

Development of problem based learning student worksheets on human digestive system materials to increase students learning outcome

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Article Information	Abstract
Keyword: Development research; Problem based learning; Student worksheets; Digestive system; Learning outcome Kata Kunci: Penelitian pengembangan; Pembelajaran berbasis masalah; Lembar kerja peserta didik; Sistem pencernaan; Hasil belajar History: Received : 31/05/2022 Accepted : 13/06/2022	The lack of learning media for biology material in high school, so it is necessary to develop a PBL-based student worksheet as a learning media. This research aims to develop PBL-based student worksheets that are appropriate, practical, and effective in improving student learning outcomes. This study uses the ADDIE model. Quantitative data analysis examines the level of feasibility, practicality, and effectiveness. Meanwhile, qualitative research can be obtained from observations, criticisms, comments, and suggestions. The student worksheet developed meets the valid criteria to be tested with revisions. The practicality of student worksheets also obtained very practical criteria according to the teacher I and practical criteria according to teacher II. The practicality of this student worksheet also got practical criteria for the responses of class XI IPA¹ students and was very practical on the responses of class XI IPA² students. The development of student worksheets is also said to be effective based on the completeness of the pre-test and post-test results of class XI IPA¹ and XI IPA² students, namely the high category. So these results can be concluded that the developed PBL-based student worksheet is declared valid, practical, and effective. These results also show PBL-based student worksheets can also improve student learning outcomes. Abstrak Minimnya media pembelajaran materi biologi di SMA, sehingga perlu pengembangan LKPD berbasis PBL sebagai media pembelajaran. Tujuan penelitian ini mengembangkan LKPD berbasis PBL yang tepat, praktis dan efektif untuk meningkatkan hasil belajar siswa. Penelitian ini menggunakan model ADDIE. Analisis data kuantitatif mengkaji tingkat kelayakan, kepraktisan, dan efektivitas. Sementara itu, analisis kualitatif dapat diperoleh dari pengamatan, kritik, komentar dan saran. Pengembangan LKPD memenuhi kriteria valid untuk diuji dengan revisi. Kepraktisan LKPD memperoleh kriteria sangat praktis menurut guru I dan kriteria praktis menurut guru II. Kepraktisan LKPD ini juga memperoleh kriteria praktis untuk respon siswa kelas XI IPA¹ dan sangat praktis untuk respon siswa kelas XI IPA². Pengembangan LKPD juga dikatakan efektif berdasarkan ketuntasan hasil pre-test dan post-test siswa kelas XI IPA¹ dan XI IPA² yaitu kategori tinggi. Sehingga hasil tersebut dapat disimpulkan bahwa LKPD berbasis PBL yang dikembangkan dinyatakan valid, praktis, dan efektif. Hasil ini juga menunjukkan LKPD berbasis PBL juga dapat meningkatkan hasil belajar siswa.

A. Introduction

Education is a process of improving, adjusting knowledge, skills, improving the behavior and attitudes of an individual or in groups in an effort to educate human life through learning. According to Pane & Dasopang (2017), the main thing is learning is a process in organizing the environment in order to motivate students to continue learning objectives.

Improving the quality of Biology education and process capability is a major factor in learning. The material for the human digestive system is important for students to learn because it is related to life. Another important thing in every learning activity is teaching media, which is given to students to help understand the learning material. According to Widyaningrum & Hindun (2020) learning materials are important in learning to determine the effectiveness of using quality teaching media and have an effect on learning, especially since most of the facts in the field show that the current biology learning process is mostly in the hands of educators. So we need a supporting teaching media, one of which is the student worksheet.

Student worksheet becomes a teaching medium that is able to direct students to work on a description of the information they learn through systematic learning activities (Fannie & Rohati, 2014). Student worksheet can be a guide for students in understanding concepts and skills related to the material they are studying (Astuti & Setiawan, 2013). According to Rahmatillah et al. (2017), that Student worksheet can improve the skills of the Biology learning process of students because it contains syntax in carrying out activities regarding Biology process skills so that later students can gain knowledge and skills that can be mastered by students. According to Haryani & Wardani (2018), Biology is a science that studies natural events, so there is a need for a student worksheets that is able to increase the learning activities of these students through several supporting activities in accordance with the Problem Based Learning (PBL) learning syntax.

Problem-based learning, namely the PBL model, is applied to encourage students to study in groups, solve real-world problems, and make students curious about learning so that they have their own learning model. The learning process using PBL requires learning to focus more on problem solving, group discussions, arguing, and prioritizing student achievement (Hirshfield & Koretsky, 2017).

In order to achieve learning using PBL, the learning process can be carried out by learning by

using small groups (Botty & Shahrill, 2015). Through learning in groups, able to bring up meaningful learning; innovate and develop creativity; and develop collaborative skills (Isrok'atun, 2018). According to Mudlofir & Evi (2016), The existence of a PBL-based students worksheet development can help students get a fun learning experience in solving problems and help students interact which will be able to increase students' independent learning activities.

Moreover, the material for the human digestive system in grade XI requires clear explanations so that students can understand the material more easily. The syntax of the PBL model consists of: "orienting students, organizing students to learn, guiding individual/group investigations, developing and presenting work, and analyzing and evaluating problem solving processes".

Regarding the results of observations, where the learning process at the school still uses textbooks from school only, educators have not used it is student worksheet as teaching materials to support the learning process, resulting in students not understanding the concept of the material presented, and students not being creative in developing their creativity if they do not use teaching materials in the form of student worksheet. So therefore, a student worksheet is very important to be used in Biology learning to create students' independence in the learning process and provide opportunities for students to develop their abilities in the problem solving process. Student worksheet is a sheet containing the syntax or stages in completing activities (Majid, 2012). Student worksheet must be adapted to the needs of students (Sugiyanto et al., 2018).

Previous research development student worksheet PBL based has also been done a lot. Judging from the research Novianti (2014), student worksheets PBL-based can improve Biology process skills, with an average student score of 87%. Furthermore, other research suggests Maryam et al. (2018) that PBL-based student worksheets can practice skills with valid overall criteria. Thus, research focuses on producing student worksheets based on PBL with the human digestive system sub-material in grade XI SMA. With the production of student worksheets through this research, it can later be useful for educators and students to be more active in reading books and facilitate understanding of the same learning material.

Based on this description, this study aims to develop PBL worksheets with sub-materials of the

human digestive system that have valid, practical, and effective characteristics, so that they are valid to develop and improve student learning outcomes in class XI SMA.

B. Material and Method

This type of research uses R&D research through the ADDIE model. The ADDIE model is a systematic learning design model that has five stages that must be passed in the development of a product, namely the analysis stage; design stage; development stage; implementation stage; and evaluation stage. The research was conducted in grade XI IPA¹ and XI IPA² in April 2022 at SMA Negeri 1 Kualuh Leidong. The research subjects were 60 students of grade XI IPA SMA.

The research instrument is the student worksheet assessment sheet including material validation sheets and media to measure the validity of the student worksheet. In addition, there is a student response questionnaire and a high school biology teacher's response, totalling two data obtained to measure the practicality of the student worksheet, and there is also a pre-test and post-test to see the effectiveness of the student worksheet.

Data analysis in the form of quantitative and qualitative. Quantitative data include the results of material and media validation, student and teacher respondents' questionnaires and test results of the effectiveness of the products that have been developed. Qualitative data obtained from criticism, suggestions from material experts and media expert validation sheet, student and educator respondent questionnaires were calculated using a Likert scale.

1. Feasibility analysis

Eligibility results are obtained from the results of validation by media and material validators. Later the validation sheet is calculated using the Formula 1 and interpreted to the assessment category in Table 1.

$$P = \frac{\text{the number of answers for each score}}{\text{item/s ideal score}} \times 100\% \dots \text{Formula 1}$$

Information:

P = Percentage score

Table 1 Eligibility criteria

Percentage	Criteria
81 - 100%	Very worth it
61 - 80%	Worthy
41 - 60%	Decent enough
21 - 40 %	Not valid
< 21 %	Very unworthy

(Source: Riduwan, 2009)

The results of the calculation of the validity or feasibility test are declared eligible if they have. The results obtained can reach the criteria of 61-80%.

2. Practical analysis

The analysis of practicality is seen from the questionnaire of Biology teacher respondents and the respondent's questionnaire from students. Student worksheet practicality tests can be calculated by Formula 2 and interpreted using the criteria in Table 2.

$$P = \frac{\sum X}{N} \times 100 \dots \text{Formula 2}$$

Information:

P = Score percentage

$\sum X$ = Total score obtained

N = Maximum score

Table 2 Worksheet practicality test criteria

Percentage	Criteria
85,01% - 100,00%	Very Practical
75,01% - 85,00%	Practical
60,01% - 75,00%	Practical enough
50,01% - 60,00%	Less Practical
<50,00%	Very Less Practical

(Source: Irsalina & Dwiningsih, 2018)

Student worksheet can be stated practically based on the results obtained from the questionnaire respondents Biology teachers and student questionnaires showed an average of 75.01%-85.00%.

3. Effectiveness analysis

The effectiveness results were determined based on the students' pre-test and post-test results. If the post-test result is greater than the pre-test result, the worksheet is declared valid. The increase in student learning outcomes using PBL-based student worksheets is measured by the N-Gain score. The N-Gain score was calculated using Formula 3 and interpreted using the criteria in Table 3.

$$N - \text{Gain} = \frac{\text{posttest scores} - \text{pretest scores}}{\text{maximum value} - \text{pretest score}} \dots \text{Formula 3}$$

Table 3 Effectiveness test criteria based on N-gain

Criteria	Information
N-Gain $\geq 0,7$	High
$0,7 > \text{N-Gain} \geq 0,3$	Medium
$0,3 > \text{N-Gain}$	Low

(Source: Solikhah, 2020)

Later on, the pre-test and post-test can be said to be effective if the assessment of the test is with the criteria of $0.7 > \text{N-Gain} 0.3$ (medium).

C. Results and Discussion

Based on the research resulted in a teaching media in the form of PBL-based student worksheets for grade XI students of SMA Negeri 1 Kualuh Leidong. Student worksheets developed based on the ADDIE design.

Analysis Stage

In the analysis stage, it was carried out at SMA Negeri 1 Kualuh Leidong. The analysis carried out includes analysis of student worksheet needs, material coverage, and analysis of the existing curriculum, based on the observation and interview processes that have been carried out.

Where, the class still uses school textbooks as the main reference source. According to Nasrullah et al., (2018), a student worksheet worth testing if it is based on the criteria in helping students to be active in learning. Later, the results of the research can develop teaching media in the form of student worksheets based on PBL sub-materials of the human digestive system (Muslim et al., 2018). Analysis of students aims to study the characteristics of students like ability, experience, skills and others (Ruslan, 2021).

This student analysis specifically analyses the needs of students regarding learning tools used in learning that can help students understand learning materials according to the curriculum used, so that researchers can develop learning tools, namely student worksheets that can be understood and help students understand the material provided. Concept analysis is carried out to find the main concepts that will be taught in detail and systematically. The result of this concept analysis is a concept map developed in the student worksheet.

Design Stage

Student worksheets developed according to the PBL syntax by including; problem orientation; organize students for learning, guide individual and group investigations, develop and present work, and analyze problem solving. The material content is also adapted to the Digestive System material. Furthermore, image and color illustrations are added to support the reader's interest in the PBL-based student worksheets. Student worksheets can be said to be good if they have an attractive

appearance, clear writing and pictures that support the reading interest of students (Figure 1).



Figure 1 PBL-based student worksheets cover

Development Stage

This development stage is the development of PBL-based student worksheets in the form of validation carried out by education experts. The development stage or the development stage of the researcher takes data from the feasibility, practicality and effectiveness of the teaching media used. At this stage, the aim is to make student worksheets according to the revised results of the expert validators. Student worksheets are designed to be developed into proper, effective, and practical student worksheets based on revisions from the validator. The validation of media experts is very worth it can be seen in Table 4, so that it enters the very valid criteria with a revision. The material expert validator is very worth it can be seen in Table 5, so that it enters the very valid criteria with a revision.

Table 4 Media expert validation results

Aspect	Score obtained	Score maximum	Percentage	Criteria
Student worksheets	48	60	80%	Worthy
Language eligibility	49	60	81,6%	Very worth it
Total	97	120	80.8%	Very worth it



Figure 2 Display of student worksheets before and after revisions

Figure 2 is a revision on the cover of the student worksheet from media experts. The purpose of this media expert cover revision is to make the appearance of the student worksheets attract the attention of readers. Revisions from

media experts in the form of 1) writing on the cover of student worksheets must be clearly, 2) less attractive pictures, 3) this worksheets should have been reduced more, and 4) add bio on cover.

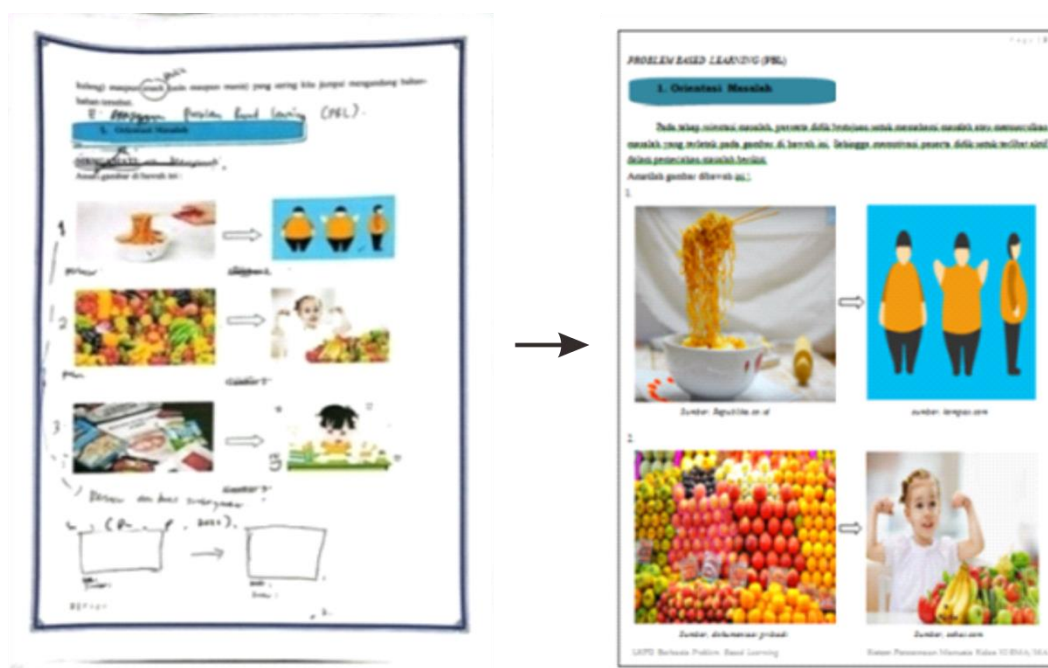


Figure 3 Syntax content displays in PBL student worksheets before and after revisions

Figure 3 is a revision to the PBL syntax that is less interesting to read, so there is a revision in the form of 1) In the student worksheets, include

the meaning of from PBL syntax, 2) please enlarge the size picture, and 3) cite the source of the image in the student worksheets.

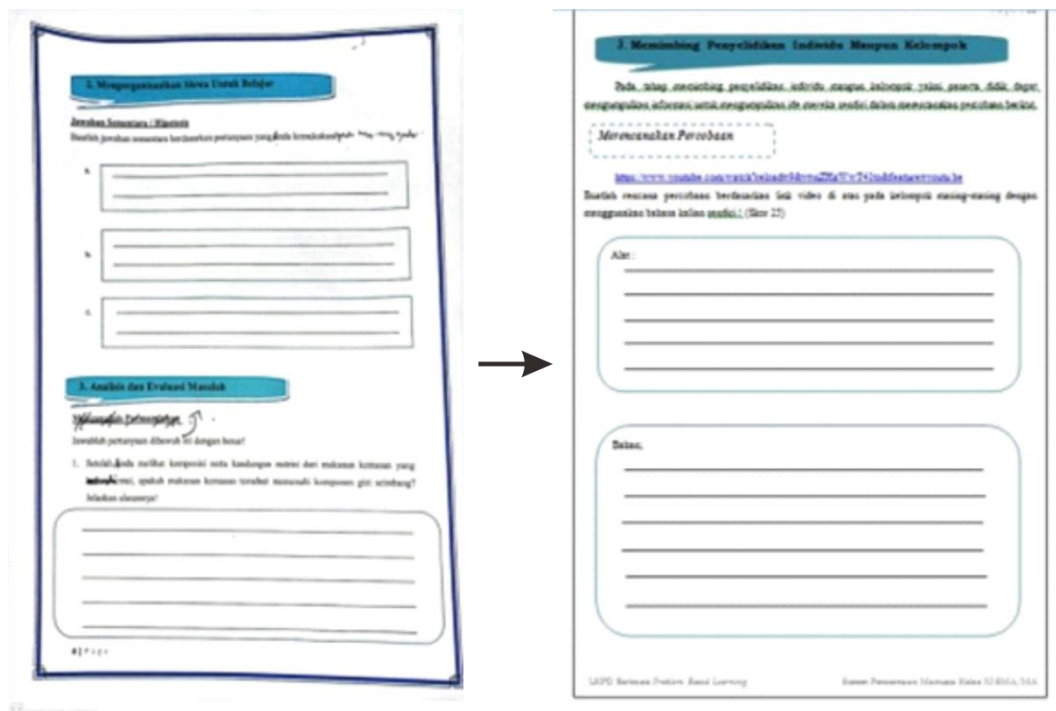


Figure 4 Before the revision and after the revision of the media expert on the questions in the student worksheets

Figure 4 there are the results of the revisions made by media experts include in the context of the content of the questions in the student worksheets,

where the revisions are in the form of 1) pay attention to the writing in the student worksheets, and 2) fix the questions according to stages PBL syntax.

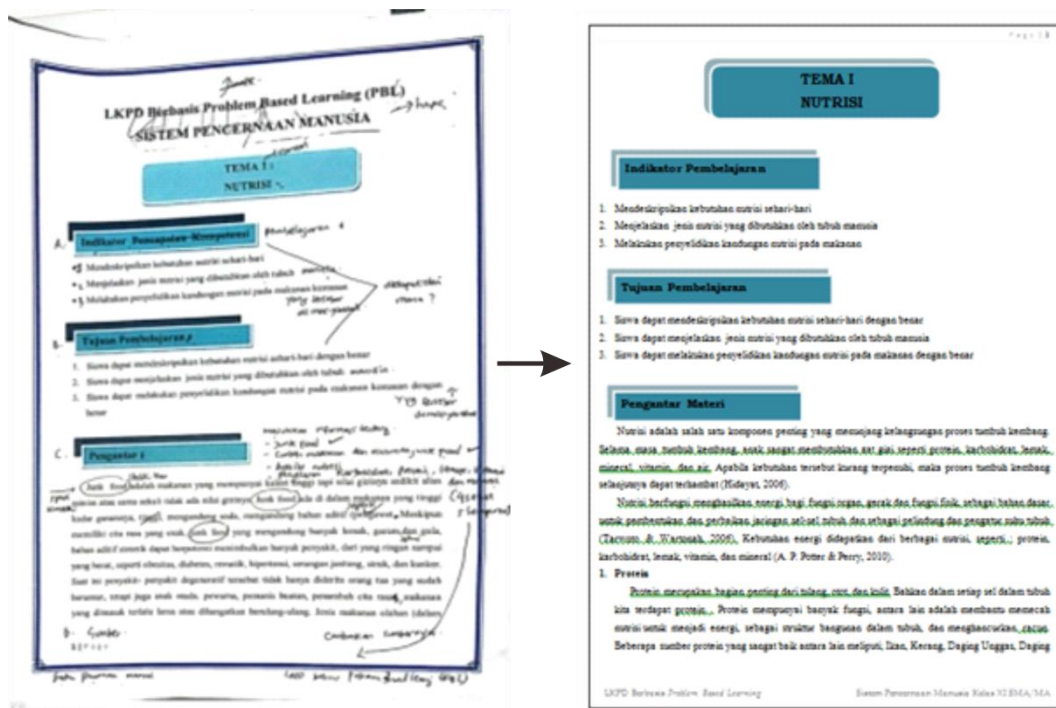


Figure 5 Before the revision and after the revision of the student worksheet from the material expert

Figure 5 is a revision of the material expert on the student worksheet in the coverage of the material content that is less widespread so that the revised

results are in the form of 1) expand the contents of the material in the digestive system, and 2) correct the words in the student worksheets.

Table 5 Material expert validation results

Aspect	Score obtained	Score maximum	Percentage	Criteria
Components of worksheet	24	25	96%	Very worth it
Worksheet learning materials	46	50	92%	Very worth it
PBL-based student worksheets	28	30	93,3%	Very worth it
Worksheet and requirement for active	14	15	93,3%	Very worth it
Worksheet and terms construction	15	15	100%	Very worth it
Worksheet and terms technical	35	35	100%	Very worth it
Total	162	170	95,3%	Very worth it

Table 6 Results of the biology teacher response questionnaire I

Aspect	Score obtained	Score maximum	Percentage	Criteria
Learning design	28	28	100%	Very Practical
Operations in worksheet visual	8	8	100%	Very Practical
Communication	20	20	100%	Very Practical
Total	56	56	100%	Very Practical

Table 7 Results of the biology teacher response questionnaire II

Aspect	Score obtained	Score maximum	Percentage	Criteria
Learning design	24	28	85,7%	Very Practical
Operations in worksheet visual	8	8	100%	Very Practical
Communication	20	20	100%	Very Practical
Total	52	56	92,9%	Very Practical

Table 8 Questionnaire results of student respondents

Class Students	Score obtained	Score maximum	Percentage	Criteria
XI IPA ¹ (30 student)	1481	1800	82,3%	Practical
XI IPA ² (30 student)	1566	1800	87,0%	Very Practical
Total	3047	3600	84,6%	Practical

From the results obtained on the response questionnaire sheet from the Biology teacher I obtained very practical results that can be seen in Table 6. The Biology teacher II obtained very practical results that can be seen in Table 7. As well as the response questionnaire sheet for grade XI IPA¹ students obtained practical criteria and XI IPA² results obtained very practical criteria, that can be seen in Table 8. The cumulative results of students in grade XI IPA¹ and XI IPA² are practical, so that the overall data acquisition shows the teacher's response and students are very positive with PBL-based student worksheets during the learning process.

The results of the student worksheet effectiveness test are known based on the pre-test and post-test test data of students in grade XI IPA¹ and XI IPA² based on the following Table 9. The acquisition of the average N-Gain score has increased with the results of the pre-test and post-test calculations with high criteria, from the data obtained it can be stated that learning using PBL-based student worksheets on the human digestive system material can improve student learning outcomes.

Table 9 N-Gain score results for grade XI IPA¹ and XI IPA²

Class Students	N-Gain	Criteria
XI IPA ¹ (30 student)	0,045	Low
XI IPA ² (30 student)	0,247	High
Total	0,292	
Average	0,146	
N-Gain Criteria	High	

So that it is obtained that the hypothesis from the results of developing PBL-based student worksheets on digestive system learning materials is said to be valid to be developed and can improve learning outcomes on PBL-based biology materials. The suitability of the research hypothesis test decision is because during learning students are accustomed to problems that are close to their lives so that students feel familiar with the existence of problems and students can find out the benefits of the material they are learning. This is in line with research, (Fitri, 2011) which states that giving problems can increase motivation to explore more information which can automatically develop students' thinking skills, especially the benefits of studying the material. Zaini et al. (2020) state that student worksheets designed to be problem-based

as an indicator of critical thinking skills can have a positive impact on learning outcomes.

Implementation Stage

The implementation stage is the stage for implementing PBL-based student worksheets that were developed to support the learning process. PBL-based student worksheets will be applied to grade XI students of SMA Negeri I Kualuh Leidong for the 2022/2023 academic year. The implementation of learning using PBL-based student worksheets is carried out offline.

The trial, which was conducted in April 2022, was conducted in five meetings. In this trial, the researcher acted as a teacher, while the Biology teacher in grade XI SMA acted as an observer. The learning process is done by the teacher giving student worksheets to all students in grade XI. In the learning process through working on existing student worksheets, students can follow the instructions for using the student worksheet as follows: 1) Read the following student worksheet carefully; 2) work on the questions on the student worksheet in the form of groups; 3) answer the question correctly; 4) use other supporting sources either from books or other references; 5) if you have trouble in understanding the material and questions, ask the teacher. After it finishes working on the student worksheet, each student is asked to provide the results of their work. Furthermore, students are asked to fill out a response questionnaire. Filling out the questionnaire aims to determine student responses and evaluation of student worksheets that have been used during the learning process. The results of the response questionnaire are used to determine the practical value of using the learning tools that have been developed.

The application of the PBL-based student worksheet has the aim of knowing the value of the feasibility, practicality and effectiveness of the PBL-based student worksheet. According to Setiawati (2017), the practicality of student worksheets has been obtained and it is easy for students to use.

Evaluation Stage

Based on the results of the test on the student worksheet that has been carried out it is valid, practical, and effective so that it is valid to be distributed to students in grade XIIPA¹ and XI IPA² as well as biology teachers at SMA Negeri 1 Kualuh Leidong. Distribution of worksheets to students where student worksheets are given to students in IPA¹ and XI IPA² in groups and one student worksheet each to the Biology teacher. This stage aims to see the practicality of student worksheets,

from the aspect of ease of use, time, and ease of interpretation. The test results on this distribution stated that the student worksheet as a whole was practical with very practical criteria. According to Magdalena et al. (2020), the learning process is a must for an educator in order to know the success or failure of students in the learning process. the impact of the success of the learning process is the increased ability of students and so on.

The assessment of the practicality of the student worksheets was also carried out by two biology teachers in class X IPA¹ and X IPA². From the results of the teacher's assessment, the student worksheets that had been applied as a whole were declared "very practical". At this stage, the biology teacher for science grade X and XI science 2 gave a very good assessment response. Therefore, it can be decided that this PBL-based student worksheet is valid to be applied in the learning process on the material of the digestive system.

D. Conclusion

The student worksheet developed meets the valid criteria to be tested with revisions. Student worksheets also obtained very practical criteria according to teacher I and practical criteria according to teacher II. This worksheet got practical criteria for the responses of class XI IPA¹ students and was very practical on the responses of class XI IPA² students. The development of student worksheets is also said to be effective based on the completeness of the pre-test and post-test results of class XI IPA¹ and XI IPA² students, namely the high category. So these results can be concluded that the developed PBL-based student worksheet is declared valid, practical, and effective. PBL-based student worksheets can also improve student learning outcomes.

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