Development of Interactive e-Worksheet to Improve Science Process Skills of Junior High School Students

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Abstract: This study aims to develop interactive worksheet, describe the validity, practicality, and effectiveness of interactive worksheet by using liveworksheets to improve junior high school students' science process skills in the material of additives and addictive substances . The research method uses the 4-D development model. The subjects of this study were 66 students consisting of 32 students in class VIII A and 34 students in class VIII B at Gajah Mada Junior High School. The instruments used in this study were questionnaires and tests. Questionnaires are used to obtain validation data, test student responses and teacher responses while tests are used to measure effectiveness by collecting pre-test and post-test data. The results of this research and development indicate that the results of the validation of material and media experts obtained a percentage of 88% in the valid category. Practical interactive worksheets are used with a percentage of values with very practical criteria. This interactive worksheet is also effective for improving students' science process skill in the experimental class with an average N-Gain of 0.72 with a high classification and the effect size value is 0.94 with the big category.

Keywords: liveworksheet, interactive worksheet, science process skill, discovery learning

Abstrak: *Penelitian ini bertujuan untuk mengembangkan LKPD interaktif, mendeskripsikan validitas, kepraktisan, dan keefektifan LKPD interaktif dengan liveworksheet untuk meningkatkan keterampilan proses sains siswa SMP pada materi zat aditif dan zat adiktif. Metode penelitian menggunakan model pengembangan 4-D. Subjek penelitian ini ialah 66 siswa yang terdiri dari 32 siswa kelas VIII A dan 34 siswa kelas VIII B di SMP Gajah Mada Bandar Lampung. Instrumen yang digunakan dalam penelitian ini berupa lembar angket dan tes. Angket digunakan untuk mendapatkan data validasi, uji respon siswa dan respon guru sedangkan tes digunakan untuk mengukur efektivitas dengan mengumpulkan data pretes dan postes. Hasil penelitian dan pengembangan ini menunjukkan bahwa hasil validasi ahli materi dan media memperoleh persentase nilai 88% berada pada kategori valid. LKPD interaktif praktis digunakan dengan persentase nilai dengan kriteria sangat praktis. LKPD interaktif ini juga efektif untuk meningkatkan keterampilan proses sains siswa pada kelas eksperimen dengan rata-rata N-Gain 0,72 dengan klasifikasi tinggi dibandingkan dengan kelas kontrol dengan rata-rata N-Gain 0,54 dengan klasifikasi sedang.*

Kata kunci: *liveworksheets, lkpd interaktif, keterampilan proses sains, pembelajaran discovery*

▪ **INTRODUCTION**

Science process skills are an important component that students must master in learning science. In science process skills there are several skills that are trained including observing, measuring, concluding, predicting, classifying, and communicating skills. By training science process skills, learning will be more meaningful because students will better understand the concept of learning science (Berland et al., 2016; Zydney & Warner, 2016; Zeidan & Jayosi, 2015). Science process skills have several advantages, namely being able to provide scientific stimulation, so students can

understand facts and science concepts better (Darmaji et al., 2019; Duda et al., 2019; Serevina et al., 2018). Provide opportunities for students to work with science, not just tell or listen to stories about science. This causes students to become more active. Science process skills make students learn both scientific processes and products. Science Process Skills in science learning emphasizes the formation of skills to acquire knowledge and communicate the results. Science process skills are intended to develop the abilities possessed by students. According to Funk (1985) contains a review of the science process skills approach taken from the following opinions: (a) the science process skills approach can develop the nature of student knowledge. Students are motivated to acquire knowledge well because they better understand the facts and concepts of science; (b) learning through science process skills will provide opportunities for students to work with science, not just telling, and or listening to the history of science; (c) science process skills can be used by students to learn processes and at the same time products of science. The application of a science process skills learning approach allows students to develop abilities that are basically already possessed by students. This is supported by the opinion of Arikunto (2004), a process skill based approach is an insight or model for the development of intellectual, social and physical skills originating from fundamental abilities which in principle these intellectual skills are already possessed by students.

According to 2018 PISA results, Indonesia is ranked 72 out of 77 PISA participating countries with a science score of 396 and an average science score of 489 (OECD, 2019). Based on this explanation, it can be seen that students' scientific abilities in Indonesia are still very low. Low PISA results imply concerns about the ability of Indonesia's young generation to compete in the future, even competitiveness with other Southeast Asian countries (Nopilda & Kristiawan 2018). According to Marshall et al., (2017) the low level of science learning is due to the fact that the benchmark for the success of education in schools is still focused on the concept aspect. This is supported by the results of the preliminary study, which showed that as many as 68% of students had difficulty understanding the material because they were not yet independent in learning and looking for additional information. In addition, students' low science process skills are caused by the ability of students who are only limited to remembering and recognizing scientific knowledge, without linking science topics to everyday life. Thus the teacher must prepare learning with appropriate media and learning resources in learning activities (Churiyah et al.,2020; Dhaki et al.,2020). Learning media is an intermediary that makes it easier for educators to convey material to students, learning can be achieved according to learning objectives (Williamson et al., 2020; Hew et al., 2019). One of the learning media is student worksheets.

Worksheet which is integrated with science process skills will help students improve cognitive understanding and students' science process skills (Marzuki, 2019; Af'idayani et al., 2018). Worksheet is one of the learning resources that can be developed by the teacher as a facilitator in learning activities (Romli & Riyadi; 2018). Worksheet can improve students' skills through interaction between students and students as well as with teachers. Worksheet can increase student motivation in learning as well as help student effectiveness in learning (Ismail et al.,2021). One platform that can be used to convert conventional worksheet into electronic is liveworksheets.

Liveworksheets is a web-based platform that can convert conventional worksheet into electronic by utilizing new technology that is implemented in the world of education because it can produce sound, display videos and even produce voice messages (Avalos Valverde, 2022). Interactive worksheets with liveworksheets are very useful in improving students' Information and Communication Technology (ICT) skills, fostering an independent attitude, curiosity and discipline (Lawrence & Tar, 2018). In addition, worksheets using liveworksheets are also useful for improving students' science process skills because they practice science skills such as observing, measuring, conclude, predict, classify, and communicate with attractive and interactive displays and designs so that students are more enthusiastic and interested in participating in learning. Worksheet using a liveworksheet is very easy to make, the teacher only needs to enter the design and format of the questions that have been made in pdf form then the answer keys can also be directly entered in the application so that after students have finished working, grades can appear immediately without having to correct one by one. Furthermore, according to Prabjandee (2023) liveworksheets is a free website which is an interactive online learning medium by converting printed worksheets into online worksheets. In addition, student worksheet answers that have been worked on by students will be sent to the teacher's account and email that was previously registered, then the student's grades will be automatically processed by the system. This provides an advantage for the teacher, where the teacher does not need to manually correct the answers from students. In addition to learning media, an appropriate and varied learning model is also needed so that students will play an active role and achieve the expected results.

Discovery Learning model is a model for developing active student ways of learning by discovering themselves, investigating on their own, so the results obtained will be long lasting in memory, students will not easily forget. Discovery learning is an effective learning where students are active and the teacher plays a role in directing students to form a concept, principle, generalization or theory that can be obtained (Druckman & Ebner, 2018). The steps or stages and procedures for implementing discovery learning are as follows: (1) Stimulation, namely starting the teaching and learning process by asking questions, encouraging reading books, and other learning activities that lead to preparation for problem solving; (2) Problem statement/identification, namely giving students the opportunity to identify as many problems as possible that are relevant to the subject matter, then one of them is selected and formulated in the form of a hypothesis (temporary answer to the problem question); (3) Data collection, namely providing opportunities for students to collect as much relevant information as possible to prove whether or not the hypothesis is true; (4) Data processing (data processing), namely processing data and information that has been obtained by students through interviews, observations, and so on, then interpreted; (5) Verification, namely carrying out a careful examination to prove whether or not the hypothesis set earlier is related to the results of data processing; (6) Generalization, namely drawing a conclusion that can be used as a general principle and applies to all the same events or problems, taking into account the verification results. Based on the problems that have been described, the researcher is interested in conducting research entitled "Development of worksheets with liveworksheets based on the Discovery Learning model on additives and addictive substances to improve science process skills"

▪ **METHOD**

Participants

Population in this study were 8th grade students of SMP Gajah Mada Bandar lampung for the 2022/2023 academic year, totaling 122 students and spread over 4 classes. All students are a single population unit because of the similarity in academic abilities. This is due to SMP Gajah Mada Bandar Lampung, the distribution of students in each class in grade 8 is heterogeneous, so that the proportion of the number of students who have high, moderate or poor academic abilities in each class is almost the same between one class and the other. Sampling was carried out using a purposive sampling technique, namely a sampling technique based on consideration of students' initial cognitive abilities which were relatively the same. In this study, class 8A was selected as the experimental class and class 8B was selected as the control class

Research Design and Procedures

The research design used in this study is research and development with the 4D model, namely Define, Design, Develop, Disseminate. The development of this model is based on the instructional development by Twelker, Urbach, and Buck (Thiagarajan et al., 1974). Student worksheets are designed by determining learning objectives, and the steps in learning are in accordance with discovery learning model. Next, develop student worksheets according to the designs that have been made. After the product was finished, it was then validated by 2 experts and the responses of 3 science teachers. The next stage is applying student worksheets in class 8 SMP Gajah Mada. The last stage is evaluating learning outcomes in order to determine the effectiveness of student worksheets. The effectiveness of student worksheets can be seen from the value of n-gain and effect size. The research period was conducted for approximately 2 months.

Instrument

In the preliminary study, instruments were used in the form of a teacher needs questionnaire and a student needs questionnaire to find information about the learning media used and science process skills. Product validation was used as an instrument in the form of a content and construction conformity validation questionnaire. Each instrument has a suggestion column so that the validator can write suggestions for product improvement. The questionnaire instrument for student and teacher responses was in the form of statements to assess the attractiveness and readability of liveworksheet interactive worksheets that were tested during product trials. In the Product Effectiveness Test, used include pretest and posttest in the form of essay questions. The data obtained from this test aims to determine the effectiveness of the developed interactive liveworksheet in improving science process skills.

Data Analysis

In the preliminary study stage, an analysis was carried out on a questionnaire analyzing the needs of teachers and students which were described in the form of percentages, then analyzed or interpreted qualitatively and descriptively. In the product effectiveness testing stage, what was carried out was the analysis normality test using the One Sample Kolmogrov-Smirnov Test. Then homogeneity test, two paired samples test using paired sample t test and effect size test according to Jahjuoh (2014). In the product validity section, steps taken are:

1. Coding and classifying data, this aims to group answers based on questionnaire statements. To simplify this process, a table was created containing the statements and answer codes for each statement in the questionnaire.
2. Tabulating data based on the classification that has been made, this aims to provide an overview of the frequency and trend of the answers to each statement in the questionnaire and the number of samples that filled out the questionnaire.
3. Giving score answers from the sample. In scoring answers from the sample is done by using a Likert scale. On a Likert scale, the answers contained in the instrument items had a gradation from very positive to very negative. The scoring of the answers from the sample in the questionnaire was carried out using a Likert scale
4. Calculating the percentage of answers for each statement in the questionnaire Make an interpretation based on the percentage of the questionnaire.

▪ **RESULT AND DISSCUSSION**

The results of this study focused on the development of teaching materials in the form of liveworksheet-based interactive worksheets on additives and addictive substances to improve students' science process skills. This worksheet was designed using Canva for Education and Microsoft Word and then integrated into the liveworksheet. The results show that there are 8 worksheet pages containing covers, prefaces, instructions for using the worksheet, worksheet identity, student identity, and author profile. Figure 1 shows the results of product development made using a liveworksheet.

Figure 1. Product development results using liveworksheet

Product development results have been validated by content experts and construction experts. This assessment from experts or validity aims to determine the quality of a learning media (Hanafi et al., 2020; Duckworth & Yeager, 2015). Based on the validation results, product development obtains valid criteria. In other words, this e-worksheet is categorized as suitable for use with improvements. These results were obtained from several aspects of the assessment, including the quality of the content, the accuracy of the material, the currentness of the material and the questions. Suggestions or input in the material validation process by experts, in order to improve the e-worksheet product so that later it is expected that the resulting e-worksheet is suitable

for use and makes students interested in using this e-worksheet. The input and suggestions given by material experts are adding science process skills indicators to the data processing section. According to Lawrence & Tar (2018) content validity aims to determine the relevance of learning media to learning materials. Then the advice given by the construction validator ohle is to reduce the animated images on the cover, making one worksheet link in one product. This is in line with Suryawati & Osman's opinion (2017) that appearance is considered important because the first thing that attracts students' interest is the appearance of the worksheet, not the content. Based on the results of expert validation both content and construction, an average score is obtained with the validitas category. It is stated that. The developed worksheet can be used by students and teachers as learning materials in class or wherever they are independently.

Furthermore, the teacher's response was assessed from three aspects, namely the content aspect, the construction aspect, and the readability aspect. The results of the teacher's response to the content aspect obtained a score of 80% with very high criteria. In this aspect, the three teachers did not provide any feedback/suggestions, so it can be said that liveworksheet-based interactive worksheets are used to improve science process skills according to Basic Competencies and Learning Materials. Then on the construction aspect, it obtained a score of 88% with very high criteria. In this aspect, the three teachers did not provide any feedback/suggestions, so it can be said that liveworksheet-based interactive worksheets to improve science process skills have a good construction. Furthermore, on the readability aspect, it obtained a score of 89% with very high criteria. In this aspect, the three teachers did not provide any feedback/suggestions, so it can be said that the liveworksheet-based interactive worksheet to improve the developed science process skills has good readability.

Then the student responses were reviewed from several aspects, namely attractiveness and readability of the use of the e-worksheet. Collecting student response data using a questionnaire given to 30 students. Students' responses were assessed from two aspects, namely aspects of attractiveness and readability. The results of students' responses to the attractiveness aspect obtained a score of 89.64% with very high criteria. In this aspect, all students did not provide any feedback/suggestions, so it can be said that the liveworksheet-based interactive worksheet to improve the developed science process skills has good appeal. Furthermore, the readability aspect obtained a score of 88.42% with very high criteria. In this aspect, all students did not provide any feedback/suggestions, so it can be said that the liveworksheet-based interactive worksheet to improve the developed science process skills has good readability. Based on the responses made by students on the aspects of readability and attractiveness, the criteria are very high. Based on these results, it can be said that liveworksheet-based interactive worksheets to improve the developed science process skills are declared valid according to the interpretation of Arikunto (2010).

After the validity test, then the N-Gain Test is carried out. This test was conducted to find out the increase in students' pretest and posttest scores on students' science process skills. The results of the pretest and posttest have different N-Gains. N-Gain experimental class is higher than the control class. Figure 2 shows the difference between the N-Gain control class and the experimental class
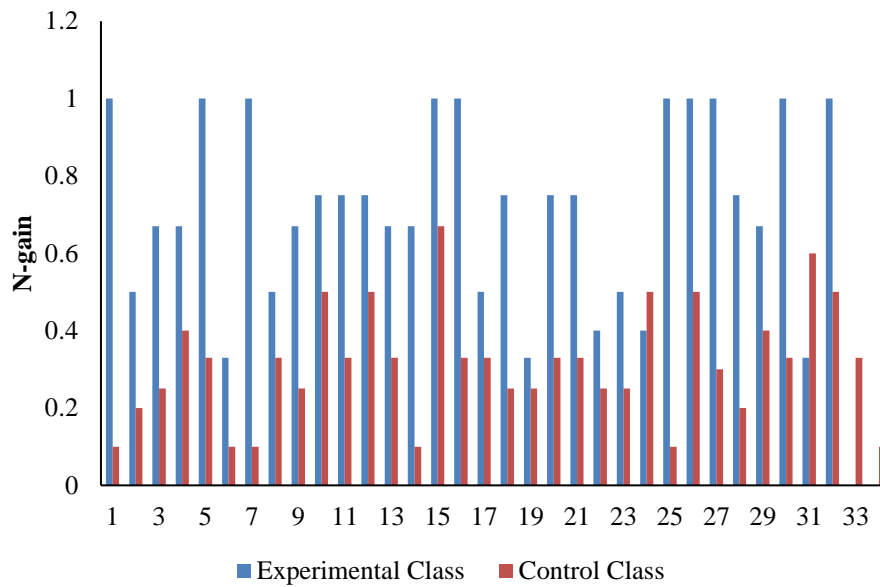
Figure 2. N-Gain experiment class and control class

Next, the effect size test was carried out. The effect size test is used to determine how much influence the student worksheet has on students' science process skills after the pretest and posttest in the experimental class. The calculated t value obtained from the paired sample t-test analysis is needed to calculate the effect size which is calculated using the Jahjouh formula (2014).

Based on the results of the calculation of the effect size in the experimental class and the control class both have an influence with the "large effect" category. The use of interactive liveworksheet-based worksheets in improving students' science process skills. These results can be explained that 94% of students' science process improvement skills are due to the effect of using worksheet-based worksheets using the discovery learning model. Based on the results of the effectiveness test and effect size test, it shows that learning using liveworksheet-based interactive worksheets using the discovery learning model is effective and has a major effect on training students' science process skills. This is in line with the results of the study (Anggrahini & Rusmini, 2022; Winarti et al., 2019; Gultepe & Kilic; 2015) which stated that electronic worksheet can increase science process skills.

▪ **CONCLUSION**

Interactive worksheets with live worksheets based on discovery learning models on additives and addictive substances are declared valid. This can be seen from the results of expert validation on the aspect of completeness of the content which obtains a proportion of 88% with the validity criteria and the construction aspect obtains a proportion of 88% with valid criteria. The expert's response includes the aspect of obtaining a proportion of 80% with very high criteria, the aspect of construction obtaining the proportion of 88% with a very high classification, and the legibility of obtaining a proportion of 89% with a very high classification. Student responses to the attractiveness aspect of the acquisition proportion were 89.64% with very high criteria,

and the readability aspect of the acquisition proportion was 88.4% with very high criteria. Interactive worksheets with a liveworksheet-based discovery learning model on additive and addictive material to improve students' scientific process skills effectively with the high category based on N-gain and based on an effect size value of 0.94 with a large effect category.

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