

DEVELOPMENT OF E-WORKSHEET BASED ON COLLABORATIVE LEARNING ON ENVIRONMENTAL CHANGE MATERIAL TO TRAIN SCIENCE LITERACY SKILLS FOR 10TH-GRADE HIGHSCHOOL

Pengembangan E-LKPD Berbasis Collaborative Learning pada Materi Perubahan Lingkungan untuk Melatihkan Keterampilan Literasi Sains Kelas X SMA

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Abstract

Science literacy very important to trained in learning because it is needed in the process of solving problems in everyday life. This study aims to produce E-worksheet based on collaborative learning on environmental change material to train 10th students' science literacy skills that are feasible based on validity, practicality and effectiveness. E-worksheet based on collaborative learning developed with 4D models include define, design, develop, disseminate. The targets in this study were 20 students of 10th grade SMAN 1 Taman. The data were analyzed using validation sheet to determine the validity of Eworksheet, implementation observation sheet and response questionnaire to determine practicality, pretest and post-test sheet to determine the effectiveness. The results showed that the E-worksheet based on collaborative learning to train science literacy skills was valid with a score of 98.7% in terms of didactic, construction and technical aspects. E-worksheet based on collaborative learning was also declared practical based on the implementation of 97.14% and the response results of 98.75% with very practical interpretation. E-worksheet based on collaborative learning is declared effective based on N-Gain, which is an increase of 0.79 with high category and sensitivity of ≥ 0.30 . The effectiveness is reviewed from the achievement of science literacy indicators, namely identifying scientific phenomena by 100%, formulating problems 89%, designing investigations 98%, analyzing the results of the investigation 81%, evaluating results of investigation 87% and drawing conclusions with score of 83% with very high interpretation and on the indicator of analyzing the results of nvestigation with high category. Keyword: science literacy, E-worksheet, collaborative learning, environtmental changes

Abstrak

Literasi sains sangat penting untuk dilatihkan dalam pembelajaran karena dibutuhkan dalam proses penyelesaian masalah di kehidupan sehari-hari. Penelitian ini bertujuan untuk menghasilkan E-LKPD berbasis collaborative learning pada materi perubahan lingkungan untuk melatihkan keterampilan literasi sains siswa kelas X yang layak berdasarkan validitas, kepraktisan dan keefektifan. E-LKPD berbasis collaborative learning vang dikembangkan dengan model pengembangan 4D (Define, Design, Development, dan Disseminate). Sasaran pada penelitian ini adalah peserta didik kelas X SMAN 1 Taman sebanyak 20 orang. Data dianalisis menggunakan lembar validasi untuk menentukan validitas E-LKPD, lembar observasi keterlaksanaan dan angket respon untu menentukan kepraktisan, dan lembar pre-test dan post-test untuk menentukan keefektifan E-LKPD. Hasil penelitian menunjukkan E-LKPD berbasis collaborative learning untuk melatihkan keterampilan literasi sains valid dengan skor 98,7% ditinjau dari aspek didaktik, konstruksi dan teknis. E-LKPD berbasis collaborative learning juga dinyatakan praktis berdasarkan keterlaksanaan yakni sebesar 97,14% dan hasil respon 98,75% dengan interpretasi sangat praktis. E-LKPD berbasis collaborative learning dinyatakan efektif ditinjau berdasarkan N-Gain memperoleh peningkatan sebesar 0,79 dengan kategori tinggi dan sensitivitas sebesar $\geq 0,30$. Keefektifan ditinjau dari ketercapaian indikator literasi sains yakni mengidentifikasi fenomena ilmiah sebesar 100%, merumuskan masalah 89%, merancang penyelidikan 98%, menganalisis hasil penyelidikan 81%, mengevaluasi hasil penyelidikan 87% dan menarik kesimpulan dengan skor 83% dengan interpretasi sangat tinggi dan pada indikator menganalisis hasil penyelidikan dengan kategori tinggi.

Kata kunci: literasi sains, E-LKPD, collaborative learning, perubahan lingkungan



INTRODUCTION

The 21st century is characterized by the rapid advancement of science and Technology allowing the challenges of the times to be more complex and diverse. Responding to the development of science and technology in developed countries raises efforts, especially in the realm of education so that students have science literacy skills (Sitomurang, 2016). Science literacy refers to an individual's ability to understand, communicate and apply the scientific concepts in everyday life (Suciati et al., 2011). Science literacy can also be interpreted as a person's ability in the process of solving problems in everyday life based on scientific knowledge (Pujiyanti et al., 2021). According to Sutrisna (2021), there are 4 components of science literacy, namely competence (science process), knowledge (science content), science application context and science attitude.

Based on data from OECD 2018, aspects of science competence include explaining scientific phenomena, designing and evaluating scientific investigations and interpreting evidence scientifically. Unfortunately, Indonesia's science literacy skills are still unsatisfactory. According to data on student's science literacy performance in PISA in 2018, which was attended by 78 countries, the average score was 396 below the average PISA score of 500 (OECD, 2018). Whereas in the 2022 PISA results, Indonesia's ranking improved by 5-6 positions compared to its placements of the PISA results in 2018 (Kemendikbud, 2022). Unfortunately, the increase was not accompanied by a satisfactory score. This is also supported by research by Suroso et al. (2021) which states that the profile of science literacy skills in the East Java region is still relatively low. Low science literacy is generally caused by internal and external factors. Internal factors that influence, namely sometimes students think that science is difficult to understand so that students are less interested in science. Meanwhile, external factors that influence are the inappropriate application of the learning model, method approach and the selection of books and teaching media that do not support the application of science literacy for high school students (Novita, 2021). One way that can train science literacy is to choose the appropriate learning model and teaching materials. The learning model that can be applied to train science literacy is the collaborative learning model.

The collaborative learning is a learning model that provides basic concepts, instructions, references and skills or skills needed in learning activities (Dana, 2021). At its stages, collaborative learning requires students to be active in problem solving, so that it can train science literacy skills. This aligns with Anfa's (2016) research, which states that the collaborative learning model can develop students' science literacy skills trough groupbased activity. The stages of collaborative learning include: (1) Engagement, namely the process of providing a stimulus for students to be able to group heterogeneously, (2) Exploration, namely the process of exploring students, (3) Transformation, namely the transformation of students' knowledge, (4) Presentation, namely the stage of communicating the results and (5) Reflection, namely the stage of answering questions from presentations and reflections.

The theory underlying the collaborative learning model is the theory of constructivism proposed by Vygotsky. Vygotsky stated that different levels of actual and potential development in problem solving can be achieved independently with the guidance of adults or peers (Novitasari et al., 2019). In addition, social constructivism theory also plays a role in collaborative learning. In the context of collaborative learning occurs when learners can more easily understand concepts through discussion sessions in solving complex problems. Meanwhile, motivation theory in the context of collaborative learning can create a conducive learning environment so as to create a situation of mutual learning (Ntobuo, 2017)

The implentation of the learning model also requires appropriate teaching materials. Teaching materials make the learning process more interactive. Therefore, teaching materials are essential to support the learning process alongside the conventional model implemented by the teacher. One of these teaching materials can be in the form of E-worksheet. Student worksheet developed digitally can be more practical to use. The advantage of E-worksheet is that it is easy to use and can reduce restrictions on space and time so that it is effective for use in learning (Suryaningsih & Riska, 2021). The utilization of digital platforms is also an effort to habituate digital literacy which is also needed in the 21st century. The developed E-worksheet contains readings in the form of news or journals, images and videos that support the material contained so that it becomes contextual.

Electronic-Student Worksheet (E-worksheet) allow students to solve problems independently. A good worksheet is prepared based on several existing criteria and requirements. A good worksheet is prepared based on several existing criteria and requirements. According to Roheati et al. (2009) the requirements in preparing a



good worksheet are meeting the didactic, construction and technical requirements. Didactic requirements include the content and content of the worksheet related to the learning experience. Construction requirements relate to how to use good and correct language, vocabulary and sentence preparation in worksheet, and technical requirements include presentation in the form of writing and display images.

One of the materials in biology learning that requires science literacy skills is environmental change material. One of the steps that can be taken to address this is through learning in the world of education (Nirwana, 2021). Education as early as possible with the right steps can foster a generation that is highly aware and cares about the surrounding environment. In the *Kurikulum Merdeka*, environmental change material is listed in Phase E with the learning outcomes of students having the ability to create solutions to problems based on local, national or global issues related to understanding the diversity of living things and their roles, viruses and their roles, technological innovation, ecosystem components and interactions between components and environmental change.

According to interviews conducted with teachers at SMAN 1 Taman, the results show that the learning resources that are widely used are textbooks. Teachers also develop worksheet independently, however the worksheet provided is not based on a particular approach and is not yet available as digital teaching materials that can that can be accessed digitally. In addition, students' science literacy still needs stimulus in the form of case study questions related to current phenomena so that students can be more motivated and increase literacy and relate what is obtained in learning with what is encountered in everyday life. Thus, the purpose of this research is to produce valid, practical and effective learning-based collaborative E-worksheet on environmental change material to train students' science literacy skills

METHOD

This study is a development research using the 4D model includes Define, Design, Develop, and Disseminate stages. The research was conducted on June 2024 to July 2024. The development stage was carried out at State Surabaya University. Teaching materials that have been developed will be tested on a limited basis on 20 students in 10th grade from SMAN 1 Taman who have received environmental change material.

The methods used for data collection include validation method, observation method, questionnaire

method and test method. The validation method conducted to test the feasibility of E-worksheet before the trial is based on didactic, construction and technical aspects. E-worksheet validators are educational expert lecturers and material expert lecturers. The observation method was conducted during the research to test the practicality of E-worksheet based on the observation of the implementation of activities during learning using Eworksheet. Observers during the product trial were 2 observers majoring in biology. The observed aspects include the implementation of student activities based on the E-worksheet implementation observation sheet. The response questionnaire is used to measure the practicality of E-worksheet based on the response of students after using E-worksheet. The questionnaire is given after students carry out learning E-worksheet. The test method was conducted to determine the effectiveness of the Eworksheet through the pre-test given before using the Eworksheet and the post-test conducted after using the Eworksheet. The test instrument developed is in accordance with science literacy indicators.

At the define stage, the analysis includes curriculum analysis, learner analysis and material analysis and task analysis. Learners in this study have an age range of 15-16 years which according to Jean Piaget at that age the cognitive development of students reaches the peak stage, namely the formal operation stage. The material used is environmental change in the sub material of water pollution and soil pollution. Based on the results of the analysis, a learning objective is compiled. While the task analysis is carried out by detailing the environmental change material on the environmental pollution sub material and integrated in the form of exercise questions on worksheet. Activities carried out by students refer to the learning objectives that have been developed with the help of relevant learning resources.

At the design stage, it is done by selecting media by paying attention to its practicality. Next is the preparation of test instruments and the initial design of E-worksheet. E-worksheet was designed using canva and developed through the liveworksheet site so that it can be accessed digitally. The E-worksheet was developed in accordance with the guidelines including the table of contents, preface, concept map, and features integrated with the collaborative learning model and science literacy indicators. While the features contained in the Eworksheet are Bio-Literacy, Bio-Investigation, Bio-Review and *Sobat-Bio*.

Druing the development stage, the product undergoes a validation process. Validation is carried out by material expert lecturers and media experts. From the validation



stage, a valid product is obtained and ready for testing. The trial was limited to 20 students of SMAN 1 Taman. The trial design in this study is to use a one group pretest post-test design, namely by giving a pre-test before being given treatment and giving a post-test. The results of the two tests can then be compared to determine their effectiveness.

The validation results were analyzed using a Likert scale of 1-4 in the validation assessment. The scores obtained from validator lecturers 1 and 2 were then calculated using the following partial formula.

$$Validity = \frac{score \ of \ each \ criterion}{number \ of \ validators} \times 100\% \dots \dots (1)$$

After obtaining the validation score, the score is categorized with the table. E-worksheet based on collaborative learning is declared valid if it gets a score \geq 61%.

Table 1. Validity Level of E-worksheet

Score	Category
0-20	Not valid
21-40	Less valid
41-60	Fairly valid
61-80	Valid
81-100	Very valid

In measuring practicality using the implementation of activities and the results of student response questionnaires. The results of activity implementation were analyzed using a guttman scale with the provision of "Yes" answers worth 1 and "No" answers worth 0. The implementation score is then calculated by the following formula.

$$Practicality = \frac{Total \ score \ obtained}{Total \ maximum \ score} \times 100\% \dots (2)$$

After obtaining the implementation score, the score is categorized with the table. E-worksheet based on collaborative learning is declared practical in terms of implementation if it obtains an implementation score of \geq 75%.

Table 2. Practicality Level of E-worksheet

Score	Category
0-48	Not practical
49-61	Less practical
62-74	Practical enough
75-87	Practical
88-100	Very practical

The practicality of E-worksheet is also reviewed from the results of the students' response questionnaire. The results of the response questionnaire were analyzed using a guttman scale with the provisions of the answer "Yes" worth 1 and the answer "No" worth 0. The response

https://ejournal.unesa.ac.id/index.php/bioedu

questionnaire score is then calculated by the following formula.

$$Practicality = \frac{respondents \ answering \ "yes"}{number \ of \ respondents} \ x \ 100\% \dots (3)$$

After obtaining the learner response score, the score is categorized with the table. E-worksheet based on collaborative learning is declared practical in terms of response questionnaire if it gets a response questionnaire score of $\geq 75\%$

Ta	ble	3.	Practica	lity	Level	of E	-works	heet	based	on

response

Score	Category
0-48	Not practical
49-61	Less practical
62-74	Practical enough
75-87	Practical
88-100	Very practical

The effectiveness of collaborative learning-based Eworksheet is obtained from the results of pre-test and post-test scores. To determine the sensitivity of the items, the sensitivity test is carried out with the following formula.

$$S = \frac{\sum s \, ses - \sum s \, seb}{N(S \, \max - s \, \min)} \ge 100\% \dots (4)$$

Note :

S : question item sensitivity index

- *N* : number of learners
- $\sum s \ ses$: total score after learning
- $\sum s \ seb$: total before learning
- *S* max : maximum value
- *S* min : minimum value

The question item is declared sensitive if it obtains a result of ≥ 0.30 . The improvement in learning oucomes from before to after trial wa caluclated using the gain-score method with formula below.

(g) = S post - S pre	(5)
$N(g) = \frac{s \text{ post} - s \text{ pre}}{s \text{ max} - s \text{ pre}} x 100$	9%(6)

Note :

N(g) : degree of improvement in results

S post : score after using E-worksheet

S pre : score before using E-worksheet

S max : maximum score

After the results are obtained, they are categorized with the table. E-worksheet based on collaborative learning is declared effective if it obtains a gain score \geq 0.30.



Table 4. Effectiveness Level of E-worksheet

Score	Category
$0,70 < g \le 1,00$	High
$0,30 < g \le 0,70$	Medium
$0,00 < g \le 0,30$	Low

The effectiveness of E-worksheet is also measured using the achievement score on science literacy indicators. The scores obtained by students were used to calculate the percentage of students' achievement using the following formula.

 $Presentase (\%) = \frac{\text{Total score obtained}}{\text{Total maximum score}} \ge 100\% \dots (7)$

The calculation results obtained are then categorized in the following table.

Tuble 5. Indicator Temevenient			
Score	Category		
25-39,9	Not good		
40-54,9	Less good		
55-69,9	Good enough		
70-84,9	Good		
85-100	Very good		

RESULT AND DISCUSSION

Profile of E-worksheet

This research produces E-worksheet with environmental change material consisting of Topic 1 on soil pollution sub-material and Topic 2 on water pollution sub-material. This E-worksheet can be accessed through a link that is directly connected to the liveworksheet site. Each topic in the E-worksheet contains learning activities with a time allocation of 2 x 45 minutes. Both of E-worksheet consist of a cover that contains the material topic, group identity, learning outcomes, learning objectives, and time allocation information. The cover is presented in the following figure.



Figure 1. E-worksheet

Activities in this E-worksheet are integrated in the form of features namely Bio-Literacy, Bio-Investigation, Bio-Review and *Sobat-Bio*. The presentation of information in the E-worksheet includes news text of certain phenomena or issues, links that refer to journals or articles in the form of barcodes and YouTube.

Table 6. Presentation of Information on E-Workhseet Features

No	Faatura	Presentation of information			Presentation of information		
•	reature	Topic 1	Topic 2				
1.	Bio-Literacy Bio Literacy	Contains links to information related to soil degradation articles	Contains links to journal information related to articles and videos of simple phytoremediation experiments.				
2.	Bio-Investigation	Activitytodesignideasrelatedtomakingorganicpesticideswithnaturalingredients	Activity to design a phytoremediation experiment with water hyacinths				
3.	Bio-Review	Practice questions on true/false statements on soil pollution sub-materials	Practice questions on true/false statements on water pollution sub-materials				
4.	Sobat-Bio	Guidance when designing procedures for making organic pesticides	Instructions for designing a simple phytoremediation experiment				

The Validity of E-worksheet

The Electronic-Student Worksheet (E-worksheet) that has been developed will then be reviewed by validators and revised by researchers so as to produce a product in the form of a valid E-worksheet. According to Roehati et al. (2009), there are requirements for preparing good E-worksheet including didactic requirements, construction requirements and technical requirements. The following table shows the results of E-worksheet validation.

Table 7.	Result of	of E-workshe	et Validity
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No.	Aspect	Score	Category
A.	Didactic Aspect		
1.	Suitability of learning activities with learning objectives	100%	Very Valid
2.	Suitability of E-worksheet with collaborative learning model	100%	Very Valid
3.	Conformance with aspects of science literacy skills	100%	Very Valid
4.	Suitability of material	100%	Very Valid

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	substance with learning objectives		
5.	Feature availability	100%	Very Valid
В.	Technical Aspect		
6.	Presentation of covers and titles	96,8%	Very Valid
7.	Format of presentation	96,8%	Very Valid
C.	Construction Aspect		
8.	Use of good Indonesian and proper language	93,7%	Very Valid
	Overall average	98,47%	Very Valid

Based on table 7, the validation results on didactic, construction and technical requirements get very valid results. Based on the assessment results on the didactic requirements, the validation results are 100% which indicates that the E-worksheet developed is in accordance with the learning objectives, stages of collaborative learning and science literacy indicators and the availability of features in the form of Bio-Literacy, Bio-Investigation, Bio-Review, and Sobat-Bio can help students understand the substance of the material. Features are included in one of the advantages of Eworksheet according to Nufus and Sakti (2021), namely the presence of features that attract students to learn such as audio, video and images. The suitability of the Eworksheet model with the skills that will be trained in understanding learning materials will facilitate the learning process. E-worksheet based on collaborative learning contains phenomena of problems in everyday life that require problem solving so that it is contextual and provides learning experiences for students.

The technical requirements obtained validation results of 96.87% with a very valid category. The technical requirements in this validation assessment include the presentation of E-worksheet such as an attractive cover design, a title that can represent the topic of E-worksheet material, the availability of identity columns, proportional images and fonts on the cover, and content on E-worksheet containing clear images, videos and audio with proportional placement and layout according to its features. An attractive E-worksheet display can increase students' interest and motivation. This is reinforced by research by Kurniawan et al. (2018) which states that the display with the right resolution, menu size and layout, font size, clarity of images that match the needs make it easier for users to understand the material. This has an influence in fostering motivation to learn using the E-worksheet that has been developed (Samawati & Rahayu, 2021).

There are several things that need to be improved, namely color composition and adding an identity column. Color composition is important for the presentation of E-worksheet. The right color composition will produce E-worksheet that attract students. Meanwhile, the identity column also makes it easier for students and researchers so that the results of the work are not easily confused. Based on the assessment results on technical requirements, it shows that the E-worksheet developed has been well presented by paying attention to the use of fonts, color composition, presentation of images and videos, and instructions for accessing other information. Material information is presented in the form of images and videos so that it is more contextual.

In the construction requirements, the validation results were obtained at 93.75% in the very valid category. The construction requirements in this validation assessment include aspects of language and accuracy in writing. In the construction requirements, the things that need to be improved are the use of Indonesian language and the right instruction sentences. The instruction sentence is improved so that the information can be easily accepted by students and does not cause double meaning. This is in line with research from Ruku and Purnomo (2020) which states that some of the requirements for preparing teaching materials are in accordance with the General Guidelines for Indonesian Spelling (PUEBI), communicative according to the age of the user, effective, not double meaning, and able to motivate students. Construction requirements get very valid results which indicate that the E-worksheet developed uses instructions and language that are easily understood by students. The three conditions have very valid results so that the collaborative learning-based Eworksheet on environmental change material to train science literacy skills can be carried out limited trials to determine its practicality and effectiveness.

The Practicality of E-worksheet

The results of practicality in terms of implementation were obtained from observations of student activities. The results of implementation are presented in the table below.

No.	Activity	Implementation of E-worksheet (%)	
		Topic 1	Topic 2
1.	Access E-worksheet through a teacher-provided link that connects to the Liveworksheet page.	100%	100%
2.	Read the instructions for using the E- worksheet	100%	100%
3.	Fill in the group identity on the E- worksheet	75%	75%
4.	Reading the learning objectives	100%	100%



5.	Reading the news at the Engagement stage	95%	100%
6.	Reading and answering each question on the E- worksheet at the Exploration stage	100%	100%
7.	Accessing information and watching videos on the Bio- Literacy feature	90%	85%
8.	Using tips on the Sobat-Bio feature	100%	100%

		Implementation of		
No.	Activity	E-worksheet (%)		
		Topic 1	Topic 2	
	Designing and conducting			
9.	simple experiments at the	100%	100%	
	Transformation stage			
	Analyze the findings or			
10.	research results at the	100%	100%	
	Transformation stage			
	Fill in suggestions and			
	questions given by other group			
11.	members during the	100%	100%	
	presentation in the			
	Presentation stage column			
	Filling in individual and group			
12.	reflections in the Reflection	100%	100%	
	stage column			
12	Fill in true/false statements in	1000/ 1000/		
15.	the Bio-Review feature	100%	100%	
14	Complete all stages and submit	100%	100%	
14.	it by clicking finish	100% 100%		
	Average	97,14%	97,14%	
	Overall average	97,1	14%	

The results of the E-worksheet implementation obtained a result of 97.14% on both E-worksheet topics namely soil pollution and water pollution which both have a very practical category. Students follow the learning process well from the beginning to the end of the activity. This shows that learning using collaborative learning-based E-worksheet is proven to be practical to use so that it helps students to participate actively and enthusiastically in the learning process. The collaborative learning model helps learners to explore the things they encounter by conducting investigations to answer the problem formulation.

There were several activities that were not carried out, including playing videos and accessing journals on Bio-Literacy. Some students experienced problems in the form of internet connection when watching videos and when other tabs were opened some components on the Eworksheet were reset, so students decided to take turns with other group members. In addition, some learners did not fill in the identity section on the cover of the soil pollution E-worksheet and water pollution E-worksheet because they felt it was enough after filling in the identity on the main page. However, researchers are quite helpful because the identity is listed on the main cover and at the task division stage. This is in accordance with the suggestion from validator 2 to add an identity column on the main cover.

According to the results of the implementation obtained, most of the activities are well implemented which shows that the collaborative learning stage has a positive impact on students' learning activities. The collaborative learning model can be developed in the form of teaching materials in the form of E-worksheet. This is in line with Anfa's research (2016) which states that the collaborative learning model can train students' science literacy skills in the form of group learning activities. Practicality is reviewed from the response questionnaire of students after using collaborative learning-based E-worksheet to train science literacy skills. The results of the response questionnaire are presented in the following table.

Table 9. Result of Student Res	sponse Questionnaire
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No	Statement	Respons	
No.	Statement	Yes	No
А.	Presentation aspect		
1.	Presentation of an attractive E- worksheet cover	100%	-
2.	The font style selection and size on the E-worksheet can be read clearly	90%	10%
3.	The color selection on the E- worksheet is interesting	100%	-
4.	The images on the E-worksheet are clearly visible	100%	-
5.	Videos on E-worksheet can be accessed and clearly visible	100%	-
6.	Links and QR codes are easily accessible	100%	-
B.	Content aspect		
8.	The instructions in the E-worksheet are easy to follow	100%	-
9.	The content of the E-worksheet is in accordance with the material	100%	-
10.	The time allocation in the E-worksheet is in accordance with the learning activities	100%	-
11.	Learning objectives in E-worksheet are in accordance with the learning material	100%	-
12.	The instructions/commands in the E- worksheet are easy to understand	100%	-
13.	This E-worksheet can train the skill of explaining scientific phenomena.	100%	-
14.	This E-worksheet can train the skills of evaluating and designing scientific investigations.	100%	-
15.	This E-worksheet can train the skills of interpreting data and evidence scientifically.	100%	-
16.	E-worksheet presents problems that are often encountered in everyday life	100%	-



17.	This E-worksheet can attract your interest in literacy	95%	5%
18.	This E-worksheet motivates to learn the material more deeply	95%	5%
19.	This E-worksheet motivates to work in teams	100%	-
20.	The activities in the E-worksheet train communication skills	100%	-
21.	This E-worksheet makes learning easy and fun	95%	5%
C.	Language Aspect		
C.	Language Aspect	Respo	onse
С. No.	Language Aspect Statement	Respo Yes	onse No
C. No. 22.	Statement The language used is easy to understand	Respo Yes 100%	onse No -
C. No. 22. 23.	Internal Language Aspect Statement The language used is easy to understand The language used is in accordance with good Indonesian language rules	Respo Yes 100% 100%	onse No -
C. No. 22. 23. 24.	Internal Language Aspect Statement The language used is easy to understand The language used is in accordance with good Indonesian language rules The language used is communicative	Respo Yes 100% 100%	onse No - -

Based on Table 8, the results of students' responses obtained quite good practicality results of 98.8%. This shows the positive response of students after the collaborative learning-based E-worksheet learning process. The responses given by students include aspects of presentation, content, and language in the E-worksheet that has been developed. Based on the positive responses from students, the E-worksheet developed is easily accessible, interesting, and easy to understand. In addition, the E-worksheet also presents contextual problems that can train science literacy skills on science competency indicators. In the language aspect, the developed E-worksheet has used good Indonesian language, communicative, and easy to understand.

Most students also felt motivated after using this Eworksheet as evidenced by the results of good implementation and improved post-test results. This is in line with the opinion of Bagiarta et al. (2015) which states that the existence of good motivation in learning has an influence on student learning outcomes. In the presentation aspect, 2 students chose the "No" option in question number 2 because according to some students, the font used was too small, especially in the answer column so that it needed improvement. This indicates that the selection of fonts and the use of size also affect the ease of users in reading the developed E-worksheet.

In the content aspect, statements number 17, 18, and 21 received a practicality of 95% each with 1 "No" response. This is because the question is subjective and some students are not fully motivated to learn by reading a lot of information using collaborative learning-based E-worksheet on environmental change material. This is supported by the implementation of several learner activities to read readings and information that are not implemented. Students who are less accustomed to

exploring learning and are accustomed to being explained directly by the teacher cause students to be less active and still need motivation (Herianto & Indana, 2020). The existence of motivation to learn a lot and literacy is influenced by each individual. This is in line with the statement of Irfansyah and Surya (2021) which states that there are internal factors and habits that are the main and fundamental factors.

The Effectiveness of E-worksheet

The results of the effectiveness of collaborative learningbased E-worksheet in terms of sensitivity in each indicators, N-Gain and achievement of science literacy indicators. The results of the sensitivity index are presented in the following table.

No.	Indicator	Sensitivity
1.	Identifying scientific phenomena	0,32
2.	Formulating a problem	0,47
3.	Designing a scientific investigation	0,3
4.	Analyzing data	0,32
5.	Evaluating the investigation	0,3
6.	Drawing conclusions	0,39
	Average	0,35

Based on table 4.7, all items have good sensitivity results with an average result of 0.35 which indicates that each item has good sensitivity in the learning process. Good question items have sensitivity results \geq 0.30. The greater the sensitivity score of an item, the more sensitive the item is in learning (Brown, 2017). The improvement in student learning outcomes between the pre-test and post-test or N-Gain is shown in the table below.

Table 11. Recapitulation of Efectiveness Based on N-

Gain

Student's	Va	lue	N Coin	Catagory
Number	Pre-test	Post-test	IN-Gain	Category
1	30	80	0,71	Medium
2	50	76	0,52	Medium
3	43	87	0,77	Medium
4	80	100	1	High
5	53	87	0,72	Medium
6	67	97	0,9	High
7	43	77	0,59	Medium
8	53	97	0,93	High
9	60	93	0,82	High
10	83	100	1	High
11	67	90	0,69	Medium
12	37	93	0,89	High
13	47	83	0,67	Medium
14	63	100	1	High
15	70	93	0,76	High
16	40	93	0,88	High
17	60	93	0,82	High
18	70	97	0,9	High



19	40	77	0,61	Medium
20	40	83	0,71	Medium
Average	54,6	89,8	0,79	High

Based on the N-Gain results, there is an increase in student learning outcomes in terms of pre-test and posttest results with a score of 0.79 with a high category. While the results of effectiveness in terms of increasing results on each indicator are presented in the diagram below.



Figure 2. Diagram of Achievement of Science Literacy Indicators

Note :

- A : Identifying scientific phenomena
- B : Formulating a problem
- C : Designing a scientific investigation
- D : Analyzing data
- E : Evaluating the investigation
- F: Drawing conclusions

Indicators of identifying scientific phenomena get pre-test results of 68% while in the post-test results obtained results of 100%. These results show that students are better able to answer questions after learning with collaborative learning-based E-worksheet which contains questions related to phenomena in everyday life. The developed E-worksheet presents news that can be explored at the exploration stage. Learners are asked to read and identify problems related to causes, impacts until a problem-solving solution is obtained. E-worksheet provides Bio-Literacy features as a supporting reference. This is in line with the research of Azhari and Huda (2022) which states that E-worksheet provides additional references that students can use so that the material can be studied more deeply. This indicator is found in the aspect of science competence. Identifying scientific phenomena is the activity of learners to remember and relate back the knowledge they have to provide explanations for certain phenomena (OECD, 2018). The indicator of identifying scientific phenomena has a cognitive dimension of C2, namely identifying and explaining scientific phenomena.

The indicator of formulating problems obtained results of 42% in the pre-test and 89% in the post-test. These results prove that students experience a fairly high increase in results on the indicator of formulating problems. This is because in the E-worksheet developed there is a Sobat-Bio feature that provides instructions for students in formulating problems by linking two variables. The discovery of problems at the beginning will attract students to formulate problems and conduct investigations that facilitate students to learn from each other until problem solving is obtained. This is in line with the theory of motivation in the context of collaborative learning that creates a conducive learning environment so as to create a learning atmosphere between learners (Ntobuo, 2017). Learners are asked to formulate a problem based on the activities that will be carried out next to solve the problem in the E-worksheet. The indicator of formulating problems is found in the aspect of science competence in OECD 2018, namely identifying questions that can then be explored scientifically. Science literacy means that a person can ask, discover, and find answers to curiosity in everyday experiences (Sutrisna, 2021).

In the indicator of designing scientific investigations, students get results of 68% in the pre-test and 98% in the post-test. The post-test value has increased after learning using E-worksheet. In the developed E-worksheet, after formulating the problem formulation, students are asked to design an investigation by determining research variables, making hypotheses, detailing tools and materials and investigation procedures. There is a Sobat-Bio feature that helps provide tips to students in designing investigations such as determining hypotheses and variables. The existence of problems and investigations presented in collaborative learning-based E-worksheet is a means of practicing learners to design scientific investigations such as detailing material tools, determining variables and designing procedures in groups by discussing so that each member can complement each other. Indicators of designing investigations in science literacy are found in the competency aspect of designing and evaluating scientific investigations. This requires knowledge related to things that must be measured, variables that are changed and measured, data collection procedures or actions (OECD, 2018).

In the indicator of analyzing the results of the investigation, the pre-test results were 49% and the results in the post-test were 81%. The post-test results on this indicator were the lowest due to some students lacking in linking the data presented with the process that



occurred. In the E-worksheet that has been prepared, students are asked to discuss to analyze the results or data obtained after the investigation by answering questions on the E-worksheet. Learners are more capable in linking the experimental data presented by explaining the cause and effect. The indicator of analyzing the results of the investigation in OECD 2018 is included in the aspect of science competence, namely interpreting data and evidence scientifically. The indicator of analyzing the results of the investigation has a cognitive dimension of C4, namely analyzing. Generally, low science literacy is caused by students not being able to work on science literacy-based questions that require analysis and understanding of questions (Wardi & Jauhariyah, 2023). However, the increase in these results shows that students are better able to answer questions after going through learning using collaborative learningbased E-worksheet which contains practice questions as a stimulus for students to analyze the results of the investigation.

The pre-test results on the indicator of evaluating the results of the investigation obtained a result of 57% and in the post-test obtained a result of 87%. This indicates an increase in student learning outcomes after learning by using collaborative learning-based E-worksheet that facilitate students to find out obstacles, evaluate investigations by providing improvements to the next experiment. In the E-worksheet that has been developed, students are asked to evaluate the results of the investigation by filling in questions related to obstacles or things that are improved in the investigation that has taken place. In OECD 2018, the indicator of evaluating the results of the investigation is included in the science competency aspect of designing and evaluating scientific investigations. Collaborative learning emphasizes learners to evaluate their results together to ensure each member develops in a team (Respati, 2018). The indicator of evaluating the results of the investigation has a cognitive level of C5, namely evaluating. Similar to designing an investigation, the indicator of evaluating the results of an investigation also requires basic knowledge of scientific research (OECD, 2018).

The indicator of drawing conclusions in the pre-test gets a result of 44% and in the post-test gets a result of 83% which indicates a fairly high increase after learning using collaborative learning-based E-worksheet. Some students had difficulty in making conclusions during the pre-test. After using E-worksheet, students are better at making conclusions. In the E-worksheet that has been developed, students are asked to conclude the results of the investigation based on data analysis and link the reasons supporting the conclusion. This indicates that the E-worksheet can facilitate students in making conclusions based on the data analysis carried out. The indicator of drawing conclusions in OECD 2018 is included in interpreting data and evidence scientifically in the competency aspect of science literacy. Results in Scientifically "literate" individuals should be able to identify the relationship between the evidence obtained and the conclusions drawn (OECD 2018). Based on these data, there is an achievement of science literacy in the indicator of drawing conclusions.

collaborative The learning-based E-worksheet product produced has effective results as evidenced by the N-Gain value of 0.79 and the achievement of science literacy indicators with very high categories in 5 indicators and high categories in 1 indicator, namely analyzing data. The increase occurs because in collaborative learning there is a transformation of learning knowledge (Ntobuo, 2017). Knowledge transformation can occur between group members during discussions and the teacher's role as a facilitator. As in the theory of constructivism by Vygotsky, it is also explained that different levels of actual and potential development in problem solving can also be achieved with the help of peers or teacher guidance (Novitasari et al., 2019). In addition, the role of teaching materials is also important in the learning process. This E-worksheet can provide a means of practicing for students in each science literacy indicator as evidenced by the validation results in Table 7 which in all six indicators get very valid results. This E-worksheet is able to facilitate students to find problem solving in everyday life by working on problems in the E-worksheet by involving science literacy. This is in line with the function of Eworksheet according to Prastowo (2015) that one of the functions of E-worksheet is as a concise teaching material and contains many exercises to practice.

CLOSING

Conclusion

In this study, it was concluded that the validity of Eworksheet was declared valid with a very valid interpretation. The practicality of E-worksheet in terms of implementation and students' responses was declared practical with a very practical category. The effectiveness of E-worksheet is declared effective in terms of item sensitivity, N-Gain and achievement scores on science literacy indicators.



Suggestion

Suggestions on E-worksheets that are developed and will be widely implemented it is imprtant to consider the design and font size in the answer column to enhance user accessibility. Developing an E-worksheet with practical activities is essential to make the learning process more meaningfull

Acknowledgments

The researcher would like to thank Sifak Indana, M.Pd. and Tarzan Purnomo, M.Si. as validators as well as examiners who have provided suggestions on the Eworksheet products developed. In addition, thanks to the Biology teacher of SMAN 1 Taman, Mochammad Nasrul Hidayat, S.Si., who has been pleased to provide research permission and students of SMAN 1 Taman who have participated in the product trial of the assessment instrument.

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