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Development of Student Worksheets Based on Problem Based Learning on Excretory System Material for Grade XI Senior High School

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ABSTRAK

Model *Problem Based Learning* (PBL) pembelajaran intelektual tingkat tinggi yaitu analisis, kritik dan penarikan kesimpulan diaplikasikan kepada LKPD digunakan sebagai pendukung dalam kegiatan pembelajaran sesuai kompetensi yang dicapai. Penelitian bertujuan untuk menentukan kevalidan, kepraktisan, dan keefektifan LKPD berbasis PBL materi sistem ekskresi. Jenis penelitian ini adalah *Research and Development* (RnD) dengan model 4D (*Define, Design, Develop, Disseminate*). Hasil penelitian memperlihatkan bahwa lembar kerja peserta didik (LKPD) berbasis pembelajaran berbasis masalah (PBL) yang dibuat dengan skor 100% (validasi isi) kriteria sangat valid, 75% (validasi konstruk) kriteria yang valid, dan 98% (respons guru biologi) serta 81,5% (respons peserta didik) kriteria yang sangat praktis. LKPD tersebut terbukti efektif dalam mencapai hasil peningkatan (N-Gain) dengan mencapai skor rata-rata kelas yang tinggi sebesar 0,702. Dan disimpulkan bahwa LKPD berbasis PBL yang dibuat adalah valid, praktis, dan efektif diaplikasikan dalam kegiatan pembelajaran di kelas.
Kata kunci: LKPD; *Problem Based Learning;* Sistem Ekskresi.

ABSTRACT

The Problem Based Learning (PBL) model of high-level intellectual learning, namely analysis, criticism, and conclusions is applied to LKPD used as a support in learning activities according to the competencies achieved. The research aims to determine the validity, practicality, and effectiveness of PBL-based worksheets on excretory system material. This type of research is Research and Development (RnD) with a 4D model (Define, Design, Development, Disseminate). The results showed that student worksheets based on problem-based learning were made with a score of 100% (content validation) very valid criteria, 75% (construct validation) valid criteria, 98% (biology teacher response), and 81.5% (student responses) very practical criteria. The LKPD proved to be effective in achieving increased results (N-Gain) by achieving a high-class average score of 0.702. And it was concluded that the PBL-based LKPD that was made was valid, practical, and effectively applied in classroom learning activities
Keywords: *Excretory System; Problem-Based Learning; Student Worksheet.*

INTRODUCTION

Education is a tool to help students in dealing with technology and information in the era of globalization (Putri & Fitrayati, 2019). Learning in the 21st century is oriented towards the activity of guiding skills in learners using pointing to learning activities. Learning can be interpreted as a teacher's effort to put stimulus, guidance, direction & encouragement to students so that the learning process occurs (Mardhiyah et al., 2021). This is in line with the skills that must be possessed in the 21st century, namely creative thinking, critical thinking, communication, collaboration, and problem-solving, which are needed by students to support the development of education (Septikasari & Frasandy: 2018).

One of the problem-solving skills can be applied to the problem-based learning (PBL) learning model, which is a learning process toward understanding and solving problems in a real context (Barrows et al., 1980). The PBL learning model is designed to support learners in developing thinking skills, problem-solving, intellectual, understanding and learning real situations, and making independent learning (Arends, 2012).

Facts in the field say that students mostly use conventional learning models, where this learning model refers to lecture methods, discussions, questions and answers, demonstrations, exercises, and memorization (Maria Magdalena, 2018). This is in line with the results of the study by Bahri et al., (2018) which states that the factors that influence the low achievement problem-solving skills originate from the students themselves. Learners have difficulty understanding biology lessons because they consider the material difficult and have to remember many things and use scientific language that is difficult to understand. This makes students not motivated to be active during learning.

To support the learning process, educators can utilize learner worksheets (LKPD) containing the stages of completing a task to achieve clear competencies (Prastowo, 2012). LKPD has the advantage that it can assist teachers in guiding students' concept discovery through group and individual activities. LKPD can expand the process skills and scientific attitudes of students, and become a tool to facilitate the design of teacher and learner interactions. LKPD is designed to be interesting to increase interest in learning and make it easier for students to complete tasks (Mago et al., 2022).

Based on the results of observations and interviews with biology teachers at SMAS Mulia Medan, the LKPD used by students still uses the publisher's printed LKPD with specifications of multiple choice questions and essays as a form of LKPD. The type of LKPD worksheet that is often found is questions that are not in line with the character of students, and students are not motivated to learn and have a low understanding of learning concepts (Muslem & Rini, 2019:28-34).

The LKPD developed in the study is a PBL model that can increase students' problem-solving skills. Astuti et al., (2018) confirmed that the use of PBL- based LKPD can produce learning that focuses on students (student-centered) and teachers as facilitators who help students develop their cognitive, affective, and psychomotor aspects. One of the biology topics that require solutions is the excretory system, which

is the body system of organisms that plays a role in removing metabolic waste substances that are not needed by the body and regulating the concentration of salt and water in the body (Aji, 2017). In the interview results, students did not understand the excretory system material. The amount of teaching material delivered through books with a language style that tends to be abstract and uses many foreign terms that require them to memorize many things (Cahyaningtyas & Raharjo, 2017).

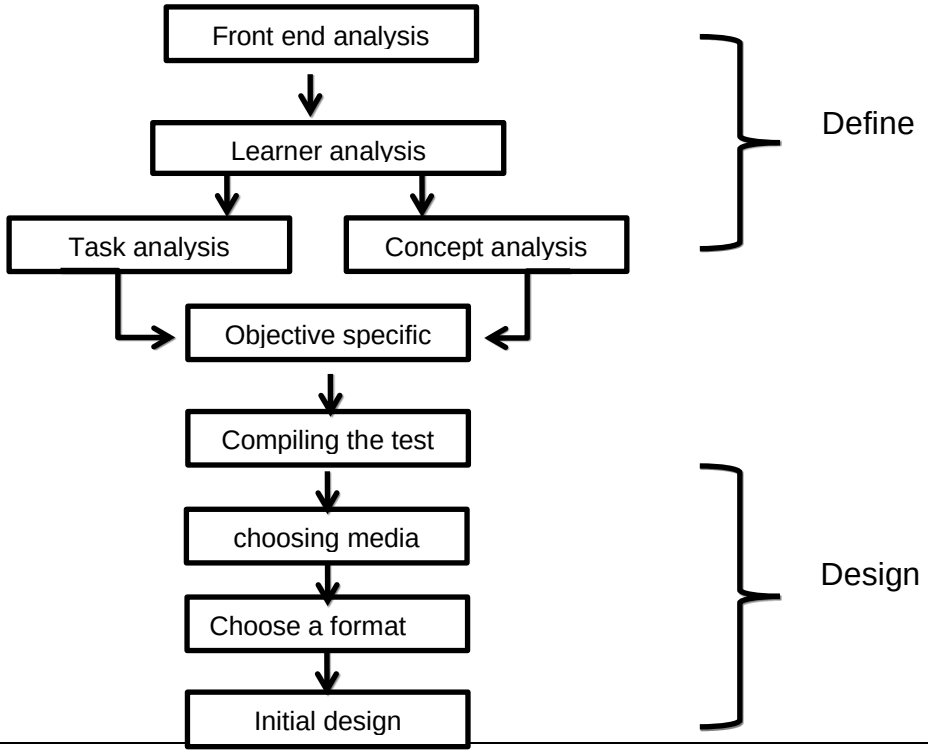
PBL-based LKPDs have been carried out in many other subject, including PBL based LKPDs in mathematics for class VII. (Abdillah & Astuti, 2021), chemistry subject for class X (Yuliandriati et al., 2019), and physics subjects for grade (Warti & Hurriyah, 2019). The PBL-based LKPD on biology material still covers the theme of viruses in class X SMA (Aida, Fariroh & Yustinus, 2015), the theme of ecology in class X SMA (Arimurti & Purnomo, 2018), and the theme of biodiversity class X SMA (Hsb & Lufri, 2021). So it is necessary to develop teaching materials, one of which is PBL-based LKPD to increase students' mastery in increasing students' interest in learning (Aini et al., 2019). This LKPD aims to produce a PBL-based LKPD that is valid, effective, and efficient.

METHOD

This type of research uses an R&D model with a 4D design (Thiagrajaran.S et al.,1974). The purpose of this research is the development of learning products that are valid, effective, and efficient. As well students of class XI MIA 2, and biology teachers of SMAS MULIA Medan, construct validators and content validators as the subject of this research. And the object of research is PBL-based LKPD products on excretory system material.

Research Procedure

In this research, the 4D model is:



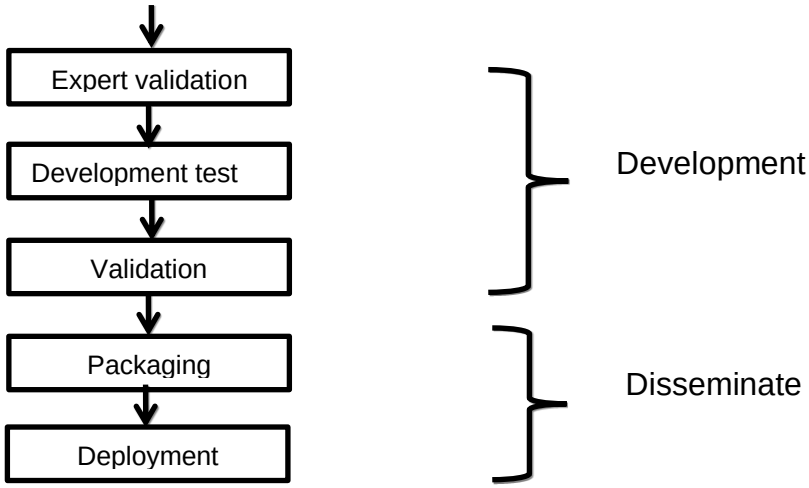


Figure 1. Model 4-D
(Source: Al - Tabany, T, I, 2017)

Research Instrument

This research instrument is in the form of a needs analysis sheet for students and teachers, interviews, and observations as information gathering related to biology learning in the classroom. Questionnaire sheet for the response of students and biology teachers related to the application of LKPD, and an expert validation sheet in the form of construct experts and content experts in assessing LKPD products developed in terms of feasible. The design validation stage is carried out to ensure the product is feasibility. The design validation stage is carried out to ensure the product is feasible to use for learning (Mardiani et al., 2020).

Quantitative Data Analysis

1) Feasibility Analysis

Use of data on the results of content validation and construct validation by each validator. Calculation of the validation results with the formula:

$$P=\sum FN \times 100\%$$

Source: (Akbar, 2013)

Description : P = Percentage
F = Number of values
N = maximum value

Table 1. Validity Criteria

No	Validity criteria	Validity level
1.	81-100	Very valid
2.	61-80	Valid
3.	41-60	less valid
4.	21-40	Invalid
5.	0-20	Very Invalid

(Source: Akbar, 2013)

2) Practicality Analysis

The practicality of LKPD is considered from the results of respondent teachers and students related to PBL-based LKPD learning of excretory system material, to see how practical LKPD is used by students and teachers. The percentage calculation is calculated by the formula:

$$\text{Practicality\%}=\frac{\text{total score for each question}}{number\ of\ respondents}\times 100\%$$

Source: (Irsalina & Dwiningsih, 2018)

Table 2. Criteria for Practicality by Learners and Teachers

Value sequence	Criteria
81% - 100%	Very feasible
61 % - 80 %	Worth
41 % - 60 %	Decent enough
21 % - 40 %	Less feasible
0% - 20 %	Very less feasible

(Source: Riduwan, 2012)

3) Effectiveness analysis

The effectiveness of LKPD products is assessed using a posttest and pretest, it is said to be practical if the posttest value is greater than the pretest value with effectiveness test data calculated using the formula:

$$\text{N-Gain}=\frac{\text{final test score}-\text{initial test scores}}{\text{max value}-\text{initial test scores}}\ X\ 100\%$$

Source: (Novita et al., 2019)

Table 3. Effectiveness Test of N-Gain Value

No	N-Gain Value	Interpretation
1	g> 0,7	High
2	0,7 ≤ g ≥ 0,3	Medium
3	G<0,3	Low

(Source: Novita et al., 2019)

RESULTS AND DISCUSSION

Define Stage

The first stage of LKPD development, namely define, consists of several stages, the initial analysis stage applies a questionnaire analyzing the needs of teachers and students, where the results of the teacher needs analysis questionnaire are the need for innovations in the learning process in the form of media, namely in the form of LKPD developed. The teacher needs analysis also confirms that there is a need for learning development based on problem-solving in the application of everyday life.

Questionnaire analysis of students found that learning is still conventional learning concerning the teacher. Students also do not understand the concept of problem-solving making them less active in learning activities. The learner analysis

stage is to analyze the academic abilities of students and teacher interviews from the results of the interview, namely the use of the 2013 curriculum in learning where the results of the completeness of learning outcomes are low and the learning methods carried out using conventional methods cause less active students in learning activities.

The define stage analyzes the concept and task analysis where in this stage determining the concept map of the excretory system itself by KI and KD 3.9 and 4.9 presents information on excretory system material which can then determine the stage of learning objectives of PBL-based LKPD, namely: 1. Learners can explain the organs that make up the excretory system. 2. Learners can analyze the functions of the organs that make up the excretory system. 3. Learners can analyze diseases/disorders of the organs that make up the excretory system. 4. Learners can conclude the results of the investigation regarding the problem of excretory system disorders.

Design Stage

Display design of PBL-based LKPD on excretory system material using the Canva application with an attractive design by PBL syntax. At the design stage also designed an effectiveness sheet consisting of a questionnaire sheet for teacher effectiveness and learner effectiveness, and post-test and pre-test grids to see the effectiveness of LKPD, PBL-based LKPD by PBL syntax supported by attractive colors and images.

Development Stage

At this stage, the LKPD will be validated by expert validators and revised. The function of product revision as a standard for expert assessment related to the LKPD developed, so that it can be tested (Destiara et al., 2021). The designed LKPD will be developed into valid, effective, and practical LKPDs based on revisions from validators.

Table 4. Content Validity Results

Aspects	Value obtained	Max value	Percentage	Criteria
LKPD organization	15	15	100%	Very Valid
Originality of concept	10	10	100%	Very Valid
Material similarity	10	10	100%	Very Valid
Content of the 2013 curriculum	5	5	100%	Very Valid
Implement the ability of the question	15	15	100%	Very Valid
Language is in line with the structure of learner development	20	20	100%	Very Valid
The material is presented clearly	10	10	100%	Very Valid
Problem-based learning approach	15	15	100%	Very Valid
Amount obtained	**100**			
Max number	**100**			
Percentage	**100%**			
Criteria	**Very valid**			

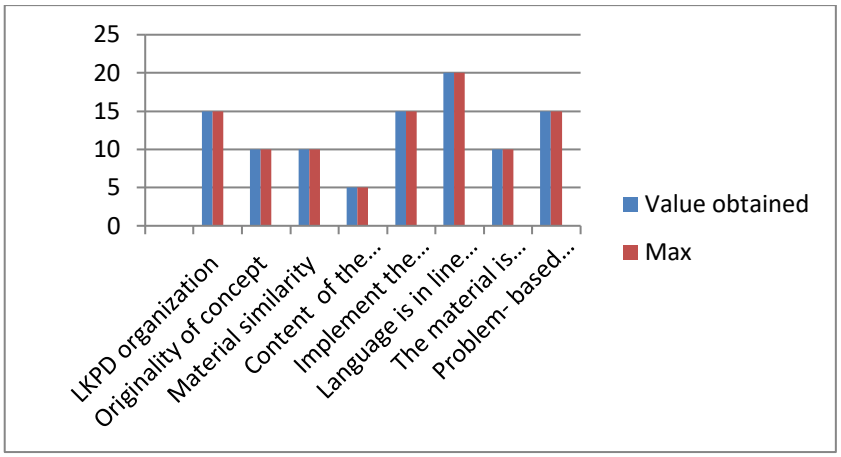


Figure 2. Content Validation

The content validator is Mrs. Febry Rahmadhani Hasibuan, M.Si with the number obtained 100 with a maximum number of 100 and a percentage of 100% '' very valid'' criteria, which means that the LKPD is very valid to be tested by students.

Table 5. Revised Results of Content Validity

Validator Feedback	Before Revision	After Revision
Separation of KI 1,2,3 and 4		
Giving topics in each learning activity and adding pictures and sources of discourse in the LKPD as well as improving the use of foreign language. Use of foreign language.		

Table 6. Construct Validity Results

Aspects	Value obtained	Max value	Percentage	Criteria
Font usage and writing	32	40	80%	Very Valid
LKPD has an attractive appearance	17	25	68%	Valid
Value obtained	**49**			
Max Value	**65**			
Percentage	**75%**			
Criteria	**Valid**			

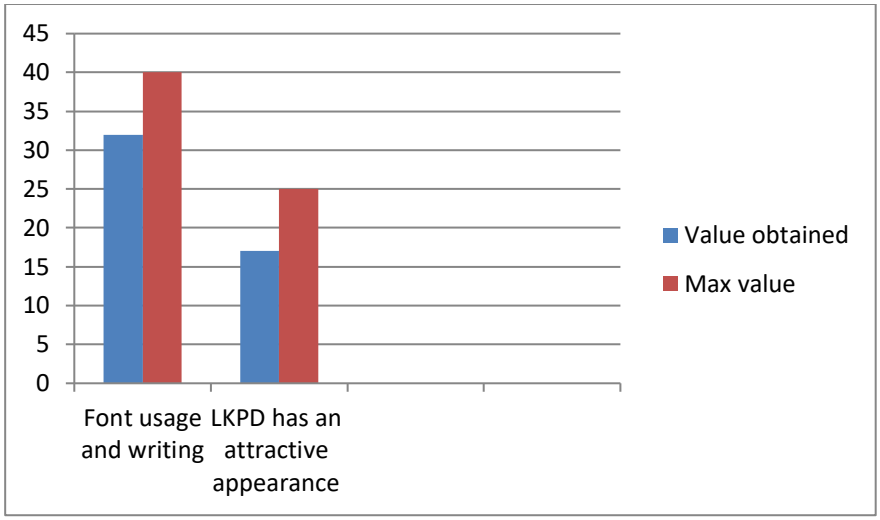
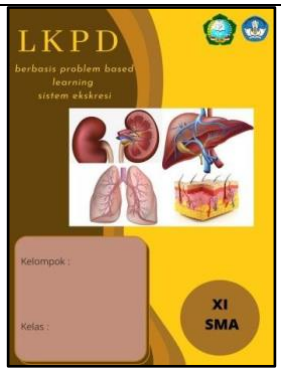
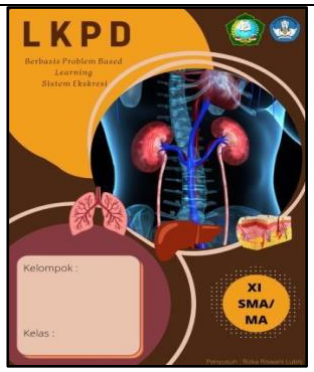
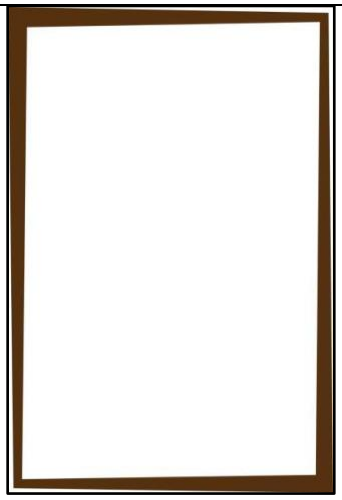
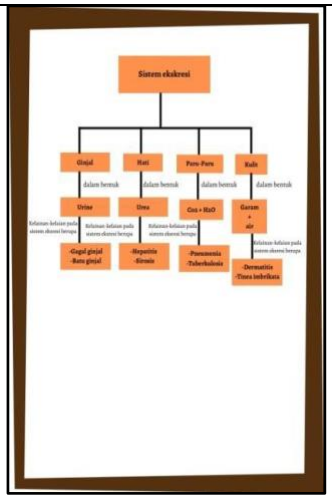
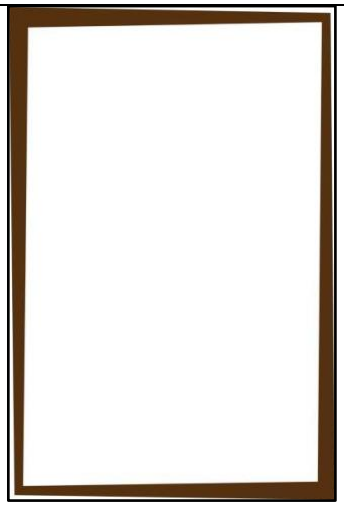
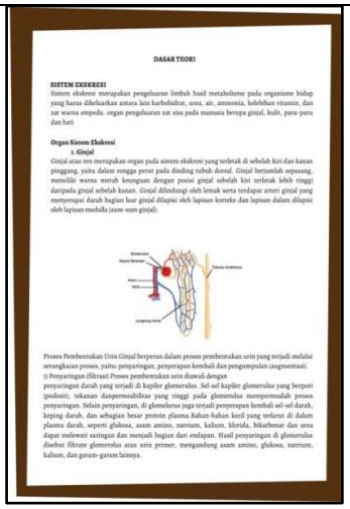


Figure 3. Construct Validation

The construct validator was Mrs. Miftahul Khairani, M.Pd. The overall number of scores obtained was 49 with a maximum score of 65 and a percentage of 75% ''valid'' criteria, which means that the LKPD is valid to test usefulness to students.

Table 7. Revised Results of Construct Validity

Validator feedback	Before Revision	After Revision
Revise the shape of the picture to make it look more attractive		

Validator feedback	Before Revision	After Revision
Unnecessary use of symbols in core competency and basic competency sheets		
Addition of concept maps		
Addition of excretory system material		

Validator feedback	Before Revision	After Revision
Removing unnecessary symbols and adding them with knowledge in the form of Did you know?		

Table 8. Teacher Practicality Test Score

Aspects	Value obtained	Percentage	Criteria
1 Biology teacher	98	98%	Very practical
Total number of value	100	100%	
Percentage	**98%**		
Criteria	**Very practical**		

Based on the results of the biology teacher's response, it is known that, in the practicality test for class XI teachers, the average score is 98 with a percentage of 98% with the criteria ''very practical''.

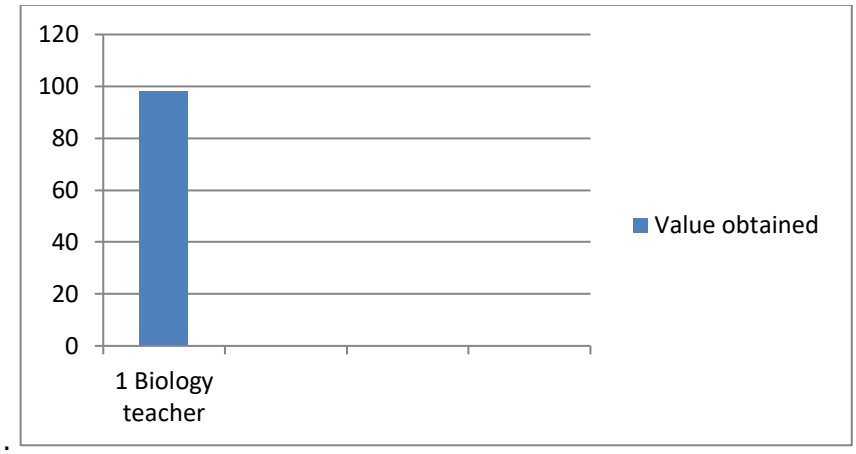


Figure 4. Teacher effectiveness test scores

Table 9. Practicality Test Score for Learners

Number of learners	15 students
Total average score	159
Total maximum score	195
Percentage	**81,5%**

Based on the results of the responses of 15 students of class XII-MIA 2 SMA Mulia Medan, it is known that, in the practicality test to students, the average score was 159 with a percentage of 81,5% with the criteria ‘’very feasible’’.

Effectiveness test data

The results of the effectiveness test through the average calculation of the N-Gain value obtained from the pretest and posttest scores.

Table 10. Effectiveness Test Value

Number of learners	**15 students**
Total number of values	10,54
Average N-Gain score	0,702
N-Gain classification	N-Gain ≥0,7 (tinggi)
Criteria	**Highly effective**

Based on the results of the posttest and pretest scores given to students, the overall average is 0.702 with a value of 10.54 classification of N-Gain values ≥ 0,7(high) criteria ‘’very effective’’

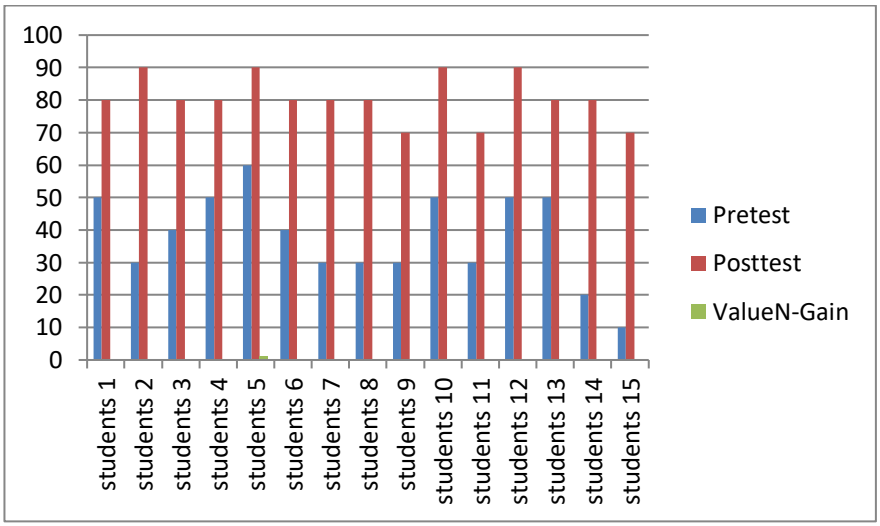


Figure 5. Effectiveness Test Scores

Disseminate Stage

The distribution was carried out on a small scale at SMAS Mulia Medan by distributing it to biology teachers and several students in class XI of SMAS IN MIA class. Some studies suggest that the PBL-based LKPD developed is valid to be implemented in the teaching and learning process to facilitate students’ authentic problem-solving skills (Wahyuni et al., 2020), and critical thinking ability affects students’ learning outcomes (Nurlaela et al., 2020). PBL-based LKPD is designed and designed with questions that can help students solve problems that are presented with

steps that students can use in solving problems (Astuti, 2021) to provide effective interaction between teachers and students, LKPDs that are easy to understand, use attractive colors, and motivate the student to learn (Sartika et al., 2020)

CONCLUSION AND RECOMMENDATION

This study presents teaching materials in the form of PBL-based LKPD using the 4-D research model with several stages namely define which has 5 steps in the form of front-end analysis, learner analysis, task analysis, concept analysis, and formulation of learning objectives, then continued with an attractive design by PBL syntax.

After being designed, the next development is to validate the appropriate LKPD validated by 2 lecturers for content validation and construct validation to see whether this LKPD can be tested, after being validated it will be revised according to the suggestions and input from the validator, the results of construct validation with a value of 49 percentage 75% very valid criteria, content validation with a value of 100 percentage 100% very valid criteria and can be tested.

Practicality from teachers on PBL-based LKPD with a value of 98 percent of 98% very practical criteria and students with an average value of 159 percent of 81.5% very feasible criteria. The effectiveness of PBL-based LKPD is 0.702 classification of N-Gain value ≥ 0.7 (high) very effective criteria. Disseminate on a small scale for biology teachers and some students of class XI SMAS Mulia Medan. This research can be done with more material applied to problem-Based Learning based LKPD.

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