JPBIO (Jurnal Pendidikan Biologi)
Vol. 7, No. 2, November 2022, 167 – 176 //e-ISSN 2540-802X
http://jurnal.stkippersada.ac.id/jurnal/index.php/JBIO/index

Development of scientific-based student worksheets to improve science process skills through problem-based learning

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Article Info

Article History:
Received 18 June 2022
Revised 06 Agust 2022
Accepted 01 October 2022
Published 30 November 2022

Keywords:
Scientific Approach
Science Process Skills
Problem Based Learning

ABSTRACT

LKS is a product that can help achieve the desired learning objectives. This study aims to determine the feasibility and effectiveness of LKS with a scientific approach to the respiratory system material to improve students' science process skills in PBL learning in high school based on the results of expert validation, science process skills (KPS) tests and observations. The research method used in this research is (R&D) and experiment. The results of the feasibility test analysis based on the results of the validation of media, material and pedagogic aspects obtained a score was 83.5%. LKS effectiveness test results of the KPS difference test between the experimental class and the control class, the sig value was obtained. (2-tailed) 0.002 and the comparison of the test results for the increase (N-gain) of the experimental class KPS was 0.40 and the control class of 0.27 and based on these results from the comparison of the KPS observations the control class gets the value of 74% while the experimental class got a value was 96%, so it can be concluded that the LKS has a scientific approach very feasible and effective to use to improve students' science process skills in PBL learning.

Citation: Nurjanah, S., Alamsyah, M.R.N. & Pamungkas, S.J. (2022). Development of scientific-based student worksheets to improve science process skills through problem-based learning. *JPBIO (Jurnal Pendidikan Biologi), 7*(2), 167-176. DOI: https://doi.org/10.31932/jpbio.v7i2.1737

INTRODUCTION

The learning process in the 2013 curriculum for high school or equivalent is required to use a scientific approach. The ideal learning should be able to involve students actively. Likewise in the teaching and learning process with a scientific approach. The scientific approach (scientific approach) is a learning model that uses scientific principles which includes a series of data collection activities through observation, questioning, experimentation, processing information or data, then communicating it (Kemendikbud, 2013).

In the 21st century, learning biology is expected to not only equip students with knowledge, but also skills. Basic science process skills such as observing, classifying, measuring and using tools, making inferences, predicting, communicating, and using space and time relationships as well as integrated science process skills such as interpreting data, operational definitions, control variables,

making hypotheses and experimenting are required skills in 21st century skills (Turiman et al., 2012).

One of the materials studied in biology subjects is the human respiratory system. The material on the respiratory system contains concepts about natural phenomena related to daily life, such as processes that occur when breathing, organs that play a role in the respiratory system, respiratory mechanisms, and disorders of the respiratory system. In addition, this material is a material that is difficult to understand because it cannot be seen directly with the five senses of the eye. In research Romaisyah et al,. (2018) shows that the human respiratory system material includes material that is difficult for students to understand, especially on indicators of the human respiratory mechanism and the process of exchanging O2 and CO2 because this material requires memorization, uses a lot of foreign terms, and also includes abstract concepts that make students experience learning difficulties so that they do not achieve complete learning.

Material about the human respiratory system should be studied directly through experiments and observations of natural phenomena in everyday life so that students better understand a concept from the material. Munandar, et al (2019) stated that practical or experimental activities in biology learning are the right method to achieve learning objectives, especially on respiration material which is very important for students to understand. But in reality the implementation of biology learning in high school still emphasizes learning as a result, not a process. So that the ability of students' process skills is still very low. One of the efforts to improve students' science process skills is the Student Worksheet (LKS) which is oriented towards improving aspects of science process skills which can include an assessment of process skills.

Several studies have shown that worksheets can improve skills and can also attract students' interest in learning (Sari, et al. 2020). So that the existence of LKS in teaching and learning activities is very necessary to support learning activities and achieve complete learning. LKS is one component of the learning system that plays an important role in helping students achieve competency standards and basic competencies. All branches of science in learning really need teaching materials including Biology (True, A. 2020).

LKS cannot stand alone without the right approach and the learning model will not be implemented properly, because the learning model can help teachers carry out effective learning and make students active in learning. Dellu, (2016) states that the learning model is one of the most important parts in helping teachers carry out learning that can activate students.

One alternative learning model that provides opportunities for students to have science process skills is the Problem Based Learning (PBL) learning model. The success of this PBL model can be seen from the completion of various learning problems found in several studies, including research conducted by Novita, LD, et al (2014) regarding problem-based learning on process skills showing the results that there are significant differences. in science process skills between groups of students. the learning process is carried out using the PBL learning model and groups of students whose learning process is carried out using the conventional learning model.

Based on this background, the problem analysis and problem solutions offered by this study aim to develop scientific approach worksheets and see how the feasibility and effectiveness of scientific approach worksheets respiratory system to improve science process skills in PBL learning at SMA IT Ihsanul Fikri Mungkid.

RESEARCH METHODS

Research Design

This research uses mixed methods, namely using two methods in one research and development (R&D) and experiment. R&D Sugiyono (2015) was used to develop products in the form of LKS with a scientific approach to the respiratory system to improve science process skills in PBL learning in high school and to test the feasibility of the products developed, through 4-D

stages which were simplified into 3-D namely define, design, and develop. While the experimental method used in this research is Quasi Experimental Design. Experiments were conducted to test the effectiveness of the product developed based on the results of PPP testing and observations.

Population and Samples

This research was conducted at SMA IT Ihsanul Fikri Mungkid, with a population of 201 students of class XI MIPA. Sampling in this study used a purposive sampling technique referring to Arikunto (2012) who took a sample of 20-25% of the total population, besides that the sample selection technique was based on certain criteria, namely looking for samples with almost the same level of understanding of students' biology. The sample used in this study consisted of 2 classes, each class consisting of 30 students. Class XI MIPA 4 was used as the experimental class and class XI MIPA 5 was used as the control class.

Instruments

This study uses two instrument criteria, namely the development and implementation of experiments. The development instrument used a media expert assessment questionnaire, material expert, and pedagogic aspect expert. Each questionnaire was used to meet the eligibility criteria of the developed LKS. While the experimental implementation instrument is used to determine the effectiveness of the product that has been developed, namely: in the form of 25 multiple choice test questions that have been validated by 2 validators with 98.3% results with very valid criteria and also using an observation sheet that contains aspects of science process skills.

Procedures

The stages in this research are: (1) Observing the problems that occur in SMA IT Ihsanul Fikri Mungkid, the problem in this research is that there are no teaching materials that can support students' science process skills. (2) Finding and collecting research references related to the problem to be studied. (3) Developing the products of the LKS Scientific Approach which is oriented towards improving students' science process skills. (4) Validation of LKS products. (5) Product trials that have been validated on control and experimental class students. (6) Giving test questions and conducting KPS observations to obtain supporting data. (7) Analyze the research data that has been obtained so that conclusions can be drawn from the research conducted.

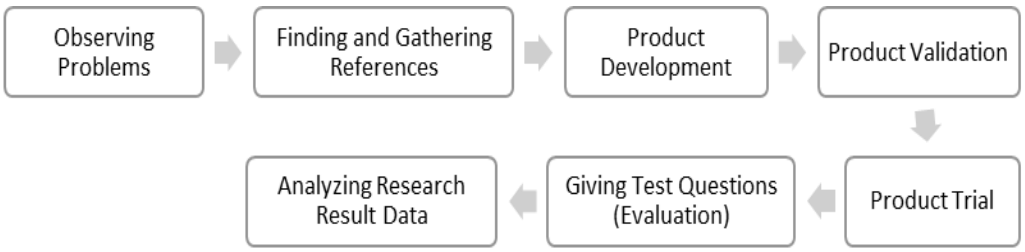


Figure 1. Research Procedure Diagram.

Data Analysis

The technique of analyzing the feasibility and effectiveness of the student worksheet data used in this study is a descriptive analysis technique. The feasibility of the worksheets was analyzed using a measurement scale, namely the Likert scale with a category range of 1-4, the scores obtained from the questionnaire were then converted to determine the percentage of eligibility, the percentage was determined by the following formula according to Arikunto (2012: 244):

$$Feasibility\ \% \frac{score\ obtained}{max\ score} \text{ X } 100\ \%$$

Data on the effectiveness of LKS were analyzed using KPS test results and observation. The test results are then tested using prerequisite tests, hypothesis testing and N-gain tests. While the results of the KPS observations were analyzed using a measurement scale, namely the Likert scale with a category range of 1 - 4, the scores obtained from the observation sheet on the ability of science process skills were then converted and analyzed by the following formula:

$$Score\ (\%) = \frac{\sum average\ score\ obtained}{\sum average\ max\ score} \text{X}100\%$$

To find the percentage of each student activity, the formula is also used (Trianto, 2011):

$$AP = \frac{\sum P}{\sum p} \text{ X } 100\ \%$$

Information:
AP = Percent of searched value
P = Number of students doing activities
p = Number of students

RESULT

The development of the scientific approach of LKS on the respiratory system before being tested was first validated to determine the feasibility of LKS based on the results of expert validation on media, material and pedagogic aspects. The results are as Table 1.

Table 1. Average Data Validation Results

No	Validation Assessment	Score obtained	Percentage	Category
1	Media Aspect	75	75%	Worthy
2	Material Aspect	82.7	82.7%	Very Worthy
3	Pedagogic Aspect	92.8	92.7%	Very Worthy
	Total score	250.5	83.5%	Very Worthy

The scientific approach of the respiratory system LKS after being validated was then tested on students to determine the effectiveness of the LKS as seen from the results of the independent sample test, N -gain test, and observation results. The results are as Table 2.
Independent sample test results:

Table 2. Initial KPS and Final KPS Independent Sample Test

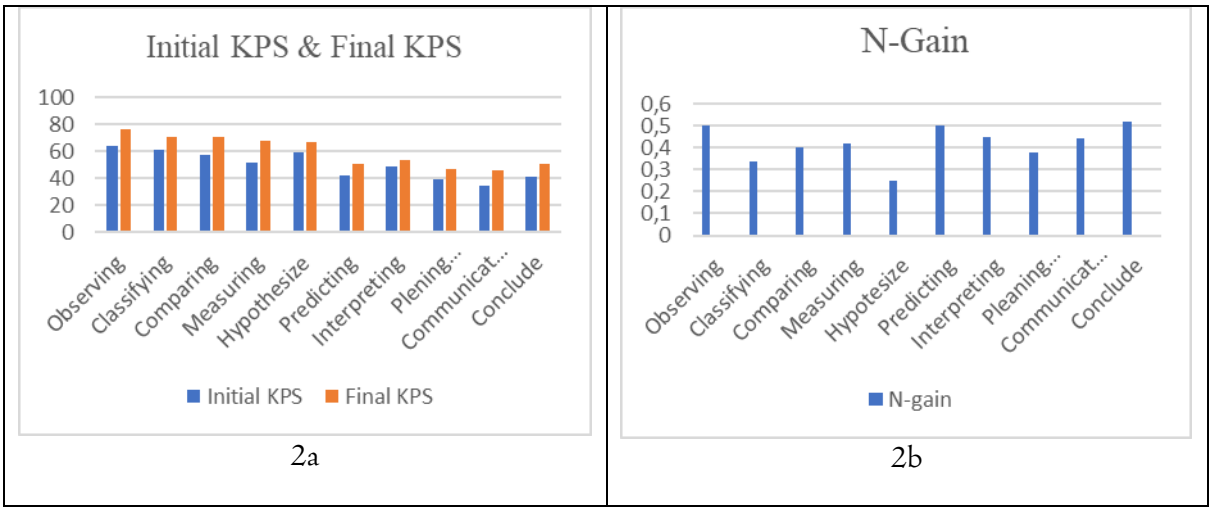
Data	Results	Signature. (2-tail)	Difference Means
Initial KPS Between Experiment Class and Control Class	Equal Variance Assumed	0.673	0.867
Final KPS Between Experiment Class and Control Class	Equal Variance Assumed	0.002	5,333

N gain test results:

Table 3. Result of N -gain Value for Experiment and Control Class

Class	Initial KPS Average	Final KPS Average	N-gain value	Category
Test	66.73	80.67	0.40	Currently
Control	65.87	75.33	0.27	Low

Improving the ability of science process skills based on the Early-Late KPS and the results of the N-gain test for each indicator can be seen in the following bar chart Figure 2a and Figure 2b.



2a 2b

Figure 2a Initial KPS and Final KPS Diagrams, and Figure 2b N-Gain.

The results of observing students' KPS activities are: the control class gets a score of 74% while the experimental class gets a score of 96%. The results are based on the overall calculation of each KPS aspect, namely: observing, comparing, classifying, making hypotheses, predicting, measuring, interpreting, concluding, interpreting experimental results and communicating.

DISCUSSION

The feasibility of the worksheets can be seen from the validation results, namely media aspects, material aspects and pedagogic aspects in learning. Based on the results obtained, the media aspect obtained a score of 75% with the "decent" category, the results of the assessment were based on the physical appearance of both an attractive cover, supporting images, writing and also good language. Sari, D.P, et al (2015) stated that the LKS assessment in terms of readability, have generally used EYD and compliant grammar have pictures/graphs/tables that the comparison corresponds to letter. The entire LKS have also used the type and easy-to-read font size use sentence structure effective, and LKS does not use ambiguous sentences. While in the aspect of attractiveness, in general, LKS has have a section layout that regular and coherent and the distance between the LKS share is proportional, using a variety of types and matching font size and part big worksheet appearance (picture and color) can attract attention students and increase motivation student learning.

The results of the material aspect validation assessment have a score percentage of 82.7% with the "very feasible" category, the results of the assessment are based on the assessment criteria including the breadth, depth and suitability of the material with KI and KD as well as the accuracy of the material with the examples provided, so it can be categorized as very worthy. Saidah, et al (2014) stated that the results of the material validity test can be achieved if the teaching materials have a relationship between the material with SK/KI and KD and the suitability between teaching materials and KD that must be mastered by students.

The results of the validation assessment of the overall pedagogic aspect obtained a percentage score of 92.8% with the "very feasible" category, the results of the assessment are based on approach learning activities scientific, instructional, student organization for learning and experimentation. orientation contained in the worksheet. The results of the validation of the pedagogic aspects of the LKS with a scientific approach that were developed were quite high compared to the value of the validation of materials and media. Overall, the expert's assessment got a score of 83.5% in the "very feasible" category, so it can be concluded that the LKS developed is very feasible to be used in learning.

Effectiveness of LKS Scientific Approach on KPS

The effectiveness of the LKS can be seen from the test results and also observations of the KPS while the results are as follows:

I. LKS Scientific Approach Based on Test Results

The test results were analyzed using 2 tests, namely hypothesis testing and N -gain test. The hypothesis test used the T test to determine the difference between the initial and final KPS between the experimental class and the control class. While the N-gain test is used to determine the increase in KPS between the experimental class and the control class.

Based on the results of the independent test of the sign value sample. (2-tailed) Initial KPS data 0.673 > 0.05 means that there is no difference in the data obtained. While in the Final KPS data the value of sig. (2-tailed) 0.002 < 0.05 means that the data obtained have a significant difference. This result is in line with Nahak's research (2020) which states that 0.001 < 0.05 means that there is a significant difference in the average value between the control class and the experimental class. So, it can be concluded from the data generated in this study that there are differences in the ability of science process skills between the experimental class that uses LKS and the control class that does not use LKS. Meanwhile, based on the results of the N-gain test for the experimental class, it was 0.42 in the medium category. While the control class got a value of 0.27 with a low category. These results indicate that the increase in students' KPS in the experimental class is greater than in the control class, so it can be concluded that the LKS with a scientific approach to the respiratory system to improve KPS is effectively used in learning.

The results of the N -gain value of the scientific process skill indicator in the observing aspect got a value of 0.50 in the medium category, the increase in the KPS indicator in observing was influenced by observation activities. This agrees with Riyadi (2014) which states that science process skills in observing aspects can be developed through observation activities in experiments and observing problems presented in learning.

The results of the N -gain indicator of grouping or classification get a value of 0.34 while the comparison indicator gets a value of 0.40. Both indicators are included in the medium category, it's just that the ability to compare skills is higher than the ability to classify skills. These indicators are supported by activities to identify, classify and compare data resulting from experiments or experiments. This agrees with Emda, (2017) which states that scientific process skills in the aspect of classifying or classifying can be developed through identifying and searching activities based on differences and similarities in the nature and characteristics of phenomena or objects.

The results of the measurement of the N-gain indicator obtained a value of 0.40 in the medium category. The previous student's ability to measure was still lacking, because students rarely did experiments so that students were often less thorough in measuring or calculating experimental data. This is in accordance with the statement of Karuniawan, (2012) in Evriani, E., et al. (2017) which states that the ability to measure is low because students are not used to doing experiments so that students lack knowledge in using practical tools which will result in students being less careful in reading measuring instruments.

The results of the N- skill gain indicator value is hypothesized to get a value of 0.25 in the

low category. As for predictive skills, students get a score of 0.50 in the medium category. These skill indicators are supported by problem solving activities presented in the LKS which require students to be able to hypothesize. This agrees with Lestari, et al (2015) which states that hypothesizing and predicting can be familiarized by giving questions that lead students to rethink, so that students are encouraged to find their own answers by formulating possible answers to each question which ultimately makes students hypothesize. and predict.

the N-gain indicator of interpreting skills obtained a value of 0.45 with a medium category, students' interpreting skills were developed through questions that led students to relate variables, find patterns or create graphs based on experimental results. This is supported by Karisman, et al (2019) which states that interpreting skills are very important and can be developed through activities that direct students to be able to connect variables, find patterns and conclude graphs with theories that have been given during teaching and learning. School activity.

-gain indicator value of experimental design skills got a score of 0.38 in the medium category, the ability of students to design experiments on the previous respiratory system material was less because students were not used to doing experimental activities or experiments. . This has an impact on increasing experimental design indicators, because after using the developed LKS which directs students to carry out experimental activities during the posttest the results are quite improved.

The results of the N -gain value of the communication skill indicator obtained a value of 0.44 in the medium category. The results of improving communication indicators are supported by the preparation of practicum reports and the submission of experimental results in practicum activities contained in the LKS. This is in accordance with Perkemendikbud Number 81 A of 2013, communication activities can be developed through the delivery of observations, conclusions based on the results of analysis both orally, in writing, and in the media. In line with this, Kurnianto, et al (2010) also argue that communication skills can be developed through reporting experimental results in the form of reports or essays.

The results of the N-gain indicator concluded that the score was 0.52 in the medium category. The ability of students to conclude the previous respiratory system material was still lacking so that at the time of the pretest the score of questions containing indicators concluded that the results were low. After learning the use of worksheets and practicum activities the increase in scores was quite significant. This improvement in the indicator of the ability to conclude is supported by the presentation of the question "let's analyze!" and also the conclusions made in the practicum report. This is supported by Kurnianto, et al (2010) which states that conclusion skills can be developed through the presentation of questions that lead to the conclusion of experimental results.

2. Effectiveness of Scientific Approach LKS Based on KPS Observation Results

Based on the results of the analysis of students' KPS activities during learning between the control and experimental classes, the control class got a score of 74% while the experimental class got a score of 96%, this shows that the experimental class was more enthusiastic. in learning activities, especially during practicum.

The enthusiasm of students in learning in the experimental class is due to the more structured learning activities systematically, students carry out learning activities according to the direction of the teacher with the help of LKS teaching materials developed. So that students understand the steps of learning activities that will be carried out, especially during practicum. This is in accordance with Bago's opinion, (2018) which states that the existence of LKS can affect the success of learning in the laboratory because it becomes a reference or guideline for students to carry out practical activities. The implementation of the practicum can develop a scientific attitude

that supports students' knowledge to gain more knowledge, not only theory but also experience and increase the ability of science process skills. This is supported by the opinion of Safahi, L., et al (2020) which states that the implementation of practicum can bring up science process skills such as observing, hypothesizing, predicting, experimenting, interpreting, communicating, and concluding skills.

Based on the results of the KPS test and KPS observations, it can be concluded that the existence of the LKS has a scientific approach effectively used to assist students in learning activities and to improve science process skills.

CONCLUSION

Based on the validation of the media, material, and pedagogic aspects with an average score of 83.5%, it can be concluded that the scientific approach worksheets are in the "very feasible" category to be used as teaching materials in PBL learning in high school. Meanwhile, based on the results of the KPS difference test between the experimental class and the control class, the sig value was obtained. (2-tailed) 0.002 and the comparison of the test results for the increase (N-gain) of the experimental class KPS of 0.42 and the control class of 0.27 where the experimental class is higher than the control class, and based on these results from the comparison of the KPS observations the control class gets a score of 74% while the experimental class got a score of 96%, it can be concluded that the LKS with a scientific approach is very effective in learning to improve students' science process skills. Researchers hope that the results of this study can improve the quality of learning by developing worksheets with a scientific approach in learning. In addition, this research can help further research on the development of scientific-appropriate worksheets to improve students' science process skills.

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