



Development of Science Literacy-based E-Booklet to Improving Students' Critical Thinking Ability on Immune System Materials

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Abstract

The immune system is one of the most difficult subjects for students. In view of this, the use of technology as a learning medium for immune system material is one way to help students improve their critical thinking skills. This study aimed to develop and analyze the application *e-booklet* to be effective and able to improve students' critical thinking skills on immune system material. The research method used was *Research and Development* (R&D) using the *Four-D*. The research instrument used is an instrument in the form of a questionnaire and a test. The data analysis technique was in the form of a questionnaire using a Likert scale and a test using the n-Gain formula. This research was carried out in January-October 2021. The subjects of this study were students of class XI MIPA 4 at one of the public high schools in Bogor Regency for the academic year 2020/2021 as many as 36 students. field trial was conducted in a limited manner using a *one group pretest-posttest*. The results showed that the *e-booklet* developed had a very valid/feasible category with a percentage of 83.2%. For the feasibility test, three media and materials experts and two high school biology teachers were used. Critical thinking questions that have been validated also have a very valid category. Moreover, this scientific literacy e-learning also able to improve students' critical thinking skills from moderate to high.

Keywords: Critical Thinking; *E-Booklet*; Immune System

INTRODUCTION

Global demands on education always adapt to technological developments (Budiman, 2014). Education is an asset for the progress of a country whose development is always side by side with technology and the times to help students learn (Budiman, 2014). With the development of technology, the learning process is also developing very rapidly, for example learning via mobile phones (Purwanti, 2021). According to Saat (2015) education is a system consisting of teachers, students, educational facilities, educational goals and educational environment.

Quality education is education in which all learning objectives are achieved. The quality of Indonesian education can be seen from the results of an international study, namely PISA (*Program for International Student Assessment*) on scientific literacy, mathematics and reading in 2019, which was ranked 74th out of 79 countries and is classified as low. This shows that the quality of science learning in Indonesia is not uniform and comprehensive. The condition of the scientific literacy level of students at the MA/SMA level is still in the low category due to learning that does not empower students to carry out the scientific process (Fadilah *et al.*,

2020). In learning science in schools, students do not improve their understanding of the material to be applied in everyday life. Thus, students' critical thinking skills in solving problems and finding solutions are low.

Based on the results of observations made at SMA Negeri 1 Ciomas on September 28, 2021, it was found that the level of critical thinking of students on the immune system material was low, it was proven that there were still many students' scores that were below the average and did not reach the KKM (Minimum Completeness Criteria) for Science, which was 75. The results of the analysis of student characteristics, namely the ability to think critically based on a questionnaire in the form of a *Google form*, obtained a percentage of 35% with a very low category. In the learning process the teacher still uses *power point* with teaching methods in the form of lectures and has not used learning media in teaching.

Critical thinking is a person's mental activity in thinking to evaluate an argument and make decisions. The ability to think critically in learning to use mental with intellectual processes such as observing, finding, analyzing and evaluating information from observation and experience as well as taking an action (Wahyudi *et al.*, 2019).

Learning media plays an important role in the learning process to support the success of education in the teaching and learning process. The success of learning is determined from the use of learning media that matches the material being taught. According to Purwono *et al.*, (2014), one of the learning media currently widely used by teachers is audio-visual media. According to Rahmawati & Zaka (2021), the presence of videos, images, and sounds in learning media can improve students' critical thinking skills and make it easier for students to understand the subject matter. The use of computer-based learning media is an important thing that must be developed in the learning process to facilitate and improve critical thinking skills (Latip & Permanasari, 2015). All learning media tools and materials that can be used are radio, television, books, newspapers, magazines, internet, and so on (Rao, 2019). One of the learning media that can contain audio-visual is *e-booklets* or electronic books. According to Azinar & Fibriana (2019), *e-booklets* are media that can be accessed easily on electronic devices such as computers, tablets, and smartphones. *E-booklets* can also be used in the learning process in the classroom and outside the classroom (Setiawan & Wardhani, 2018). The material listed in the *e-booklet* is material that has many explanations and pictures to explain briefly (Darlen *et al.*, 2015). *E-booklets* can help students to improve students' critical thinking skills towards material, especially the immune system which has been considered difficult because in *e-booklets* there are interesting interactive features in the form of learning videos that can stimulate students in understanding the material and have the potential to develop critical thinking skills. student. This is supported by the research of Pujiasih *et al.*, (2021) which states that *e-booklets are* effective in improving students' critical thinking skills and increasing students' affectiveness towards environmental care attitudes.

Based on the description above, this study intends to develop an *e-booklet* based on science literacy in improving students' critical thinking skills on immune system material with the title "Development of *E-Booklet* in Improving Students' Critical Thinking Ability on Immune System Materials".

METHOD

The product developed in this research is an *e-booklet* based on scientific literacy to improve students' critical thinking skills. This research was conducted in one of the public high schools in Bogor Regency, in the odd semester of 2021/2022 for one of the XI classes, totaling 36 students. The development model used in this research is a 4-D model (*four D*) consisting of *define, design, develop, and disseminate* which was developed by Sugiyono 2011, which is one of the development models and *Research and Development* (R&D) methods. This model was chosen on the basis of the consideration that this model is used to develop or validate products used in education and learning (Sugiyono, 2011). In this study, a limited trial was used, namely the *One Group Pretest-Posttest design* to determine the differences in the improvement of students' critical thinking skills. In this study, we did not use a comparison class to find out

more precisely the magnitude of the effect of using an e-booklet and it was replaced using an initial test.

In the defined stage ,curriculum analysis, student analysis, learning media analysis, and analysis of learning objectives are carried out. The *design* media product *e-booklet* with a content framework as a result of the needs analysis that has been carried out. Next *development* media products *e-booklet* to improve students' critical thinking skills and validating the products developed and conducting limited trials in class XI MIPA 4. It begins with a *pretest* and ends with a *posttest* after being given the treatment listed in Table 1.

Table 1. Research design

Sampel	Pretest	Treatment	Posttest
Experiment	O ₁	X	O ₂

Description:

X₁ = Media treatment *E-Booklet*

O₁ = *Pretest*

O₂ = *Posttest*

Finally disseminate, disseminates e-booklet after viewing it if the results of the limited trial show consistent results.

Data collection techniques carried out in this study used validation sheets, tests, observations and questionnaires. The validation sheet is used to find out how feasible the media developed can be used in the learning process. The test is used to obtain the value of students' critical thinking skills with the type of essay test which consists of 10 questions. The critical thinking indicators used according to Ennis in (Khasanah *et al.*, 2017) include basic clarification, providing reasons for decisions, concluding, further clarification and thinking and considering reasons.

Test the validity of the feasibility or suitability of the content of the test using analysis by expert judgment (assessment of experts) with a scale of 1 to 5 and proven using the Aiken index formula proposed by (Retnowati, 2016). With the formula:

$$V = \frac{\sum S}{N(C - 1)}$$

Description:

V = Index of expert agreement regarding item validation

S = R- L₀

L₀ = The lowest validation

C = The highest validation score

N = Number of experts/validators

R = Numbers given by experts

Data analysis techniques are processed and analyzed by type. The data analysis technique of student answer scores on critical thinking ability test questions uses scoring guidelines according to (Wiliyati, 2012). And calculated by the formula:

$$\text{Student's Value} = \frac{\text{Score of answers obtained}}{\text{Maximum score}} \times 100\%$$

The results of the percentage of critical thinking values are interpreted according to (Arikunto, 2003). To calculate the increase in students' critical thinking skills using the gain index formula. With the formula:

$$(g) = \frac{((\%post) - (\%pre))}{(100\% - (\%pre))}$$

Description:

- < g > = average normalized gain
- % post = score after being treated
- % pre = score before being treated

The results of the calculation of the average value of normalized gain then converted into the classification of normalized gain according to (Sukmadinata, 2007) . Calculation of validation data for e-booklet uses the formula according to (Arikunto, 2013). With the formula:

$$P = \frac{\sum X}{\sum Xi} \times 100\%$$

Description:

P = Percentage of Eligibility

X = Answer Validation Score (Real Value)

Xi = Highest Answer (Expected Value)

The results of this percentage are converted into criteria (Arikunto, 2013).

RESULT AND DISCUSSION

Eligibility of Learning Media

The product developed is an e-booklet based on science literacy using Flip PDF Corporate Edition for making e-booklet into a book-like form and adding videos in the *e-booklet*. This learning media is expected to help educators and students in the learning process. Students are expected to be able to learn independently anywhere and anytime so that they can improve their critical thinking skills.

The learning media developed consisted of a front cover and a back cover. front cover contains the title e-booklet, class, and a picture of a virus with a health symbol which means a defense system for the body. On the back cover there is an explanation of the use of *e-booklet* . The front and back cover pages can be seen in Figure 1.

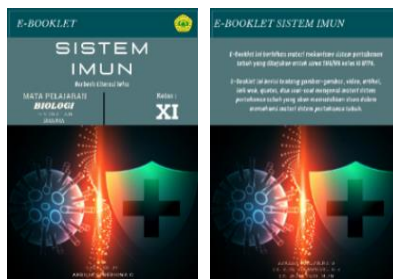


Figure 1. Front and back cover pages

To instill scientific literacy in students and improve students' critical thinking skills, there are supporting features in the e-booklet. In Figure 2 there are features of Portions (information corner) and Artology (biological articles). The portion contains information sourced from articles and journals as supporting material for the immune system. And Artology contains news and information related to the material that begins with questions to stimulate students' critical thinking and student curiosity. Portion and Artology page display can be seen in Figure 2.



Figure 2. Portion and Artology page image

To stimulate students' critical thinking skills, there is a Kovit feature (activity column) and quizzes containing questions to stimulate students' critical thinking and determine the ability to understand the material on student. The display of the Kovit and quiz pages can be seen in Figure 3.



Figure 3. Images of the Kovit and Quiz pages

To stimulate students' critical thinking skills and attract students' attention in learning, the e-booklet is equipped with interesting learning videos and quotes containing motivational wise words and inspiring for students. The display of the learning video page and quotes can be seen in Figure 4.



Figure 4. Image of the learning video page and quotes

Data from the validation results e-booklet on the immune system material from five validators, namely three expert lecturers and two biology teachers on three aspects namely the content/content aspect, the language aspect and the display aspect. For the content/content aspect, it is presented in Figure 5.

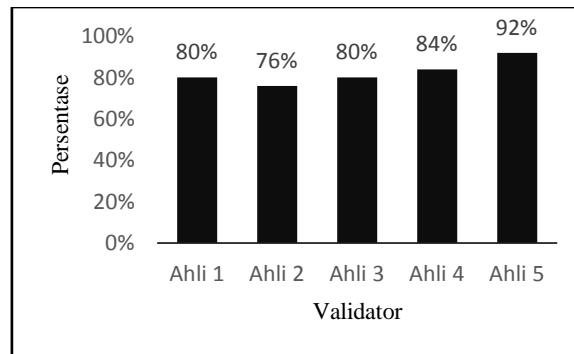


Figure 5. Learning media e-booklet on the content/content aspect

In Figure 5 it is found that in the content/content aspect of the assessment by expert validators 1 and 3 obtained a percentage of 80%, expert 2 obtained a percentage of 76%, expert 4 of 84% and expert 5 of 92%. The average value of the percentage of validation by experts in the content aspect is 82.4% and the category is very valid. This shows that the e-booklet on immune system material is included in the very valid criteria and is worthy of being used as a learning medium in the aspect of content. According to Yulianti et al (2019), to attract students to use the e-booklet, the materials presented must include interesting pictures and videos.

Data of the validation results of the e-booklet by the expert validator is then on the language aspect. For the language aspect, it is presented in Figure 6.

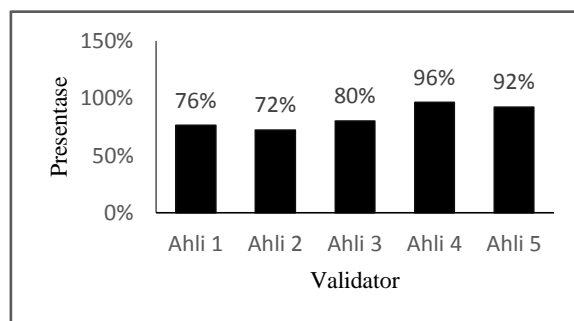


Figure 6. The image of the validation results of the e-booklet on the language aspect.

In Figure 6 it is found that in the language aspect, the assessment by the expert validator 1 obtained a percentage of 76%, expert 2 obtained a percentage of 72%, expert 3 obtained the percentage of 80%, expert 4 obtained an almost perfect percentage of 96%, and expert 5 obtained a percentage of 92%. The average value of the percentage of validation by experts in the language aspect is 83.2% and the category is very valid. This shows that the e-booklet on the immune system material on the language aspect is included in very valid criteria and is suitable for use as a learning medium. According to Panjaitan et al (2016), the use of vocabulary and language in the media to make it easier for students to understand the meaning of sentences and words used in the media does not use language that can lead to multiple meanings. The use of language that is easily understood by students can make it easier for students to understand the material on the media so that students' understanding of the material increases.

Data from the validation results of e-booklet by expert validators on the last aspect, namely the display aspect. For the display aspect, it is presented in Figure 7.

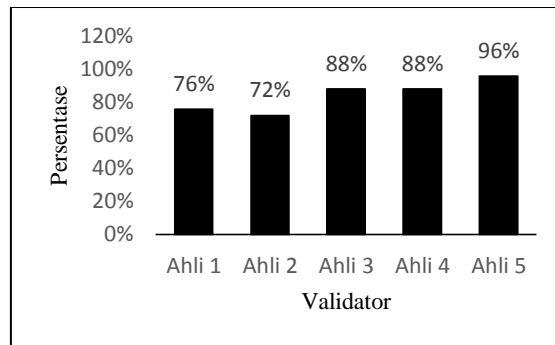


Figure 7. Learning media e-booklet on the display aspect

In Figure 7 it is found that in the display aspect, the assessment by the expert validator 1 obtained a percentage of 75%, expert 2 obtained a percentage of 72%, expert 3 and 4 obtained the same percentage of 88%, and expert 5 obtained the highest percentage of 96%. The average value of the percentage of validation by experts on the display aspect is 84% and the category is very valid. This shows that the e-booklet on immune system material is included in the very valid criteria and is suitable for use as a learning medium in the display aspect.

Based on the data that has been described, the results of the validation of the e-booklet on the immune system material by five validators, namely three expert lecturers and two biology teachers from three aspects of content, language and appearance, got an overall percentage score of 83, 2%. This shows that the e-booklet is included in the very valid criteria without revision and is feasible to be used for testing with students in class. The material on the immune system is presented briefly starting from the understanding of the immune system, the function of the immune system, the mechanism of the immune system, examples of the immune system in everyday life, learning videos, interesting pictures that support the material on the immune system and examples of questions that can improve students' critical thinking skills.

The data from the instrument validation on critical thinking were validated by three expert validators. results of the instrument validation on critical thinking questions are presented in Figure 8.

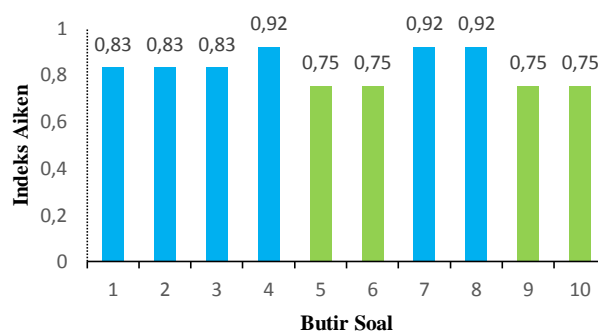


Figure 8. Image of the results of the validation of the instrument for critical thinking.

In Figure 8 it is found that the validation results by three expert validators are known that 6 out of 10 questions have a very valid question category (high validity) with The highest aiken value is 0.92 while the other 4 questions have a fairly valid category (medium validity) with the same value of 0.75. The total aiken value obtained is 0.83 with a very valid/high validity category because it has V 0.8. This shows that the critical thinking question instrument can be used for testing the feasibility of e-booklet in improving students' critical thinking skills. Questions used to measure higher order thinking skills must be given a basic question (stimulus) that begins with the source/reading material in each item (Rosnawati, 2012).

Improving Students' Critical Thinking Ability

The results of students' critical thinking ability tests to test the effectiveness of the e-booklet on students are from pretest-posttest. The results of the pretest-posttest of students are presented in table 2.

Table 2. Results pretest-posttest student

No.	Implementation Criteria	Pretest	Posttest
1.	Number of students	36	36
2.	Total Value	1518	2886
3.	Score Maximum	60	92
4.	Score Minimum	26	70
5.	Average	42,17	80,17
Nilai <i>N-Gain</i>		0,66 (Medium/Effective Enough)	

Based on table 2 the average percentage pretest obtained is 42.17% in the medium category and the posttest of students' critical thinking skills obtained is 80.17% in the high category. And obtain an n-gain value of 0.66 with moderate/fairly effective criteria. This shows an increase in students' critical thinking skills by 38.00% and states that the use e-booklet is quite effective in improving students' critical thinking skills significantly. This is in line with (Ngurahrai et al., 2019) that the use of learning media can train students' critical thinking skills which can help students and teachers in the learning process. The importance of training students' critical thinking skills in schools can prepare young people who are able to make decisions and become critical thinkers (Siburian et al., 2019).

Learning media e-booklet have also been carried out by (Muhdar et al., 2018) and (Rosida et al., 2018) in that study it was also stated that the use of e-booklet effective in improving students' critical thinking skills and knowledge.

CONCLUSION

Learning media e-booklet developed is valid and effective so that it is feasible to use. effectiveness of the e-booklet as seen from the students' critical thinking skills after using the e-booklet experienced a significant increase, and was included in the moderate or moderately effective category. So that the e-booklet media can be used as an alternative learning medium in schools on immune system material to help improve students' critical thinking skills.

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