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THE DEVELOPMENT OF BLENDED LEARNING E-WORKSHEET TO IMPROVE STUDENTS' CRITICAL THINKING SKILLS ON MEMBRANE TRANSPORT

Pengembangan E-LKPD Berbasis Blended Learning *untuk Meningkatkan Keterampilan Berpikir Kritis Siswa pada Materi Transpor Membran*

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Abstract

Education in society 5.0 makes learning activities, including practicum, more varied with technology. The challenges of 21st-century education require students to have critical thinking skills. In some schools, biology practicum activities have not been carried out due to the lack of facilities and infrastructure, for example membrane transport material need a practicum to understand the material better. This study aims to develop a blended learning Electronic Worksheet with collaborative practicum to improve students' critical thinking skills on membrane transport material that is valid, practical, and effective. This development research refers to the 4-D model without using the disseminated stage. The E-worksheet utilizes the Olabs virtual laboratory and has features including Fenomena Biologi, Wawasan Biologi, Berlatih Biologi, Memahami Biologi, Bicara Biologi. The E-worksheet trial was conducted on 30 students in Bojonegoro, East Java. Data analysis was done descriptively and quantitatively. The validity results reviewed from the assessment of three validators showed an overall percentage of aspects of 90.5%. The practicability of the E-worksheet is based on the students' response questionnaire which shows 94.33% and the questionnaire of students' activities which shows o97.77%. The effectiveness of E-worksheet is based on the increase in critical thinking skills with an n-gain score of 0.71. Thus, it is concluded that the E- E-worksheet based on blended learning with collaborative practicum on membrane transport material is valid, practical, and effective so that critical thinking skills can be higher.

Keywords: E-worksheet, blended learning, critical thinking skills, membrane transport.

Abstrak

Pendidikan di society 5.0 menjadikan kegiatan pembelajaran salah satunya praktikum lebih bervariasi berbantuan teknologi. Tantangan pendidikan abad 21 juga mengharuskan peserta didik memiliki keterampilan yakni critical thinking, collaborative, creativity, dan communication. *Pada beberapa sekolah kegiatan praktikum biologi belum dilaksanakan karena minimnya sarana dan prasarana, salah satunya pada materi transpor membran yang membutuhkan praktikum untuk lebih memahami materinya. Perlu dilakukan pengembangan media ajar untuk meningkatkan keterampilan berpikir kritis. Penelitian ini bertujuan untuk mengembangkan Lembar Kerja Peserta Didik Elektronik blended learning yang digunakan dalam meningkatkan keterampilan berpikir kritis siswa materi transpor membran yang valid, praktis, dan efektif. Penelitian pengembangan ini mengacu pada model 4-D (Define, Design, Develop, Disseminate) tanpa tahap disseminate. E-LKPD yang dihasilkan memanfaatkan laboratorium virtual Olabs dan memiliki fitur Fenomena Biologi, Wawasan Biologi, Berlatih Biologi, Memahami Biologi, Bicara Biologi. Uji coba dilakukan pada 30 peserta didik salah satu SMA di Bojonegoro, Jawa Timur. Analisis data dilakukan secara deskriptif kuantitatif. Hasil validitas yang ditinjau dari penilaian tiga validator, menunjukkan hasil persentase keseluruhan aspek sebesar 90,5%. Kepraktisan E-LKPD ditinjau berdasarkan hasil angket respon peserta didik sebesar 94,33% dan hasil angket keterlaksanaan aktivitas peserta didik sebesar 97,77%. Keefektifan E-LKPD ditinjau berdasarkan hasil kenaikan keterampilan berpikir kritis dengan skor n-gain sebesar 0,71. Dengan demikian, disimpulkan bahwa E-LKPD berbasis blended learning dengan praktikum kolaborasi pada materi transpor membran valid, praktis, dan efektif sehingga keterampilan berpikir kritis dapat lebih tinggi.*

Kata Kunci: *E-LKPD, blended learning, keterampilan berpikir kritis, transpor membran.*

INTRODUCTION

Education is one of the efforts made deliberately and arranged to realize the learning process so that students can develop the potential that exists in themselves. National Education functions to shape the character and civilization of the nation and develop the ability to educate the life of the nation. The government always makes improvements to achieve the goals of national education, some of which are improving the applicable curriculum (Putra & Amalia, 2020). One of the policies decided by the Ministry of Education and Culture of the Republic of Indonesia is independent learning (Kemendikbud RI). Currently, learning activities in the 21st century have guidance so that students can have skills, namely critical thinking, creativity, communication, and collaboration (Zahroh & Yuliani, 2021). One of the skills demanded by the 21st century is critical thinking.

Critical thinking skills are a mental process to evaluate or analyze information. Information is obtained based on observation, experience, common sense, and communication (Permana, et al., 2019). Some indicators that exist in critical thinking skills include 1) interpretation, 2) analysis, 3) inference, 4) evaluation, 5) explanation, and 6) self-regulation (Facione, 2015). Critical thinking skills are important to note, given the level of critical thinking in Indonesia which is classified in the low category. This is based on the PISA survey which shows that the results of science learning achievement in Indonesia are ranked 13th out of 81 countries participating in PISA in 2022 (PISA National Report, 2022). In another study, it was explained that the critical thinking skills of biology learning activities at Muhammadiyah Surabaya City High School had a result of 51.85%, which means that it is categorized as low (Sugiharti & Gayatri, 2021).

The development of technological sophistication can make learning activities that were originally only done traditionally can be developed to be more interactive using the blended learning model. Blended learning is one of the learning models that combines technology-based learning activities, either online or offline with face-to-face learning (Dwiyogo, 2018). Learning activities using the blended learning model can encourage students to play a critical and active role because it involves them with real-world problems meaningfully (Tridiwanro & Trishandra, 2020). In blended learning, there are three stages, namely, 1) seeking of information, 2) acquisition of information, and 3) synthesizing of knowledge (Chaeruman & Maudiarti, 2018; Lestari et al., 2020). The blended learning model can be used to improve students' critical thinking skills (Fariska & Erman, 2017).

One example of blended learning is practicum activities carried out face-to-face (offline) and practicum carried out on time. Practicum is a learning activity that aims to test and implement in real terms the theory and practical lessons obtained by students. Collaboration can be interpreted as a relationship and form of pattern carried out between individuals or groups that aim to share, participate, and agree to take action by sharing information, resources, responsibilities, and benefits in making decisions to achieve common goals (Saleh, no year). Collaborative practicum can be interpreted as practicum activities carried out in groups and the steps of practicum activities are carried out to achieve common goals or practicum objectives. Collaborative practicum with a blended learning model is carried out by carrying out real practicum and online practicum. The blended learning model can be used to overcome the limited time in carrying out learning activities (Husamah, 2015).

The demand for education to have various skills, including critical thinking, should be balanced with the development of learning resources that are matched with the skills to be achieved. This is to avoid students who have difficulty in constructing existing material information. In previous research, it was explained that the results obtained were categorized as good and could be used in increasing critical thinking skills by utilizing technology in using Leamer Worksheets (LKPD) (Melania, et al., 2021). LKPD is arguably quite effective in improving students' critical thinking skills and significantly affects the t-test (Elfma & Sylfia, 2021).

Biology is one of the Natural Sciences that uses learning which can improve students' abilities through coherent and measurable steps (Kurniawati, et al., 2019; Setiawan & Koimah, 2019). Biology material on membrane transport is taught to students in class X1 SMA which targets students to master the notion of membrane transport, various types of membrane transport, and examples of membrane transport. In addition to cognitive knowledge, students also perform an osmosis diffusion practicum to find out how membrane transport works. Diffusion and osmosis events can be found in everyday life so that they can understand the concept by making observations based on direct experience. The material cannot only be taught by providing theoretical material but also needs to be done directly with practicum activities. By the results of observation activities carried out by researchers at SMA Negeri 1 Baureno, Bojonegoro learning activities in

Biology subjects are mostly carried out traditionally with teacher-directed learning through lectures by the teacher. Traditional learning activities in class XI in semester 1 have never carried out practicum activities. In addition, membrane transport material is still delivered by lecturing by the teacher. In a study conducted by Punomo (2021), students at SMA Negeri 1 Baureno did not play an active role in learning activities and many students did not pay attention to the teacher's explanation in class. Based on observation activities, Biology practicum activities are still carried out in real laboratories. Biology learning activities on membrane transport material also have not carried out practicum activities due to limited facilities and infrastructure. Practical activities in membrane transport material can provide more experience and understanding for students. Therefore, practicum activities are needed that can support learning activities in the classrooms. Practical activities that were previously only carried out hands-on in school laboratories can now be collaborated by utilizing the sophistication of technology in the form of virtual laboratories, one of which is Olabs so that it can create collaborative practicum activities in the utilization of blended learning models.

This study aims to determine the validity, practicality, and effectiveness of E-worksheet based on blended learning with collaborative practicum to improve students' critical thinking skills on membrane transport material

METHODS

This research is a research and development (R&D) study that uses the 4-D model (Define, Design, Develop, Disseminate) without using the dissemination stage. The research was conducted in January 2024 for the development stage in the Biology Education study program, FMIPA, Unesa then continued with the trial stage in March 2024 at SMAN 1 Baureno, Bojonegoro with 30 research subjects.

The define stage is the stage of defining the requirements in learning activities through the stages of dissecting the curriculum, analyzing students, concepts, and tasks, and preparing indicators of learning objectives. The topic of membrane transport applied in the development of the E-worksheet refers to the Merdeka curriculum in phase E-Learning Outcomes. The membrane transport topics studied by students include the mechanism of membrane transport, various types of membrane transport, the application of membrane transport in everyday life, and carrying out practical activities to prove membrane transport events. Based on the Learning Outcomes and the flow of Learning Objectives to be achieved, task analysis includes analyzing, finding, evaluating, and expressing results.

The design stage is the stage of designing related to the appearance design and content of research products. The type of E-worksheet developed is based on blended learning of membrane transport material which is arranged systematically. At this stage, test making, formatting, and writing the initial E-worksheet design were carried out. The features contained in the E-worksheet include *Fenomena Biologi*, *Wawasan Biologi*, *Berlatih Biologi*, *Memahami Biologi*, and *Bicara Biologi*.

The develop stage is the stage of producing E-worksheet products that are suitable for use in trials to class XI students who have received membrane transport material. The validation stage was carried out by 2 validators who were media expert lecturers and material expert lecturers, as well as 1 biology subject teacher at SMAN 1 Baureno, Bojonegoro.

Data collection methods

Data collection methods include validity and effectiveness. Validation was carried out by validators including aspects of the feasibility of content components, aspects of linguistic feasibility, presentation, blended learning, and critical thinking. These aspects were then assessed using the Likert Scale assessment criteria, namely 1 is categorized as less good, 2 is categorized as quite good, 3 is categorized as good, 4 is categorized as very good (Riduwan, 2018). The score results obtained were then interpreted based on the interpretation criteria according to (Riduwan, 2018). E-worksheet to be valid if it gets a percentage > 75%.

The effectiveness of the E-worksheet is reviewed based on the results of the pre-test before using the E-worksheet and post-test after using the E-worksheet which is then analyzed for improvement using the N-gain score method. The results of the gain score assessment were assessed using the n-gain level assessment criteria, namely (<g>) > 0.7 in the high category; 0.3 < (<<g>) < 0.7 in the medium category, and (<g>) < 0.3 in the low category (Ramadhani, et al., 2020). The results of the gain score were then interpreted based on the criteria for the percentage of critical thinking ability (Riduwan, 2018).

RESULT AND DISCUSSION

E-worksheet Profile

This development research describes a valid, practical, and effective blended learning E-worksheet as a means of improving students' critical thinking skills.

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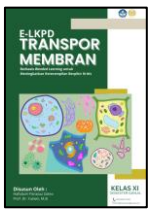
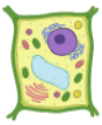
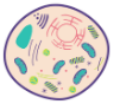
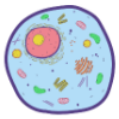
The main characteristic of this E-worksheet is that it contains various features that contain activities integrated with five critical thinking indicators namely analysis, inference, explanation, evaluation, and self-regulation (Facione, 2015). The features contained in this E-worksheet include *Fenomena Biologi*, *Wawasan Biologi*, *Berlatih Biologi*, *Memahami Biologi*, *Bicara Biologi*, and reflection. The features contained in the E-worksheet also have images, videos, and links that are on the website, Google Drive, and Google Forms. The details of the appearance and features of the E-worksheet are presented in Table 1 below.

tabel dan keterangan gambar adalah sebagai berikut:

Table 1. Detail of E-worksheet Display and Features

No	Display and Features	Description
1	Cover 	The E-worksheet cover is made with a simple design dominated by green color, there is the name of the author, the material to be taught, the critical thinking skills to be improved, and the class intended for E-worksheet.
2	*Fenomena Biologi* 	Presented as a means to identify a phenomenon in achieving analysis skills
3	*Wawasan Biologi* 	A literature study is presented as a means of achieving inference skills.
4	*Berlatih Biologi* 	Practical activities are presented as a means of achieving the skill of explaining scientific problems.
5	*Memahami Biologi* 	A task is presented as a means of achieving the skill of scientifically evaluating data and evidence.
6	*Bicara Biologi* 	Presented a means of connecting two-way communication to conduct discussion activities in achieving regulation skills
7	*Refleksi*	Presented a means of reflection by doing post-test questions as evaluation material

This E-KPD has features, reading materials, and activity/practicum steps that are blended learning used as a means of improving students' critical thinking skills. E-worksheet is presented in the form of a link which can then be accessed by students via a device or PC/laptop online. The features contained in this E-worksheet include *Fenomena Biologi*, *Wawasan Biologi*, *Berlatih Biologi*, *Memahami Biologi*, *Bicara Biologi*, and Reflection. Critical thinking skills that are improved in this E-worksheet include analysis, inference, explanation, evaluation, and self-regulation. The features of the E-worksheet are also supported by images, videos, and links to the website, google drive, and google form.

Validity of E-Worksheet

Validation was conducted to determine the validity of the E-worksheet based on the feasibility aspects of the content components, aspects of linguistic feasibility, presentation, blended learning, and critical thinking aspects. The validity results are presented in Table 2 below.

Table 2. E-worksheet Validation.

No	Aspects	Score		
		V1	V2	V3
Aspects of Content Component Feasibility				
1.	E-worksheet suitability	3	4	3,6
2.	E- worksheet content	3,8	4	4
Average Feasibility of content Components		3,73		
Score Interpretation (%)		93,25%		
Category		Very Valid		
Liungistic Appropriateness				
3.	Good readability	3	4	4
4.	Information held is clear	3	4	4
5.	Conformity of E- worksheet with the use of Indonesian language rules	3	3	4
6.	Effective and efficient use of language	3	3	4
7.	The language used is appropriate for the stundents' ability level	3	4	4
8.	Clear learning objectives	3	4	4
9.	Has a complete structure (title, instructions, objectives)	3	4	4
10	Language presentation is simple, easy to understand, and communicative	3	3	4
11	Conformity of identity to facilitate administration (name, absence number, class, etc.)	3	4	4
12	Suitability of clear E-worksheet usage instructions	3	4	4
Average Language		3,56		
Score Interpretation (%)		89%		
Category		Very Valid		
Presentation Aspect				
13	Systematization of presentation	3	3,66	4
14	Suitability of E- worksheet with the material taught	3	4	4

No	Aspects	Score		
15	E- worksheet display	3	4	3,6
16	Writing tools and materials in the E- worksheet	3	4	5
Average Presentation		3,60		
Score Interpretation (%)		90%		
Category		Very Valid		
Aspect of Blended Learning				
17	E- worksheet reflects the seeking of Information aspect that supports learners			
	Search for information from other sources related to membrane transport material	3	4	4
	Seek information from other sources related to the question posed	3	4	4
	Search for informations from other sources related to the hypothesis of the practicum that will be carried our	3	4	3
18	E- worksheet reflects the *Acqusiition of Information* aspect that supports learners			
	Understand information about membrane transport material	3	4	4
	Memahami informasi understand information about practicum activities that will be carried out	3	4	4
19	E- worksheet reflects the *Synthesizing of Knowledge* aspect that supports learners			
	Constructing knowledge from the results of practicum analysis	3	4	4
	Cosntructing knowledge from the result of practicum discussion	3	4	4
	Cosntructing knowledge from the result of formulating the conclutions of the practicum that has been carried out	3	4	4
Average *Blended Learning* Aspect		3,61		
Score Interpretation (%)		90,25%		
Category		Very Valid		
Aspects of Critical Thinking				
20	Analysis			
	Analyze the mechanism of passive membrane transport	3	4	4
	Identify examples of diffusion and osmosis activities in daily life	3	4	4
	Linking reference to other sources of information to answer the questions	3	4	4
21	*Inference*			
	Know the process of diffusions and osmosis	3	3	4
	Formulate the hypothesis of diffusion and osmosis practicum	3	4	4
22	*Explanation*			
	Carry out face-to-face diffusion practicum activities	3	4	4
	Carry out osmosis practicum activities using the Olabs virtual lab	3	4	4
	Analyze the data of diffusion practicum results	3	4	4
	Analyze the data of osmosis practicum using Olabs results	3	4	4
	Formulate conclusions based on data form diffusion practicum	3	4	4
	Formulate conclusion base on data from the osmosis practicum	3	4	4
23	*Evaluation*			
	Evaluate the data of diffusion practicum result	3	4	4
	Evaluate the data from the osmosis practicum	3	3	4
24	*Self-regulation*			
	Presenting the data of diffusions practicum results	3	4	4
	Presenting the data from osmosis practicum result	3	4	4
Average Critical Thinking Aspect		3,61		
Score Interpretation (%)		90,25%		
Category		Very Valid		
Overall Aspect Average		3,62		
Score Interpretation (%)		90,5%		
Category		Very Valid		

Description :

a. Validator 1 : Education expert lecturer
b. Validator 2 : Material expert lecturer
c. Validator : Biology teacher

Validity Score

a. 0 – 48 : Very Invalid
b. 49 – 61 : Invalid
c. 62 – 74 : Moderately Valid
d. 75 – 87 : Valid
e. 88 – 100 : Very Valid

The average result of the validity of E-worksheet development in the content feasibility aspect obtained a score of 3.76 and a percentage of 94% with a very valid category. This shows that the E-worksheet content feasibility aspect which includes the suitability of the E-worksheet with learning objectives and the content in the E-worksheet can motivate students to build their understanding of membrane transport material is declared very valid.

The average results of the validation of E-worksheet development in the linguistic aspect get a score of 3.56 and a percentage of 89% which is categorized as very valid. This shows that the linguistic aspects of E-worksheet which include E-worksheet can be read well; E- worksheet has clear information; E- worksheet conformity with the use of Indonesian language rules; the use of language is effective and efficient, the language used in E-worksheet matches the ability level of students; E- worksheet has clear learning objectives; E-worksheet has a complete structure (title, E- worksheet instructions, objectives); presentation of simple, easy to

understand, and communicative language; suitability of identity to facilitate administration (name, no. absent, class, and so on); and suitability of clear instructions for using E-WORKSHEET. absent, class, and so on); and the suitability of clear E- worksheet usage instructions show a very valid category. E-worksheet must have clarity and harmony of the language used with the level of maturity of students in the linguistic aspect so that the language or sentences can be more easily understood (Widjajanti, 2008).

The average results of E-worksheet validity in the presentation aspect get a score of 3.58 with a percentage of 89.5% which is categorized as very valid. This shows that the presentation aspect which includes systematic presentation, E-worksheet display, and writing of tools and materials in E-worksheet shows a very valid category. E-worksheet is classified as well presented if it contains attractive images and colors SO that students' understanding can increase (Pratama, et al, 2019). E-worksheet can attract students' interest which there is a combination of images, writing, and good layout (Iswanti & Pumomo, 2017) The average result of the validity of E- worksheet in the blended learning aspect obtained a score of 3.61 with a percentage of 90.25% which was categorized as very valid. This shows that the blended learning aspects which include seeking information, acquisition information, and synthesizing knowledge in E- worksheet show a very valid category. The average result of E- worksheet) validity on critical thinking aspects obtained a score of 3.61 with a percentage of 90.25% which is categorized as very valid. This shows that the aspects of critical thinking indicators, namely inference, analysis, explanation, evaluation, and self-regulation in E- worksheet show a very valid category.

The validation results of the E- worksheet development have an average of 3.62 with a percentage score of 90.5% which is categorized as very valid (Riduwan, 2018). The overall average score generated shows that the aspects assessed, mainly presentation aspects, content components, and language, show a valid category (Kurniawan, 2021). This shows that the development of E- worksheet can be said to be valid if it has a match between the content and the construction, namely in line with the curriculum used, the content of the E- worksheet is in line with the TP, and ATP prepared and the material to be provided, the use of communicative language, and an attractive layout design so that it can encourage increased student learning motivation (Pumamasari et al, 2018). The use of E-worksheet can increase students' enthusiasm for learning and their knowledge of cognitive science because E-worksheet is packaged with neat, interesting, and concise language systematics (Junita and Yuliani, 2022).

Practicality of E-worksheet

The practicality of the E-worksheet development was reviewed based on the results of the student response questionnaire test after using the E-worksheet during learning activities. Data on the results of the student response questionnaire are described in Table 3.

Table 3. Learner Response Questionnaire Data

No	Statement	Percentage (%)		Category
		Yes	No	
I. Display, components, and Language				
1.	E-worksheet has an attractive appearance	100	0	Very Practical
2.	E- worksheet are new to you	93,3	6,67	Very Practical
3.	E- worksheet uses language that is easy to understand	93,3	6,67	Very Practical
4.	The instructions for using the E- worksheet are easy to understand	90	10	Very Practical
5.	Information in E-worksheet is easy to understand	90	10	Very Practical
6.	Easy to understand work steps	93,3	6,67	Very Practical
7.	Easy to follow work steps	96,6	3,34	Very Practical
8.	The tools and materials contained in the E-worksheet are easy for you to get	90	10	Very Practical
9.	The question in the E-worksheet can be easily understood by you	90	10	Very Practical
Average Percentage of Appearance, Components, and Language		92,96		Very Practical
II. Conformity of E- worksheet with *Blended Learning Components*				
10.	E- worksheet helps you understand biology material more easily independently	96,6	3,34	Very Practical
11.	E- worksheet help illustrate real-life events in every life	96,6	3,34	Very Practical
12.	E- worksheet helps to find and apply material concepts in real lif	93,3	6,67	Very Practical
13.	E- worksheet helps communicate discussion results	93,3	6,67	Very Practical
14.	E- worksheet helps to work well in groups	93,3	6,67	Very Practical
15.	E- worksheet helps conduct experiments both	96,6	3,34	Very Practical

No	Statement	Percentage (%)		Category
		Yes	No	
	face-to-face and online			
16.	E-worksheet makes it easier to understand the experimental procedures conducted face-to-face or online	100	0	Very Practical
17.	E- worksheet helps collect data from the experiment	100	0	Very Practical
Average Percentage of Conformity of E- worksheet with *Blended Learning* Components		96,24		Very Practical
III. Suitability of E- worksheet with Critical Thinking Indicators				
18.	E- worksheet helps analyze the problem	93,3	6,67	Very Practical
19.	E- worksheet helps formulate lab hypothesis	93,3	6,67	Very Practical
20.	E- worksheet helps to explain the data from the practicum	96,6	3,34	Very Practical
21.	E- worksheet lead to providing reasonable explanation regarding the results of data analysis of practicum results	93,3	6,67	Very Practical
22.	E- worksheet helps evaluate the data from the practicum results	90	10	Very Practical
23.	E- worksheet helps to convey the results of the practicum	93,3	6,67	Very Practical
24.	E- worksheet help you to reflect on what you have done during the learning activities	96,6	3,34	Very Practical
Average Percentage of Conformity of E- worksheet with Critical Thinking Indicators		93,80		Very Practical
Overall Average		94,33		Very Practical

Student response questionnaire score :

a. 0 – 48 : Very Unpractical
b. 49 – 61 : Unpractical
c. 62 – 74 : Moderately Unpractical
d. 75 – 87 : Practical
e. 88 – 100 : Very Practical

The response questionnaire was given to students who had used the E- worksheet) by answering "Yes" or "No" to the 24 questions available. Based on the results of the student response questionnaire presented in Table 3, it can be seen that the average score obtained is 94.33%, which means it is categorized as very practical. The results of this response questionnaire state that the E-worksheet has an attractive presentation for students with the selection of an appropriate color palette and writing that can be read clearly. If the readability of a teaching material is not by students, learning will be hampered. Therefore, choosing a good font must pay attention to the level of readability because the more complicated the font used, the more difficult it will be for students to read and understand (Susanti et al, 2021). In addition, the graphic design in the E- worksheet, starting from the cover, presentation, and attractive layout can stimulate students' learning motivation (Adi et al, 2021).

The data from the students' response questionnaire in the aspect of the suitability of E-worksheets with blended learning components get an average percentage score of 96.24% which is categorized as very practical. Based on this response questionnaire, states that the E-worksheet has a clear blended learning component. The data from the students' response questionnaire on the aspect of the suitability of the E- worksheet with the critical thinking component obtained an average percentage score of 93.80% which is categorized as very practical. The results of this response questionnaire state that the E- worksheet has critical thinking components, namely inference, analysis, explanation, evaluation, and self-regulation that can be read clearly. In general, E-worksheets based on blended learning can help learning activities. A learning instrument can meet practical criteria if it is easy to use and not complicated (Arikunto, 2010).

The practicality of the blended-based E-worksheet was also reviewed based on the questionnaire of student activity implementation. Data from the questionnaire results of student activity implementation are described in Table 4.

Table 4. Data from Questionnaire Results of Implementation of Leamer Activities

No	Learner activity	Precentage (%)		Category
		Yes	No	
1.	*(Seeking of Information)* Discussion in groups using E-worksheet	100	0	Very Practical
	a. Observation of pictures of differences between watered and unwatered plants	100	0	Very Practical
	b. Finding out what happens to plants that are watered and plants that are not watered	83,34	16,66	Practical
	(analysis) a. Identify examples	100	0	Very Practical

No	Learner activity	Precentage (%)		Category
		Yes	No	
	of diffusion and osmosis activities in daily life			
	b. Discovering learning concepts independently by reading readings in E- worksheet	100	0	Very Practical
	(Inference) c. Make hypothesis based on the problem formulations of diffusion practicum	100	0	Very Practical
2.	*Synchronous Acquisition of Information* (Explanations) a. Diffusion practicum activity to prove the hypothesis made	100	0	Very Practical
	b. Determine the data from the diffusion practicum	100	0	Very Practical
	c. Analyze the data from the diffusion practicum	100	0	Very Practical
	d. Make conclusion based on the data from the diffusion practicum	100	0	Very Practical
	(Evaluasi) e. answering the questions as an evaluation of diffusion practicum	100	0	Very Practical
3.	*Synchronous Synthesizing of Knowledge* (Self-Regulation) Make a diffusion practicum paper	76,67	23,33	Practical
4.	*Asynchronous Seeking of Information* (Inference) Make a hypothesis based on the formulation of exisiting problems in osmosis practicum conducted through Olabs virtual	100	0	Very Practical
5.	*Asynchronous Acquisition of Information* (Explanation) a. Perform practical osmosis activities to prove the hypothesis			
	b. Determine the data of osmosis practicum	100	0	Very Practical
	c. Analyze data from osmosis practicum	100	0	Very Practical
	d. Make conclusions on data from osmosis practicum results	100	0	Very Practical
	(Evaluation) e. Answering question as an evaluation of osmosis practicum activities	100	0	Very Practical
6.	*Asynchronous Synthesizing of Knowledge* (Self Regulation) Make a report on *Rheo discolor* leaf osmosis	93,34	6,66	Very Practical
7.	Reflect and evaluate by presenting the results of their work then get suggestions and criticism	100	0	Very Practical
8.	Reflect and evaluate by filling in the reflections link	100	0	Very Practical
Average Percentage Implemented(%)		97,77		Very Practical

Student activity implementation questionnaire score

a. 0 – 48 : Very Unpractical
b. 49 – 61 : Unpractical
c. 62 – 74 : Moderately Practical
d. 75 – 87 : Practical
e. 88 – 100 : Very Practical

The questionnaire for the implementation of participant activities was given to four observers who observed students using the E-worksheet by giving a check mark (1) on 13 available questions. Based on the results of the student activity implementation questionnaire presented in Table 4, it can be seen that the average score obtained is 97.77%, which means it is categorized as very practical. This shows that almost all students carry out the activities in the E- worksheet based on blended learning. While as many as 2.23% of students who did not carry out activity activities on E- worksheet. This is due to the different circumstances of students when carrying out learning activities. Several factors

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influence learning activities and learning outcomes, namely internal aspects consisting of health, intelligence, talent, interest, and motivation and external aspects consisting of family, community, school, and the surrounding environment (Dalyono, 2009)

Effectiveness of E-worksheet

The effectiveness of E-worksheet development is reviewed from the completeness of student learning outcomes after using E-worksheet in learning activities. The completeness of student learning outcomes is measured by working on evaluation questions available on the E-worksheet. The test was conducted twice, namely the pre-test at the beginning of the learning activities and the post-test after the trial use of E-worksheet. The increase in pre-test and post-test scores will be analyzed using the gain score method. Students' critical thinking skills are assessed through tests, 5 multiple choice questions, and essays, where each question tested is prepared based on critical thinking indicators to be improved, namely analysis, inference, explanation, evaluation, and self-regulation. The results of the data on the completeness of students' learning outcomes in the pre-test and post-test are described in Table 5.

Table 5. Data on the completeness of student learning outcomes

R	No	Pre-test		Post-test		N-Gain	Category
		Value	Criteria	Value	Criteria		
1	2	65	NC	100	C	1	High
2	3	80	C	100	C	1	High
3	6	75	C	100	C	1	High
4	10	80	C	100	C	1	High
5	11	80	C	100	C	1	High
6	13	80	C	100	C	1	High
7	23	80	C	100	C	1	High
8	28	65	NC	100	C	1	High
9	5	65	NC	90	C	0,71	High
10	16	65	NC	90	C	0,71	High
11	17	65	NC	90	C	0,71	High
12	21	65	NC	90	C	0,71	High
13	27	60	NC	90	C	0,75	High
14	30	60	NC	90	C	0,75	High
15	1	65	NC	85	C	0,57	Medium
16	4	70	NC	90	C	0,66	Medium
17	7	65	NC	85	C	0,57	Medium
18	8	65	NC	85	C	0,57	Medium
19	9	60	NC	85	C	0,62	Medium
20	12	80	C	90	C	0,5	Medium
21	14	60	NC	80	C	0,5	Medium
22	15	60	NC	80	C	0,5	Medium
23	18	80	C	90	C	0,5	Medium
24	19	60	NC	85	C	0,62	Medium
25	20	80	C	90	C	0,5	Medium
26	22	75	C	90	C	0,6	Medium
27	24	65	NC	80	C	0,42	Medium
28	25	60	NC	85	C	0,62	Medium
29	26	65	NC	80	C	0,42	Medium
30	29	75	C	90	C	0,6	Medium
Average		69		90		0,71	
Completeness		65		NC		85	
Category		70		NC		90	

Description

C : Completed

NC : Not Completed

Based on Table 5, the data on the completeness of student learning outcomes shows that the completeness of learning outcomes before using E-worksheet in 30 students of class XI SMA Negeri 1 Baureno gets a percentage of class completeness of 55% with a fairly effective percentage category. The value of the completeness of learning outcomes after using the E-worksheet gets a percentage of class completeness of 100% with a very effective category. The results of the n-gain score, the average n-gain score of students is 0.71 which is categorized as high. Students' critical thinking skills are also seen by the achievement of critical thinking indicators in the E- worksheet which are contained in Figure 1 below.

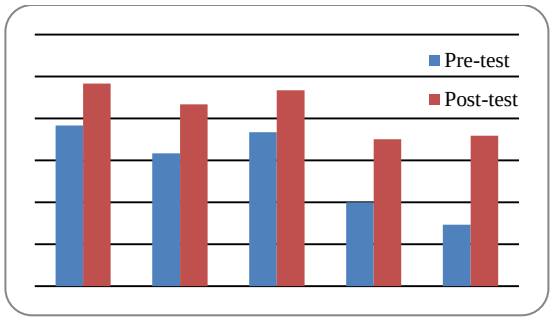

Figure 1. Recapitulation of Critical Thinking Indicator Achievement Results

Based on Figure 1, it can be seen that before using an E-worksheet based on blended learning, the achievement of critical thinking skills indicators of inference, analysis, and explanation is in the medium category and critical thinking indicators of evaluation and self-regulation are in the low category. After using an E-worksheet based on blended learning, the achievement of critical thinking skills indicators of inference, analysis, and explanation is in the high category, and critical thinking indicators of evaluation and self-regulation are in the medium category.

The application of blended learning can be used to significantly improve students' critical thinking skills (Anggreani, 2019). This is because the blended learning model can expand the range of learning where students can learn from any source (Idris, 2018). This is evidenced by the increase in the average post-test score by 21 compared to the average pre-test score.

Based on E-worksheet work by students on the biological phenomenon feature with critical thinking indicators, all groups answered correctly. In the biology insight feature with critical thinking indicators of inference, four groups answered correctly and one group answered incorrectly. In the biology practice feature with critical thinking indicators of explanation in the diffusion practicum, all groups answered correctly. In the biology evaluation feature with critical thinking indicators of evaluation in the diffusion practicum, three groups answered correctly and two groups answered incorrectly. In the biology insight feature with critical thinking indicators of inference in the osmosis practicum, four groups answered correctly and one group answered incorrectly. In the biology practice feature with the critical thinking indicator of explanation in the osmosis practicum, all groups answered correctly. In the biology talk feature with critical thinking indicators of self-regulation, three groups answered correctly and two groups answered correctly.

Students' critical thinking skills can be improved by learning activities that involve the active role of students during learning activities and collaboration (Karim et al, 2018). Based on Figure 1, the results of the achievement of critical thinking indicators show an increase. Before using E-worksheet, students' critical thinking skills varied from low to moderate. The low critical thinking skills of students are because students have not been able to apply their knowledge in terms of problem-solving, students are only able to memorize (Maknun, 2019). This is because students are less active during learning activities, so learning activities are not meaningful to students (Zulaifah & Fauzi, 2023). In addition, experimental activities, scientific skills training activities, and scientific use of science are little used during learning activities (Setiadi, 2014). The critical thinking indicators of inference, analysis, and explanation get a high score. High scores were obtained because students had the ability to analyze and conduct sufficient experiments beforehand. The critical thinking indicators of evaluation and self-regulation get a score getting a sufficient score. The score is sufficient on the critical thinking indicators of evaluation and self-regulation because students rarely do evaluation and presentation activities beforehand. This is in line with Sinaga and Simanjuntak (2020) that the results of the critical thinking skills test show an increase in critical thinking skills.

Tridiwanto and Trishandra's research (2020) showed that critical thinking skills can be improved by using a practicum module based on blended learning. This is because one of the factors that can present indicators of critical thinking skills is the use of blended learning. The role of the teacher is still very much needed in learning activities, where the teacher is a facilitator and evaluator who interacts with students which can affect learning outcomes (Muzenda, 2013). The use of virtual laboratories for practicum activities can indeed overcome the limited facilities and time for schools. Virtual laboratories can also provide different experiences for students in carrying out practicum activities.

However, the use of virtual laboratories must also be adjusted to school conditions because it requires facilities and infrastructure such as internet access and electronic devices such as laptops and devices. The use of virtual laboratories cannot provide experiences like real laboratories, for example, the experience of students interacting with practicum tools and materials in real laboratories. Learners who have carried out real practicum in the laboratory are also easier to instruct in using virtual laboratories than learners who have not previously carried out practicum activities at all. Therefore, although the use of virtual laboratories can

overcome some of the limitations that schools have in carrying out practicum, the use of real laboratories cannot be eliminated. The use of virtual laboratories is recommended for schools that have facilities and infrastructure such as internet access and the use of electronic devices such as computers, laptops, and gadgets. Based on the discussion of the results of validity, practicality, and effectiveness, overall the use of E-worksheet blended learning can be used in improving students' critical thinking skills.

CLOSURE

Conclusion

E- worksheet based on blended learning to improve student's critical thinking skills on membrane transport material is declared valid and feasible to use during learning activities with the validity results obtained from three validators of 3.62 with a percentage of 90.5% and categorized as very valid. E-worksheet is declared practical based on the results of students' responses to the use of E-worksheet development obtained an average percentage score of 94.33% and the results of the questionnaire for the implementation of students' activities regarding the use of E-worksheet development obtained an average percentage score of 97.77% which is categorized as very practical. E-worksheet is declared effective based on the test results of students on the use of E-worksheet development has increased with a vulnerable N-gain of 0.71 with a very effective category. The effectiveness of the E-worksheet development is also supported by the results of 100% complete student learning completeness.

Suggestion

Researchers suggest that the need for habituation of learning with E-worksheet blended learning in familiarizing students' critical thinking skills can be applied to other biological materials so that students get used to it and students' critical thinking skills can be improved properly.

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