturer lectures only. To overcome these problems by the use of student worksheets that can encourage interest in learning and improve students' learning competence and critical thinking. To construct students' understanding to produce critical thinking skills (critical thinking) depends on the selection of learning models that will be used. One model that can be used in constructing students' understanding is the Problem Based Learning model. Problem-based learning (PBL) is an innovation in learning because in PBL the students' thinking ability is optimized through systematic group or teamwork processes, so students can empower, hone, test and develop thinking skills systematically. PBL is a learning model that is designed so that students get important knowledge, which makes them proficient in solving problems, and has their learning model and can participate in teams^[2]. The learning process uses a systemic approach to solving problems or facing challenges that are later needed in daily life.

Student Worksheet (LKPD) is a student guide used to develop cognitive aspects as well as guidelines for investigation or problem-solving activities according to indicators of learning outcomes that must be achieved. Student

Worksheets (LKPD) are also defined as printed teaching material in the form of sheets of paper containing material, summaries, and instructions for implementing learning tasks to be done by students referring to the Basic Competence (KD) that must be achieved.

LKPD is a student guide that is used to carry out an investigation or problem-solving activities^[8]. Explained that LKPD is a stimulus or guidance of educators in learning that will be presented in writing so that in writing it needs to pay attention to the criteria of graphic media as visual media to attract the attention of students^[9].

II. METHODS

This research was conducted in class XI students of SMAN 1 Ranah Pesisir on two materials, namely KD 3.6 about the circulatory system and KD 3.7 about the digestive system of humans and animals. The research method used is research and development (R&D). This LKPD research development uses the Plomp model. Characteristics of educational design as a method in which people work systematically towards solving the problems made. This model consists of five development phases, namely 1) the initial investigation phase, 2) the design phase, 3) the realization phase, 4) the test, evaluation, and revision phase, and 5) the implementation phase. In this study, the development was only carried out up to the test, evaluation, and revision phases because the implementation phase required quite a long process and time. Learning tools developed include the Learning Implementation Plan (RPP) and the Student Worksheet.

The formative evaluation takes place in all stages and cycles, starting from the research design stage. Based on the floating model adopted from the Plomp model the procedures for carrying out this research are 1) the initial investigation phase, 2) the development or prototype stage, 3) the assessment stage^[6].

Data Analysis Technique

Test the validity of research instruments using the opinions of experts, in this study the product validation instrument, the practicality of educators, the practicality of students, the effectiveness instrument was consulted with the validator of the research instrument. The validity questionnaire is described by the data frequency analysis technique using the formula:

$$validity = \frac{TSe}{TSh} \times 100\%$$

Information:

TSe: Total empirical score TSh: Maximum total score with the following results^[1]:

Then the validation results are analyzed on a scale (0-100),

Table 1. Product Validity Categories.

Score	Validity Category	Remarks
25,00 – 40,00	Invalid	Not to be used
41,00 – 55,00	Poor Invalid	May not be used
56,00 – 70,00	Sufficient Valid	May be used after major revision
71,00 – 85,00	Valid	May be used after minor revisions
86,00 – 100,00	Very Valid	Very good to use

Practicality questionnaire based on the final value then presented with a scale of 0-100, described by the technique of data frequency analysis using the formula:

$$practicality = \frac{TSe}{TSh} \times 100\%$$

Information:

TSe: Total empirical score TSh: Maximum total score

Furthermore, the results of practicality are analyzed on a scale (0-100), with the following results: ^[1]:

Table 2. Product Practicality Categories.

Score	Practicality Category	Remarks
25,00 – 40,00	Not practical	Not to be used
41,00 – 55,00	Less practical	May not be used
56,00 – 70,00	Quite practical	May be used after major revision
71,00 – 85,00	Practical	May be used after minor revisions
86,00 – 100,00	Very practical	Very good to use

Analysis of the effectiveness of the application of PBL-based Biology LKPD with character education to improve learning competence and critical thinking of high school students is based on data obtained from data collection instruments. Based on the achievements of the KKM, the Biology LKPD results of the development were declared effective in the cognitive aspects if a minimum of 80% of students participating in learning using PBL-based Biology LKPD were character-based to improve learning competence and critical thinking of the XI high school students had reached the KKM.

III. RESULT AND DISCUSSION

A. Result

Preliminary analysis is carried out to obtain information about the problems faced in the world of Education. Information gathering is done through observation, documentation, questionnaires, and interviews. Based on the results of the analysis it can be concluded that to be able to hone the ability of problem-solving and character education of students, educators need learning tools that can help

facilitate students to develop their problem-solving abilities. Through LKPD which is based on one of the models that have been proven to improve problem-solving abilities, namely Problem Base Learning, it is expected to help students develop their problem-solving abilities. Also, students also need LKPD which can arouse the spirit of the nation's character and also motivation to learn in this case in terms of the form and content of PBL-based LKPD.

The results of the practicality of students revealed the value of PBL-based Biology practicality loaded with character education to improve learning competence and critical thinking skills of students is 91.46 and are in the category of very practical and very well used, on the assessment sheet of student practicality in the comments and suggestions column. for PBL-based Biology LKPD with character education, there are no students who provide comments and suggestions, so that LKPD Biology is developed practically in terms of ease of use, material suitability, appropriateness of appearance and is beneficial for students in the learning process in class.

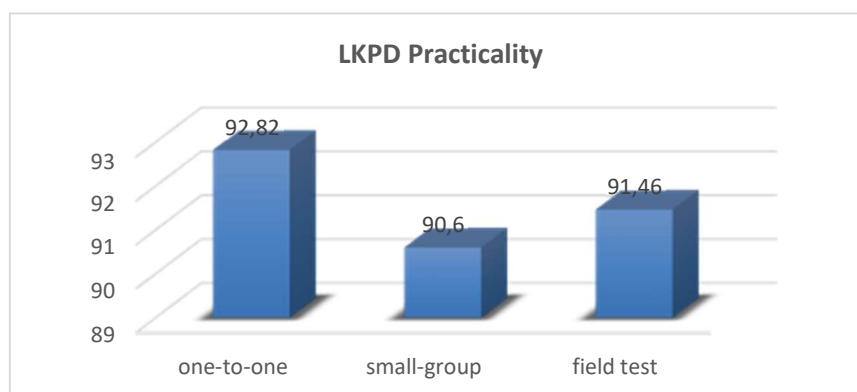


Figure 1. Results of PBL-based Biology Practicality Based on Character Education.

Based on the average affective value of 29 students, 9 assessment items get very good information and 19 assessment items get pretty good information, the overall affective aspect rating gets a value of 88.55, based on the effective data analysis table then the affective aspects assessment students get a pretty good category after using PBL-based Biology LKPD with character education. The average psychomotor scores of 29 students, 5 assessment items get very good information and 4 assessment items get pretty good information, the average overall evaluation of psychomotor aspects get a value of 90.57, based on the psychomotor data analysis table, the assessment of participants psychomotor aspects students get a very good category after using PBL-based Biology LKL with character education.

Learning competency ability of students on cognitive aspects is done in the experimental class XI MIPA 1 which is a group of students who learn by using PBL-based Biology LKPD with character education and control class XI MIPA 2

students who do not learn by using LKPD Biology based PBL with education character in SMA N 1 Ranah Pesesir. Data on cognitive aspects learning outcomes were obtained from tests at the end of learning activities in class XI MIPA 1 as many as 29 students for the experimental class and class XI MIPA 2 as many as 29 students for the control class. In the final test 30 items were used multiple choice with five alternative answers.

After obtaining the value of learning outcomes in the cognitive aspects, it is seen that the highest value achieved by students in the experimental class is 95.7 and the lowest value is 72.6 with an average value of 83.38 and a standard deviation of 7.22. The interval class that has the highest frequency is the interval class with a score range of 91.85–95.70, the number of frequencies is 7 (24.14%), while those with the lowest frequency are located at the interval class 87.99–91.84 the number of frequencies 1 (3, 45%), for more details, see Figure 2.

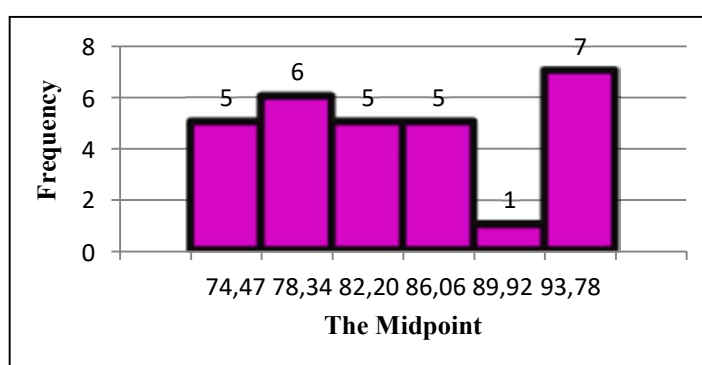


Figure 2. Histogram Student Learning Outcomes Cognitive Aspects of Experimental Classes.

Data obtained from the control class in the form of the

results of the final test conducted for students of class XI

MIPA 2 SMA N 1 Ranah Pesesir in Biology subjects in the first semester of the academic year 2019/2020 who studied without using PBL-based Biology LKPD with character education. After obtaining the value of learning outcomes in cognitive aspects, it is seen that the highest value achieved by students in the control class is 85.8 and the lowest value is 62.7 with an average value of 74.88 and a standard deviation of 7.7.

The interval class that has the highest frequency is the interval class with a score range of 81.95–85.80 number of frequencies 9 (31.03%), while those with the lowest frequency are located in the interval class 66.51–70.36 number of frequencies 1 (3.45%), for more details, see Figure 3.

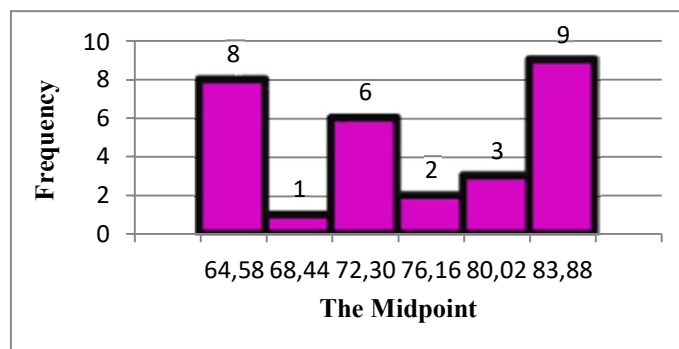


Figure 3. Histogram of Student Learning Outcomes Cognitive Aspects of Control Classes.

A comparison of cognitive aspects of learning outcomes between the experimental class and the control class shows that the average value of the experimental class is greater than the average value of the control class that is $83.78 > 74.88$. A comparison of the average value of the two classes must be tested with the t-test formula to conclude whether there are differences in cognitive aspects of learning outcomes between students who learn to use PBL-based Biology LKPD with character education and students who do not use LKPD Biology. Before testing the comparison of learning outcomes of cognitive aspects using the t-test formula, first the normality test and homogeneity test are used as initial requirements before using the t-test formula for the experimental and control classes.

The lilies test calculation shows that the Lhitung experimental class 0.1122 is smaller than the Ltable 0.1645 for $\alpha 0.05$, so the experimental group values are derived from normally distributed data. The control class obtained 0.1515 Lhitung smaller than Ltable 0.1645 for $\alpha 0.05$, thus the value of the dick group came from normally distributed data. Fisher test calculation shows that the two-party f test of the experimental and control class 0.7342 is greater than $\alpha 0.05$ ($0.7342 > 0.05$), thus the experimental and control group values have homogeneous data variance. Calculation of t-test compared with T table with $df = (N_1 - 1) + (N_2 -$

$1) = 56$, based on the T table for $\alpha 0.05$ with $df 56$ is 1.6730, it turns out that $T_{count} > T_{table}$, thus it can be concluded that

the learning outcomes Cognitive aspects of students who took part in learning using PBL- based Biology LKPD with higher character education compared to learning outcomes of cognitive aspects students who did not use LKPD, and there was a significant influence on learning outcomes of cognitive aspects of students between experimental classes using LKPD-based Biology PBL is loaded with character education compared to control classes that do not use LKPD.

Assessing students' critical thinking skills in using PBL-based Biology LKPD with character education carried out in the XI MIPA 1 experimental class which is a group of students learning by using PBL-based Biology LKPD with character education and XI MIPA control class 2 students who did not learn by using PBL-based Biology LKPD with character education in SMA N 1 Ranah Pesesir. Critical learning outcomes data obtained from the test at the end of learning activities in class XI MIPA 1 as many as 29 students for the experimental class and class XI MIPA 2 as many as 29 students for the control class. In the final test used 5 item description items with HOTS level.

After obtaining the value of critical thinking learning outcomes, it appears that the highest value achieved by students in the experimental class is 95 and the lowest value is 80 with an average value of 86.96 and a standard deviation of 5.49. the interval class that has the highest frequency is the interval class with a range of scores of 89.99–92.49 the number of frequencies 7 (24.14%), while the lowest frequency

is located at the interval class 87.48–89.98 which does not

have a data frequency, for more details seen in Figure 4.

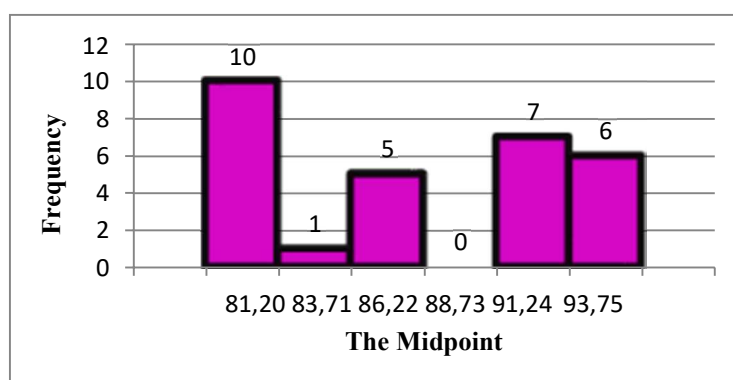


Figure 4. Histogram Hasil Belajar Berfikir Kritis Peserta Didik Kelas Eksperimen.

Data obtained from the control class in the form of the results of the final test conducted for students of class XI MIPA 2 SMA N 1 Ranah Pesisir in Biology subjects in the first semester of the academic year 2019/2020 who studied without using PBL-based Biology LKPD with character education. After obtaining the value of critical thinking learning outcomes, it appears that the highest value achieved

by students in the control class is 83 and the lowest value is 70 with an average value of 78.03 and a standard deviation of 3.36. the interval class that has the highest frequency is the interval class with a score range of 78.66–80.82 the number of frequencies 9 (31.03%), while those with the lowest frequency are located at the interval class 72.13–74.29 who do not have a data frequency, for more details seen in Figure 5.

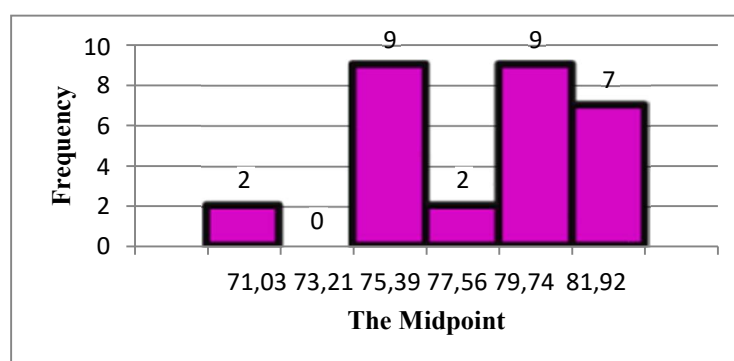


Figure 5. Histogram Learning Outcomes Critical Thinking of Students in the Control Class.

A comparison of critical thinking learning outcomes between the experimental class and the control class shows that the average value of the experimental class is greater than the average value of the control class that is $86.96 > 78.03$. Comparison of the average value of the two classes must be tested with the t-test formula to be able to conclude whether there are differences in the results of critical thinking learning between students who learn to use PBL-based Biology LKPD character education loaded with students who do not use LKPD Biology. Before testing the comparison of learning outcomes of critical thinking using the t-test formula, first the normality test and homogeneity test are used as initial

requirements before using the t-test formula for the experimental and control classes.

The lilies test calculation shows that the Lhitung experimental class 0.1618 is smaller than the Ltable 0.1645 for α 0.05, so the experimental group values are derived from normally distributed data. The control class was obtained Lhitung 0.1302 smaller than Ltable 0.1645 for α 0.05, so the value of the dick group came from normally distributed data. Fisher test calculation shows that the two-party f test of the experimental and control class 0.1164 is greater than α 0.05 ($0,1164 > 0.05$), thus the experimental and control group values have homogeneous data variance.

A comparison of cognitive aspects of learning outcomes between the experimental class and the control class shows that the average value of the experimental class is greater than the average value of the control class that is $83.78 > 74.88$. Calculation of t-test compared with T table with $df = (N_1 - 1) + (N_2 - 1) = 56$, based on T table for $\alpha 0.05$ with $df 56$ is 1.6730, it turns out that $T_{count} > T_{table}$, thus it can be concluded that the learning outcomes Critical thinking of students who take lessons using PBL-based Biology LKPD has higher character education compared to the learning outcomes of students of critical thinking who do not use LKPD, and there is a significant influence on the learning outcomes of students of critical thinking between experimental classes using LKPD-based Biology PBL is loaded with character education compared to control classes that do not use LKPD.

B. Discussion

Validity in the development of PBL-based Biology LKPD with character education included as a valid category and can be used in the learning process, so the authors also strengthen the results of research with research conducted by Nua (2018). The results of the LKPD validity obtained are as follows: (1) subject matter expert 96.66%; (2) learning design experts 92%; and (c) learning media experts 90%. The assessment results show that the validity of LKPD is included in the excellent category and can be used in the learning process.

Practicality in the development of LKPD which is categorized as very practical, so the authors also strengthen the results of research with research conducted by Surani (2018), the results of LKPD practicalities obtained are as follows: (1) the results of individual tests obtain results of 90% in qualifications very good; (2) small group test results obtained 91.6% in very good qualifications, and (3) field test results obtained 90.5% in very good qualifications. The results of the assessment indicate that the practicality of LKPD is included in the excellent and practical category used by students and educators in learning.

The results of the effectiveness test above can be concluded that PBL-based Biology LKPD loaded with effective character education is used by students in improving students' learning competencies and students' critical thinking skills. Other studies also strengthen the results of research on the effectiveness of LKPD, namely research conducted by Munandar (2015), cognitive learning outcomes scored 93.88% in the very high category, affective aspects scored 90.87% in the very high category, and psychomotor aspects scored 92.59% with a very high category. So it can be concluded that LKPD is effectively used by students because

it can improve student learning outcomes from aspects of cognitive, affective, psychomotor and students' critical thinking abilities.

IV. CONCLUSION

Developing LKPD starts with the initial investigation phase of learning Biology in class XI of high school, the stage of making prototypes of PBL-based Biology LKPD containing KD 3.6 circulatory character education and KD 3.7 food and digestive system, the prototype making stage containing the RPP preparation of LKPD, the preparation of instruments research, self-evaluation, expert review/expert review, expert review is carried out following the results of expert assessments about LKPD products developed from aspects of RPP, Material, media / LKPD, and language are considered valid with minor revisions. The average number of assessment aspects of RPP 83.89, material aspects amounted to 82.40, Media / LKPD aspects amounted to 83.33 and language aspects 84.17 with an average of 83.45 valid categories.

Practicality test results show that PBL-based Biology LKPD products are loaded with character education in terms of practicality, starting from the ease of use, benefits, appearance and time, based on the assessment of educators, a value of 89.23 is obtained with very practical criteria, and a value of 91.62 is obtained with criteria practically both in terms of students.

The effectiveness test was carried out in class XI of SMA N 1 Coastal Area, amounting to 29 people with an average cognitive learning outcome in the experimental class 83.78 and the control class 74.86, based on the t-test the experimental class was higher than the control class. Affective aspects of learning outcomes obtained with an average value of 88.55 with a pretty good category and psychomotor aspects of learning outcomes obtained with an average value of 90.57 categories very good. For learning outcomes of critical thinking skills in the 86.96 experimental class and 78.03 control class, based on the t-test the experimental class is higher than the control class. Based on the comparison of cognitive learning outcomes and students' critical thinking abilities as well as the students' affective and psychomotor aspects of learning outcomes, it is seen that PBL-based Biology LKPD with character education can improve learning competence and critical thinking abilities and help students understand Biology learning material.

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