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Development of HOTS-based LKPD on student learning outcomes in cell biology material at SMAN 2 Percut Sei Tuan

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Abstract

The Student Worksheet (LKPD) is a learning tool that teachers can use to increase the activities of students in the teaching and learning process. SMA Negeri 2 Percut Sei Tuan is one of the schools that has not used HOTS-based LKPD to improve student learning outcomes. This research produces a HOTS-based LKPD on cell material which aims to determine the feasibility of LKPD products, determine the practicality of LKPD products, and determine student learning outcomes. This study uses a 4D development model by Thiagarajan, Dorothy S. Semmel, and Melvyn I, Semmel with the stages of definition, design, development, and disseminate. The results of material expert validation obtained 93% results, and media expert validation got results of 80% with appropriate criteria so that LKPD was feasible to use. The results of practicality by teachers obtained results of 65.625%, and students got results of 76.16% with practical criteria, so LKPD were practically used as teaching materials. Student learning outcomes got results of 0.72 with very effective criteria, so LKPD is very effectively used to improve student learning outcomes. With the HOTS-based LKPD, teachers can help improve high-level thinking skills so that student learning outcomes are effective.

Abstrak

Lembar Kerja Siswa (LKPD) merupakan salah satu sarana pembelajaran yang dapat digunakan oleh guru dalam meningkatkan aktivitas siswa dalam proses belajar mengajar. SMA Negeri 2 Percut Sei Tuan merupakan salah satu sekolah yang belum menggunakan LKPD berbasis HOTS untuk meningkatkan hasil belajar siswa. Penelitian ini menghasilkan LKPD berbasis HOTS pada materi sel yang bertujuan untuk mengetahui kelayakan produk LKPD, mengetahui kepraktisan produk LKPD, dan mengetahui hasil belajar siswa. Penelitian ini menggunakan model pengembangan 4D oleh Thiagarajan, Dorothy S. Semmel, dan Melvyn I, Semmel dengan tahapan pendefinisian (define), perancangan (design), pengembangan (develop), dan penyebaran (disseminate). Hasil validasi ahli materi memperoleh hasil sebesar 93%, validasi ahli media memperoleh hasil sebesar 80% dengan kriteria sesuai sehingga LKPD layak digunakan. Hasil kepraktisan guru memperoleh hasil 65,625% dan siswa memperoleh hasil 76,16% dengan kriteria praktis sehingga LKPD praktis digunakan sebagai bahan ajar. Hasil belajar siswa diperoleh hasil sebesar 0,72 dengan kriteria sangat efektif sehingga LKPD sangat efektif digunakan untuk meningkatkan hasil belajar siswa. Dengan adanya LKPD berbasis HOTS, guru dapat membantu meningkatkan kemampuan berpikir tingkat tinggi sehingga hasil belajar siswa efektif.

A. Introduction

Education is one of the vehicles for forming quality individuals (Rofifah, 2020). Education is said to be superior if it can produce human resources that are useful, imaginative, innovative, and add to the quality of society and world civilization. The 2013 curriculum and KTSP focus on discoveries that empower HOTS. This learning trains students' abilities at higher levels, especially those related to basic thinking skills in obtaining various types of data to think imaginatively in dealing with conflicts involving the information they have and making choices in complex situations. The 2013 curriculum invites students to be better at learning exercises through perception, seeking clarification on pressing issues, thinking, and introducing what they get or know from the illustrations (Sari, 2019).

In addition to emphasizing information gathering and understanding, science learning also highlights the use, testing, assessment, deepening, and imagination, aiming that students can practice critical skills and use ideas in everyday life (Pristiyono et al., 2021). In addition, the changes in biology learning can be faced by students preventively using one of the developed teaching materials (Kusumaningrum et al., 2019).

Development is the basis for developing the resulting product. Research and development or Research and Development (R&D) is an important research activity to obtain information on needs for use (need assessment), followed by development activities to produce products and assess the effectiveness of these products. Research and development is widely used to develop teaching materials such as Student Worksheets (LKPD) (Sugiyono, 2013).

The LKPD is used to assist educators in preparing students' ability to find ideas through work steps and problems equipped with assessment strategies (Purwasi & Fitriyana, 2020). Using LKPD, teachers can improve students' educational training and provide educational experiences. LKPD contains practical instructions, experiments that users can do at home, material for discussion, practice questions, and all forms of instructions that can invite students to be active in the learning process (Noprinda & Soleh, 2019). The LKPD can also help students learn by hand at school because it contains concise material from various related book sources to make the educational experience more successful (Purwasi & Fitriyana, 2020).

Previously, the study of Nadifatinisa & Sari (2021) about developing a LKPD based on higher order thinking skills (HOTS) in learning science got validity and is easy to use for ecosystem material in elementary school. Purwasi & Fitriyana (2020) develop student HOTS-based LKPD which are valid, practical, and effective and can increase students' HOTS by a percentage of 86.7%. Afsari (2017) stated that developing high-level thinking student worksheets (LKPD) was effective in the learning process, with an average of 3.33. This previous research is necessary to develop HOTS-based LKPD on cell material.

Some concepts about HOTS need to be known first. First, HOTS were divided into four groups; critical thinking, directed, assertive reasoning, and imaginative reasoning. Second, HOTS based on the taxonomy of blocks is included at the three highest levels, namely analysis, synthesis, and evaluation (Ubaidillah, 2016). Third, HOTS makes students experience dynamic changes. Therefore, HOTS is fundamental for educating students (Fitria et al., 2020).

Based on the description above, the researcher conducted observations at the school and interviewed one of the biology teachers to learn about the learning process and the use of HOTS-based LKPD at SMA Negeri 2 Percut Sei Tuan, especially in cell biology lessons. The teacher said that the learning process was not optimum because, apart from learning, it still focused on listening to the teacher's explanations and discussing. Thus, students still have difficulty when facing HOTS problems such as analyzing, evaluating, and creating. Moreover, the use of HOTS-based LKPD teaching materials has never been implemented because schools only use books from the government.

Teachers are expected to innovate by using teaching materials that foster students' higher thinking skills, such as using HOTS-based LKPD to stimulate students' high-level reasoning abilities and reduce their thinking weaknesses (Khotimah & Sari, 2020). Therefore, researchers tried to develop HOTS-based worksheets that aim to develop student learning outcomes further, determine the feasibility level of HOTS-based LKPD, and determine the practicality of HOTS-based LKPD. This statement follows the assessment of Muslich (2010), especially LKPD has the capability to include the skills to be achieved, further develop learning outcomes, and assist educators in dealing with class. Therefore, developing HOTS-based LKPD that deserve to be surveyed in terms of content, language, and presentation is essential.

B. Material and Method

The subjects of this study were students of class XI totalling 20 students, with details of 14 female

students and six male students. This object is a HOTS-based LKPD on cell material.

The approach used in this research is quantitative research. Exploration information from the validator is to revise the item. Evaluation by material and media validators will determine the results obtained using a Likert scale which aims to see the level of feasibility or validity of products that have gone through the formula. First, determine the percentage of assessment with formula 1, and then calculate the average score of each aspect with formula 2.

$$P = \frac{\Sigma x}{\Sigma xi} \times 100\% \text{.....Formula 1}$$

Information:
P = Percentage
Σx = Number of respondents' answers
Σxi = Ideal quantity in items

$$\overline{X} = \frac{\Sigma x}{n} \text{.....Formula 2}$$

Information:
$\overline{X}$ = Average score
Σx = Score of each one
n = Number of raters

The assessment category of HOTS-based LKPD on cell material with validity criteria is in Table 1.

Table 1 Criteria Validity

No	Rating Score	Criteria
1	25% < score ≤ 43,75%	Very Less Worthy
2	43,75% < score ≤ 62,5%	Decent enough
3	62,5% < score ≤ 81,25%	Worthy
4	81,25% < score ≤ 100%	Very Worthy

(Source: Sugiyono, 2013)

Information from students and teaching response sheets determines the results obtained by using a meaningful schedule to assess the natural reactions of students and teachers to the demonstration material. From the calculation of the score, look for the response rate of all respondents with formula 3.

$$P = \frac{\Sigma x}{\Sigma xi} \times 100\% \text{.....Formula 3}$$

Information:
P = Percentage
Σx = Number of respondents' answers in one item
Σxi = Ideal quantity in items

The assessment category of HOTS-based LKPD on cell material practicality is in Table 2.

Table 2 Criteria Practicality

No	Rating Score	Criteria
1	21% - 40%	Very Less Practical
2	41% - 60%	Pretty Practical
3	61% - 80%	Practical
4	81% - 100%	Very Practical

(Source: Sugiyono, 2013)

Then, look for the N-gain value to determine the adequacy of student learning outcomes using HOTS-based LKPD obtained from pretest and posttest information using formula 4.

$$(g) = \frac{T2 - T1}{Sm - T1} \text{.....Formula 4}$$

Information:
g = Normalized gain
T1 = Pretest
T2 = Post test
Sm = Maximum score

So, the assessment category for the effectiveness of student learning outcomes on the HOTS-based LKPD is in Table 3.

Table 3 Effectiveness Criteria

No	N-gain range	Criteria
1	0,01 – 0,40	Very Less Effective
2	0,41 – 0,70	Effective
3	0,71 – 1,00	Very effective

(Source: Sugiyono, 2013)

C. Results and Discussion

The HOTS-based LKPD has been developed with a 4D model development research, completed exclusively up to the fourth stage, namely the definition stage, the design stage, the development stage and the dissemination stage.

1. Define Stage

a. Initial – Final Analysis

Observations and interviews determine the school's needs and learning process. Based on the results of the interviews, the teaching materials used were still in the form of printed books provided by the government and using the learning process still used questions that did not refer to HOTS-based questions. Hence, students had difficulties with questions requiring higher thinking skills.

According to Noprinda & Soleh (2019), the students' low high-level thinking ability is the lack of availability of test questions specifically designed to train higher-order thinking skills in solving questions that require reasoning, argumentation

and creativity in solving them. Therefore, there is a need for questions specifically designed to teach HOTS or high-level skills to train students in developing their thinking skills in solving questions that fall into the categories of analyzing, evaluating and creating.

b. Student Analysis

This stage is to find out what obstacles are experienced by students. Students expect different performance materials as far as appearances so that they are interested in understanding them. During the learning, students still tend to be passive in following the learning process and still depend on the teacher's explanations, so it is not following the 2013 education plan focused on student learning. According to Wulandari & Susanti (2019), people in the age range of 16-17 years in the formal operational stage can think abstractly, logically, and deductively-inductively. Likewise, the HOTS-based LKPD requirements, which refer to high-level thinking skills, are not yet available because they are still using LKPD from publishers whose contents are only material and multiple-choice questions and essays. When learning activities occur, it appears that students are less active and independent, still relying on teacher explanations, so they are not in harmony with the 2013 curriculum concept of learner-centred learning.

c. Task Analysis

The task analysis is to determine the substance of the material not regulated in Basic Competence (KD) and Main Competence (KI). This stage is the main task that students must master to achieve the specified skills. Under the 2013 education plan, educators expected to introduce students to the HOTS learning experience so that students prepared in their ability to reason and think where the markers that students must master include analyse (C4), evaluate (C5), and create (C6) which adapted to the KI and KD of cell materials.

d. Specifications Destination

The planned targets are obtained from KD and Competency Achievement Indicators (GPA). The motivation behind the plan is for the LKPD to be developed in accordance with the 2013 curriculum.

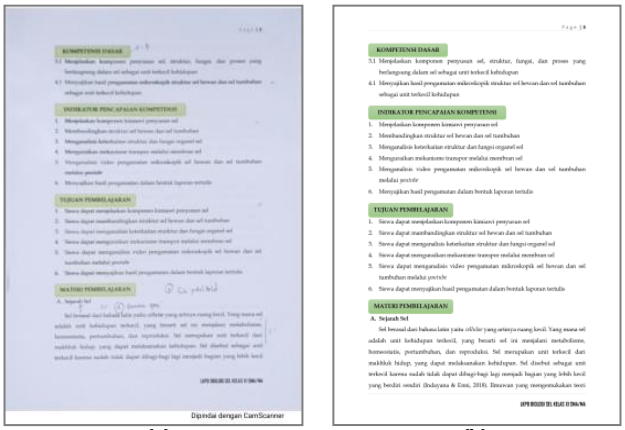
2. Design Stage

The HOTS-based LKPD includes the preparation of the developed LKPD framework, namely the front cover, LKPD identity, introduction, activity objectives, study instructions, activity sheets, and activity objectives. Cover design is an essential part of improving printed teaching materials, such as creating a cover sheet using Microsoft Word 2016. Therefore, there is a revision in the cover design and the LKPD cover design in Figure 1.

(a) (b)

Figure 1
Making the cover design of the HOTS-based LKPD.
Information: (a) before revision, and (b) after revision

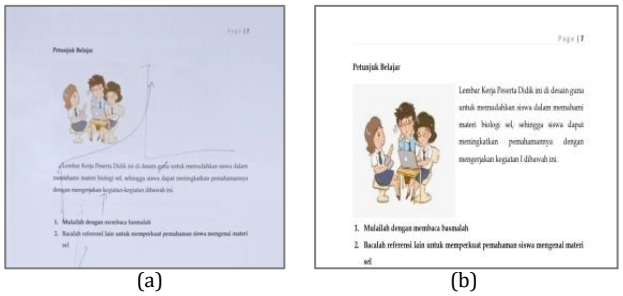
Then, making the LKPD identity and foreword. The LKPD identity contains the author's name, year of publication, LKPD size, layout, LKPD editor, author's email and institutional address. Next, the design of activity objectives. The activity objectives consist of basic competencies, competency achievement indicators, learning targets and materials. The action target plan should be shown in figure 2.



(a) (b)

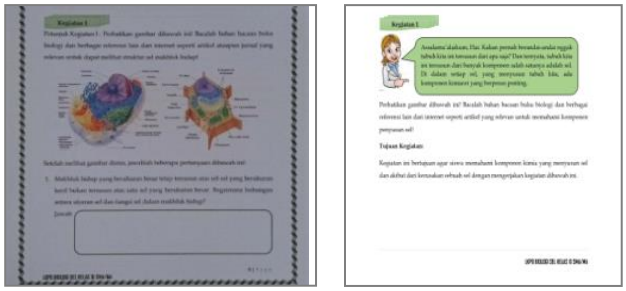
Figure 2
Design design activities. Information: (a) before revision, and (b) after revision

In addition, the LKPD is given a learning guide that is intended to make it easier for students to complete learning exercises within the specified time span. The configuration of the review guide should be shown in Figure 3.



(a) (b)

Figure 3
Making learning instructions. Information: (a) before revision, and (b) after revision



(a) (b)

Figure 4 Activitysheet creation. Information: (a) before revision, and (b) after revision

Furthermore, making activity sheets on HOTS-based LKPD. The activity sheet contains questions that students will work on in each activity. The activity sheet can be seen in Figure 4.

3. Development Stage

The development stage is assessed based on the results of the LKPD validation test. The LKPD validation test was assessed by two expert validator lecturers, namely the material expert validator and the media expert validator. The data on the results of the LKPD feasibility validation test can be seen in the table 4.

Based on Table 4, the consequences of material approval are 89 with a level of 93.68%, the aspect of learning objectives is 100% with very decent criteria, the material presentation section is 88% with very decent criteria, and part of the quality aspect of inspiration is 100% with very decent criteria.

Furthermore, making activity sheets on HOTS-based LKPD. The activity sheet contains questions that students will work on in each activity. The activity sheet can be seen in Figure 4.

Table 4 Material Expert Validation

Aspect	Rating Score		Criteria
	Number of Answers Prospector (Σx)	Amount of Ideal Value (Σxi)	
Learning Objectives	15	15	Very Worthy
Presentation of Materials	44	50	Very Worthy
Quality Motivation	30	30	Very Worthy
Amount	89	95	
Average Percentage	**93,68%**		
Description	**Very Worthy**		

(Source: Sugiyono, 2013)

Table 5 Media Expert Validation

Aspect	Rating Score		Criteria
	Number of Answers Prospector (Σx)	Amount of Ideal Value (Σxi)	
LKPD Size	8	10	Worth it
LKPD Cover Design	28	35	Worth it
LKPD Content Design	40	50	Worth it
Amount	76	95	
Average Percentage	**80%**		
Information	**Worth it**		

(Source: Sugiyono, 2013)

Based on Table 5, the results of media expert validation are obtained with a total of 76 with a percentage of 80%. The details of the validity of the LKPD size aspect are 80%, the cover design of the LKPD is 80%, and the content design is 80% with proper information.

Based on the results of calculations, the HOTS-based LKPD has been declared eligible because it has met the indicators of the National Education Standards Agency (BSNP). Although it has been declared feasible, the LKPD still has some improvements in accordance with the suggestions and comments of the validators (Putriyana et al., 2020). Some revisions from the validators were changing the LKPD cover image to make it more attractive, adding the 2013 curriculum logo and university logo, and changing the font size on the LKPD cover. This is in accordance with the opinion of Basri et al. (2019) which states that the Student Worksheet (LKPD) must be designed as attractive

as possible starting from the use of color, clarity, and attractiveness of images to make it easier for students to understand the contents of the LKPD. After the teaching materials were revised or repaired according to the suggestions and comments of the validators, the HOTS-based LKPD to improve student learning outcomes was declared feasible to be used in learning. According to Rusdi (2018) the LKPD developed is feasible and can be used in classroom learning, after undergoing a revision of the custom of improvement in accordance with the comments and suggestions of the validator.

4. **Disseminate Stage**

a. LKPD Practical Test

The data on the results of the LKPD practicality test were obtained through the distribution of response questionnaires given to 20 students and two biology teachers. The results of the practicality test of LKPD can be seen in Table 6 and Table 7.

Table 6 Teacher Response Questionnaire

Respondent	Rating Score		Criteria
	Score Earned (A)	Quantity Maximum (B)	
G1	21	65	Practical
G2	21	65	Practical
number	89	95	
Average Percentage	**65,625%**		
Information	**Practical**		

(Source: Sugiyono, 2013)

Description:
G = Teacher

Based on Table 6, the teacher response questionnaire results with a total score of 89 with a percentage of 65.625%. The details of the results of the response questionnaire scores from the two teachers in the field of biology studies, namely the G1 respondent by 65% with practical information and the G2 respondent by 65%. With practical description. So, it can be said that HOTS-based worksheets are practical to use.

Table 7 Questionnaire Responses of Students

Respondent	Rating Score		Criteria
	Score Earned (A)	Quantity Maximum (B)	
S1	50	60	Very Practical
S2	45	60	Practical
S3	42	60	Practical
S4	45	60	Practical
S5	48	60	Practical
S6	45	60	Practical
S7	46	60	Practical
S8	45	60	Practical
S9	45	60	Practical
S10	45	60	Practical
S11	45	60	Practical
S12	46	60	Practical
S13	32	60	Pretty Practical
S14	48	60	Practical
S15	48	60	Practical
S16	45	60	Practical
S17	51	60	Very Practical
S18	35	60	Pretty Practical
S19	51	60	Very Practical
S20	57	60	Very Practical
Amount	914	1200	
Average Percentage	**76,16%**		
Criteria	**Practical**		

(Source: Sugiyono, 2013)

Description:
S = Student

Table 7 shows the results of the student response questionnaires with a total score of 914 with a percentage of 76.16%. The assessment scores of 20 students include two respondents with 53% and 59% with quite practical criteria, one respondent with 70% with practical criteria, eight respondents with 75% practical criteria, two respondents with 77% practical criteria, three respondents with 80%, one respondent 83% with very practical criteria, two 85% of respondents with very practical criteria, and the highest score by one respondent of 95% with very practical criteria. So, the HOTS-based LKPD is practical. In line with the opinion of Nurhikmayati & Jatisunda (2019), the student's assessment of the developed teaching materials is good enough, and they concluded that the teaching materials are easy to use in the learning process. According to Rofifah

(2020), when there is consistency between the curriculum and the learning process, it is said that the respondents state that the learning device is easy to use in the learning shown.

b. Effectiveness Test

Effectiveness test is done with pretest and posttest values. The results of the effectiveness test can be seen in Table 8.

Table 8 Effectiveness Test (N-gain)

Respondent	Evaluation Score		Criteria
	Pre-test (T1)	Post-test (T2)	
S1	50	90	Very effective
S2	30	70	effective
S3	30	70	effective
S4	30	80	Very effective
S5	40	90	Very effective
S6	40	90	Very effective
S7	40	80	effective
S8	30	80	Very effective
S9	20	70	effective
S10	40	90	Very effective
S11	20	70	Very effective
S12	50	90	Very effective
S13	40	80	effective
S14	40	90	Very effective
S15	30	90	Very effective
S16	30	70	effective
S17	50	90	Very effective
S18	40	90	Very effective
S19	30	80	Very effective
S20	40	90	effective
Amount	720	1650	
Average	**0,72**		
Information	**Very effective**		

(Source: Sugiyono, 2013)

Based on Table 8, the effectiveness test results using the N-gain formula got a total pretest score of 722 and a total posttest score of 1640 with an average of 0.72 criteria of very effective. As for the effectiveness test results, seven students scored 0.41 - 0.70 with the Effective criteria, and 13 got a score of 0.71-1.00 with the very effective criteria. So, the HOTS-based LKPD is very effective for students to improve student learning outcomes in cell biology lessons. Using HOTS-based LKPD can improve student learning outcomes through questions that refer to high-level skills so that students can solve problems requiring high-level skills. In line with Nadifatinisa & Sari (2021), the use of HOTS-based LKPD makes students think high level, which includes critical and creative thinking so that they can see the problems they face critically and draw innovative solutions and get better results. Furthermore, using HOTS-based LKPD learning is more effective and systematic because the LKPD contains instructions for activities that students must do in learning activities. According to Aditama et al. (2019), through HOTS-based LKPD, students can think complexly in solving material, drawing conclusions, analyzing and building relationships by involving the most basic mental activities.

This HOTS-based LKPD is to assist teachers in the learning process so that it becomes a reference for teachers and schools to use LKPD in every learning to improve higher-order thinking abilities and skills so that education provides a meaningful learning experience. The advantages of this HOTS-based LKPD are not only in the form of materials and activities, but additional content can be obtained and connected directly by YouTube media to access the LKPD activities task. Therefore, the development of HOTS-based LKPD can be a solution to help improve student learning outcomes and education progress in Indonesia. Thus, this HOTS-based LKPD can be redeveloped not only on cell material but on other materials.

D. Conclusion

The results showed that HOTS-based LKPD had done with a 4D development model, namely the definition stage, the design stage, the development stage and the dissemination stage. The validation test of the validators obtained 93% at the level of material feasibility and 80% at the level of media feasibility. So that students can use the HOTS-based

LKPD cell material. The teacher's reaction to the LKPD has a typical side effect of 65.625% with common sense rules. Participants' responses to the LKPD made to have practical consequences of 76.16% with a reasonable size. So, HOTS-based LKPD cell material can use by students as teaching materials. The effectiveness test with N-gain scored 0.72 with very effective criteria. So, HOTS-based LKPD on cell material is very effectively used to improve student learning outcomes.

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