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Website-Based Interactive Learning Media to Improve Students' Critical Thinking Abilities on Body Defense System Material Class XI High School

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Abstract: This study aims to develop website-based learning media on the body's defense system and test interactive learning media's feasibility, practicality, and effectiveness to improve students' critical thinking skills. They used the ADDIE model (analysis, design, development, implementation, and evaluation). The trial of interactive learning media based on the body's defense system website was conducted using a pseudo-experimental research method using a non-equivalent pretest-posttest control design. The number of field trial subjects was 60 students from class XI MIPA SMA Negeri 1 Cangkringan, consisting of 30 experimental class students and 30 control class students. The data sampling technique used a critical thinking skills test questionnaire. The effect of website interactive learning media on essential thinking skills was measured using SPSS 26 with t-test, effect size, and correlation test. The results showed that the website-based interactive learning media is feasible and practical for teachers and students. This media is efficacious in improving students' critical thinking skills.

Keywords: Body defense system; Critical thinking; Learning media; Web-based interactive

Introduction

Critical thinking skills are the most essential capital for graduates to face intense competition in the 21st century. Among all competencies, critical thinking is often included in the list of competencies that must be acquired for 21st-century education. By formulating an assessment of critical thinking skills in learning, graduates can become ready to become critical thinkers in the world of work (Susetyarini et al., 2020).

However, based on several studies that have been carried out, the results show that students' critical thinking abilities in Indonesia still need to improve. This aligns with research conducted by Ningrum et al. (2023), which obtained a critical thinking ability score at SMA Negeri 9 Semarang of 54.7% or still in the low category. Research conducted by Benyamin et al. (2021) obtained the critical thinking ability score at St Thomas Aquinas High School NTT was 43.01% or still in the low category, and most recently, research conducted by Ferazona (Ferazona, 2022) at SMA Negeri 1 Tanah Putih Lampung was 3.85% or in the deficient category. This is reinforced by the results of the 2022 PISA scores, which show that Indonesia has indeed experienced an increase in its ranking in reading literacy and scientific literacy compared to 2018. However, its score has decreased by 13 points compared to the average for other countries, which only experienced a decrease of 12 points. This ranking increase also occurred in 2015, so it can be concluded that Indonesia has not experienced a significant increase in ranking, which means that Indonesia's PISA score is still relatively low compared to other countries (OECD, 2023). According to Sa'adah et al. (2020), the reason for the low PISA scores is that

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students need to be used to answering PISA questions, which require students to think at a higher level, such as critical thinking. Apart from that, the low critical thinking ability, according to Afni et al. (2022) in their research states that the low PISA scores in Indonesia are because students' abilities are only limited to remembering and recognizing knowledge based on facts and have not yet reached the point of understanding and linking it with other, more concrete, scientific concepts. Relate it to everyday problems. The current development of information and communication technology has experienced an increase in increasingly advanced learning skills. The existence of a learning process carried out in education is necessary so that there are changes in a person as a result of the learning process to produce personal qualities in terms of attitudes, knowledge and skills (Permendikbud, 2016). One of the basic skills students must have in 21st-century learning is the ability to think critically. Literacy can create a culture of critical thinking in students, starting with reading and writing activities. As stated by Rafi et al. (2021), literacy culture has several benefits, such as training students' basic abilities to develop critical thinking skills. Students who have good literacy skills will also have critical thinking skills.

The results of interviews with teachers and students at SMA Negeri 1 Cangkringan showed that the body's defence system material was complex in class XI. This can be seen from the students' KKM scores in the body defence system subject, which are still relatively low. The student questionnaire results prove that 72.5% of students consider the body's defence system to be complex material in class XI. This is due to the results of tests related to the body's defence system at SMA Negeri 1 Cangkringan, which obtained an average score of 1.4 for the ability to understand, 1.4 for the ability to assess, and 1.8 for the ability to apply. The teacher also said that the low KKM score on body defence system material among students was caused by several factors, such as the learning time being very short because the material was at the end of the semester, as well as the use of innovations in learning media which were still not widely implemented. In line with the questionnaire results, 93% of the learners still used textbooks, and 7% used PowerPoint media. These results conclude that technological media in classroom learning must still be appropriately utilized.

Media use in learning is essential in helping students understand the material well. Several media can be used in learning, including interactive learning media. Interactive learning media is learning media that helps students convey material, present objects, and overcome space and time barriers during the learning process. Interactive learning media, especially website-based, can provide students with a more exciting and enjoyable learning atmosphere. According to (Wedayanti et al., 2022), one of the things teachers do to train critical thinking skills is by using the Problem-Based Learning learning model (Kurniawan et al., 2023). According to Asyhari et al. (2021) Problem-Based Learning in biology learning is considered one of the contextual, innovative learning designs because it can encourage students to learn biology from real problems (cases) found around us and train students to become reflective learners. Therefore, based on the results of the presentation above, the author is aware that there is a need for innovative learning media in the body defence system learning process, which is expected to improve students' critical thinking abilities. So research is needed related to "Development of Website-Based Interactive Learning Media to Improve Students' Critical Thinking Abilities on Body Defense System Material for Class XI SMA.

Method

The research carried out in this research is a type of research and development (R&D) which aims to develop a new product or improve an existing product. This research was conducted to develop and test web-based interactive learning media's feasibility, practicality and effectiveness in improving students' critical thinking skills in class XI high school immune system material. The development model used in this research is ADDIE. The development of the ADDIE model was developed by Dick & Carry (1996) to design learning systems (Mulyatiningsih, 2013).

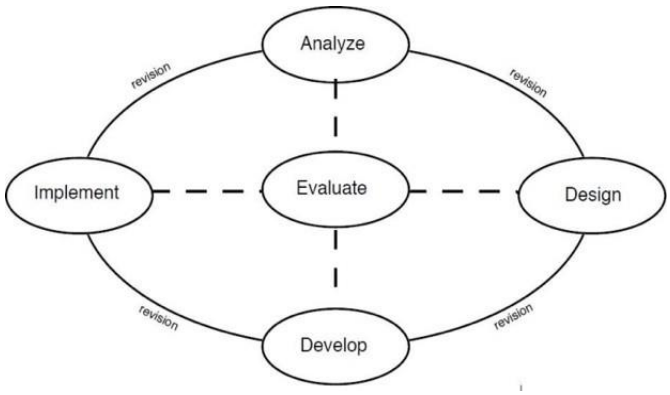

Figure 1. ADDIE model chart (Handayani et al., 2021)

Analyze

This stage is the initial step that is used for designing development learning media products based on the decisions of teachers and students at SMAN 1 Cangkringan. The analysis stage consists of curriculum and competency analysis, instructional analysis, and analysis of student needs, characteristics and problems.

Design

This stage formulates objective learning, preparation device learning, design of learning media products based on the content, selection of teaching media, design of framework products that include flowcharts and design features, design of fill material, and plan evaluation activity learning.

Development

This stage is the realization of the product from the design features and flowcharts that have been designed in the stages. The stages are: (a) Stage 1 is the production of the beginning product in the form of an interactive media-based website. (b) Stage 2 is validating products, instruments, critical thinking, and teaching modules by lecturers and experts. (c) Stage 3: try limited.

Implementation

This stage is the Meropidan stage application product that has been developed. The purpose is to know the effectiveness of interactive websites in increasing the ability to think critically in the learning process before and after using interactive websites that have been developed.

Evaluate

This stage is done every time stage of the research and development process product.

Design Trial Product

Design Trial

a) Trials limited

Thirty students in class XII MIPA carried out the learning material defense system body.

b) Field trials

One control class and one experimental class were involved in class XI Science. The experimental design used in the field scale trial was a pretest-posttest control group design.

Table 1. Experimental Design Pretest-Posttest Control Group Design

Group	Pretest	Treatment	Posttest
Experiment	Y1	X1	Y1
Control	Y2	X2	Y2

Information:
Y1 : Test before learning (pretest)
Y2 : Test after learning (posttest)
X1 : Learning use interactive websites
X2 : Learning use book lesson like normal

Test Subjects

This research product is student class XI Science SMA Negeri 1 Cangkringan, even semester year 2023/2024 teachings using material system defence body. The test subjects are limited to 30 of class XII MIPA 1, and the test subjects field is all over student class XI MIPA 1 with a total of 30 people and all student class XI MIPA 2 with a total of 30 people.

Techniques and Instruments Data Collection

a) Data collection technique

Data collection techniques in this research consist of observation, interviews, questionnaires and tests.

b) Instrument data collection

Instrument data collection used, i.e. sheet interview, sheet questionnaire analysis requirement, sheet questionnaire evaluation products by media experts, sheets questionnaire evaluation appropriateness products by experts' material, sheet questionnaire evaluation practicality products by a biology teacher, sheet questionnaire evaluation practicality products by participants educate, and sheet evaluation ability think critically.

Data Analysis Technique

Deep data analysis techniques in this study are an analysis of statistics. (a) Analysis results interview; (b) Student Decision Analysis; (c) Analysis feasibility and practicality product. Use scale likert like table following:

Table 2. Likert Scale Assessment Criteria (Sugiyono, 2018)

Scale Value	Criteria Assessment
1	Very Not Good
2	Not good
3	Good
4	Very good

Score-based Likert is then calculated and analyzed quantitatively with the use of the formula as follows:

$$M = \frac{\sum fx}{N} \quad (1)$$

Information:
M = average per aspect
$\sum$ fx = total score per side
N = number respondents
Score obtained interpreted based on system assessment and criteria in the table following:

Table 3. Product Eligibility Categories (Sugiyono, 2018)

Score	Criteria
$3.25 \leq x \leq 4$	Very Feasible
$2.5 \leq x < 3.5$	Feasible
$1.75 \leq x < 2.5$	Less Feasible
$1 \leq x < 1.75$	Very Not feasible

Table 4. Product Practically Category (Riduwan, 2015)

Score	Criteria
76%-100%	Very Practical
51%-75%	Practical
26%-50%	Less Practical
0%-25%	Very Impractical

Validity and Reliability
Validity construct

Table 5. Criteria for Validity of Test Instruments by Experts

Score Intervals	Category
$3 \leq VR \leq 4$	Very valid
$2 \leq VR < 3$	Valid
$1 \leq VR < 2$	Not valid
$0 \leq VR < 1$	Invalid

Validity Empirical Question items declared valid if fulfil criteria following:

If R count > R table or p-value <0.05, the items are declared valid (accepted). If R count < R table or p-value >0.05, then item items are stated invalid (accepted) (Sugiyono, 2019).

Reliability

Table 6. Reliability Level Criteria (Arikunto, 2019)

Alpha	Reliability Level
0.81-1.00	Very high
0.61-0.80	Tall
0.41-0.60	Enough
0.21-0.40	Low
0.00-0.20	Very low

Analysis Critical Thinking Ability

Data analysis enhances knowledge and the ability to think critically using the N-gain test. The formula for the N-gain test is:

$$< g > = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (2)$$

Information: g = N-gain; S_{post} = Post-test score; S_{pre} = Pre-test score; S_{max} = Maximum score question.

Table 7. N-Gain Scores and Categories

Presentation of Assessment Results	Category
$g \geq 0.70$	Tall
$0.30 \leq g < 0.70$	Currently
$g < 0.3$	Low

Test Prerequisites
a) Normality test
b) Homogeneity test

Hypothesis Testing
a) T-Test
b) Test effect size

Result and Discussion

The research and development carried out by the researchers produced a product in the form of website-based interactive learning media, which, in the development process, followed the research principles of Research and Development with the model developed by Dick and Carry (1996), namely Analyze, Design, Develop, Implement and Evaluate (ADDIE).

Analyze

At this stage, this researcher analyzes curriculum and competencies, as well as students (Analysis of the Learner, which includes analysis of student decisions (Need of the Learner), analysis of student characteristics (the characteristics of the student), and analysis of problem students at SMAN 1 Yogyakarta, which includes as material reference for developing a suitable product with school and student decisions.

a) Analysis curriculum and competencies results

Based on the results of interviews and observations made with one of the eye teachers' lessons in Biology, the acquired statement is that the curriculum at SMAN 1 Yogyakarta still needs to implement the curriculum independence curriculum fully. This only applied in class X. Meanwhile, classes XI and XII still use the 2013 curriculum.

b) Analysis instructional results

Results from the analysis indicate that the teacher's learning process more often uses the 5M model and method lecture with learning media assistance in the form of a PowerPoint. At this stage, there is also an analysis of teacher decisions regarding learning media and analysis related material perceived learning complex for students; one is material system defense body.

c) Analysis need results

Based on analysis-related decisions, students obtained from the results questionnaire. 67.5% of students say that the method used by teachers is still using lectures, as well as 100% of students say that the media that they use is only just a power point.

d) Analysis results characteristics student

Based on the characteristics of the analysis, students obtained results that 98% were enthusiastic about learning media websites because of their visual,

audiotorial, and kinesthetic learning styles, and 93% were interested in source learning that contained information. Analysis results in problems with students, which also results in statements that students sometimes have trouble analyzing and solving problems and are passive during the learning process. That matters because the facts say that teachers don't once hook Skills 21st century with material learning biology because of limited time and technology owned by teachers.

Design

At this stage, media design things to do that formulate objective learning moreover formerly. As for steps, the first thing to do in developing learning media products is:

a) Formulate Learning Objectives

Table 8. Flow of Learning Objectives

Body Defense System Material	JP	Pancasila Profile	Achievement Indicators
Describe and analyze the components of cells, tissues, and organs that make up the body's defense system in fighting substances that harm the body by listening to the questions and pictures presented	2 x 45 Minutes	Critical Reasoning	Answer the teacher's questions by presenting the results of an analysis based on facts from several pieces of literature related to the components of cells, tissues, and organs that make up the body's defense system in fighting substances that harm the body.
Analyze and identify body defense mechanisms and disorders/diseases of the body's defense system and immunization by presenting them in infographics.	2 x 45 Minutes	Critical and creative reasoning	Presents infographic results related to body defense mechanisms and disorders/diseases of the body's defens system and immunization.

b) Developing Learning Tools

The preparation of teaching modules contains several components, namely, module identity, including the identity of the module author, initial competencies, Pancasila student profile dimensions, infrastructure, learning materials, student targets, learning models, learning outcomes, and process skills. Core competencies include learning objectives, meaningful understanding, trigger questions, and learning activities.

c) Planning Learning Media Products Interactive Website Based

1) Selection of Learning Media

This selection of learning media is obtained from the results of the previous analysis. The analysis results of the obtained solution to the problem of learning biology are developed using interactive learning media.

2) Planning framework product

At the stage of planning the framework product, the researcher compiles several components that will be published on an interactive media website-based on compiled features and flowcharts that can be seen in the figures and tables as follows:

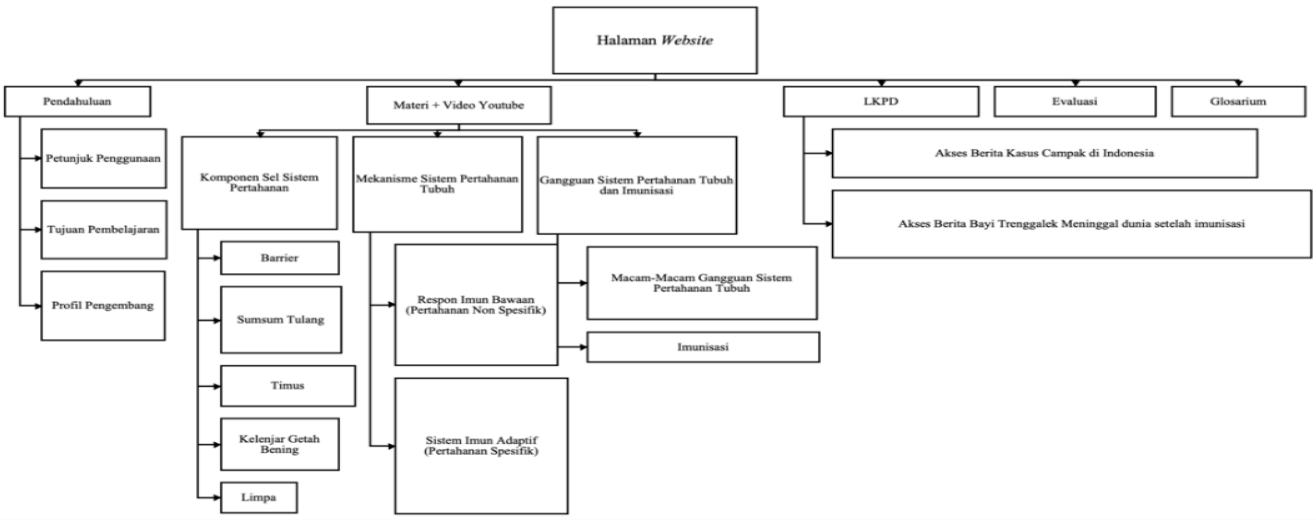

Figure 2. Product Framework Design

Table 9. Design Features and Objectives

Feature	Objective
Website Page	Presents an introductory display containing: -Instructions for use -Learning objectives -Developer profile
User Instructions Page	Presents a guide to using website- based interactive media
Learning Objectives Page	Presents learning objectives and concept maps
Developer Profile Page	Presents information regarding the researcher's profile
Materials Page	Presents material and quizzes
LKPD page	Presents questions that are adapted to the syntax of the learning model used
Evaluation Page	Presents evaluation questions to measure students' critical thinking abilities
Glossary	Presents a collection of lists of important words or terms.

d) Results Content Design of Learning Materials in Learning Media Interactive Website based

This stage is customized with results analysis of the existing curriculum. Fill in the material on the system defense body. This is designed in a way customized sequence based on channel objective learning and achievements learning curriculum independent

Table 10. Design of Website-Based Interactive Learning Media Content

Subject	Sub-Main Language
Cell components of the body's defense system	Barrier Bone marrow Thymus Lymph gland
Mechanism of the body's defense system	Innate immune response (non-specific body defense) Adaptive immune system (Specific body defense)
Disorders of the body's defense system and immunization	Various disorders of the body's defense system Immunization

e) Results Planning Evaluation Activity Study

Design results evaluation is arranged based on measured abilities. As for the inside study, each question item or questionnaire was arranged based on the indicator ability for critical thinking. Question items and questionnaires were placed and validated by the lecturer expert to see the validity of the questions before being tested by the students.

Development Results (Development)

This is a stage realization product or result Based on design features and flowcharts designed in stages design. The stages are results, initial product production, validation, practicality, limited trials, trial field, and evaluation end. As for explanation more continue on stage this, i.e., as follows:

a) Initial production results of learning media interactive website based

In the initial production stage, website-based interactive learning media is created based on the decisions of students, teachers, and student characteristics. The software used in the initial production of this interactive media is WordPress, which can be used to combine images, videos, quizzes, questions, and text of learning material.

Figure 3. Initial display of learning media

The initial display includes an introduction to interactive media based on the I-Weltims website. This initial display stimulates students to search for information on the body's defense system material. This section provides a start button to direct students in exploring the use of this media. Apart from that, in the home navigation, divided into sections and several sub-sections, a toolbar can be pressed and directed to other menus. The introductory paragraph of the menu contains three sub-sections: instructions for use, learning objectives, and developing profile. Visitors can press the start button to be directed to the next page.

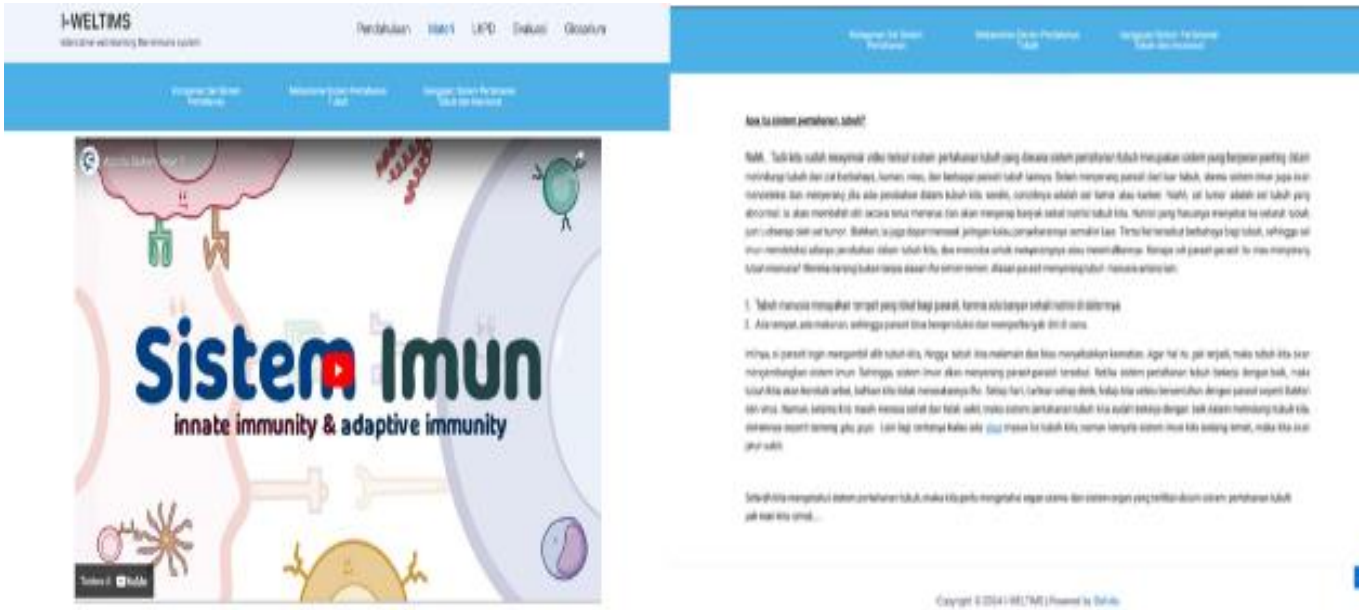

Figure 4. Display of the material section menu

This section is a material page that explains the immune system in general. The video and narration explain the general defense system. The video provides a link and match to YouTube to help students understand the immune system. Three sub-sections explain the material in general: cell components of the defense system, mechanisms of the body's defense system, and disorders of the body's defense system.

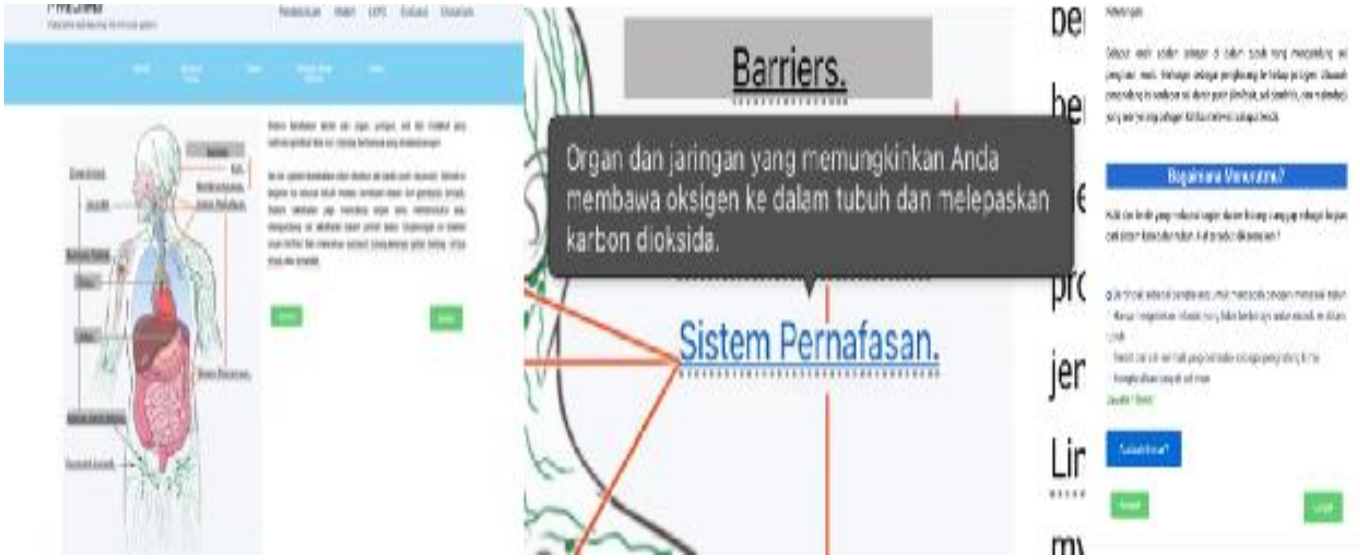

Figure 5. Various types of supporting features for learning material on the components of body defence cells

On this page, material will be explained about what the barrier, bone marrow, thymus, lymph nodes, and spleen are. Also added to this page is a photo to help visualize the organs in the human body. There is writing underneath with a dotted line, which gives a more complete definition/explanation when the computer cursor is directed at the writing. Apart from that, visitors must complete an interactive quiz when completing the lesson; the right or wrong answers to the quiz will be presented directly.

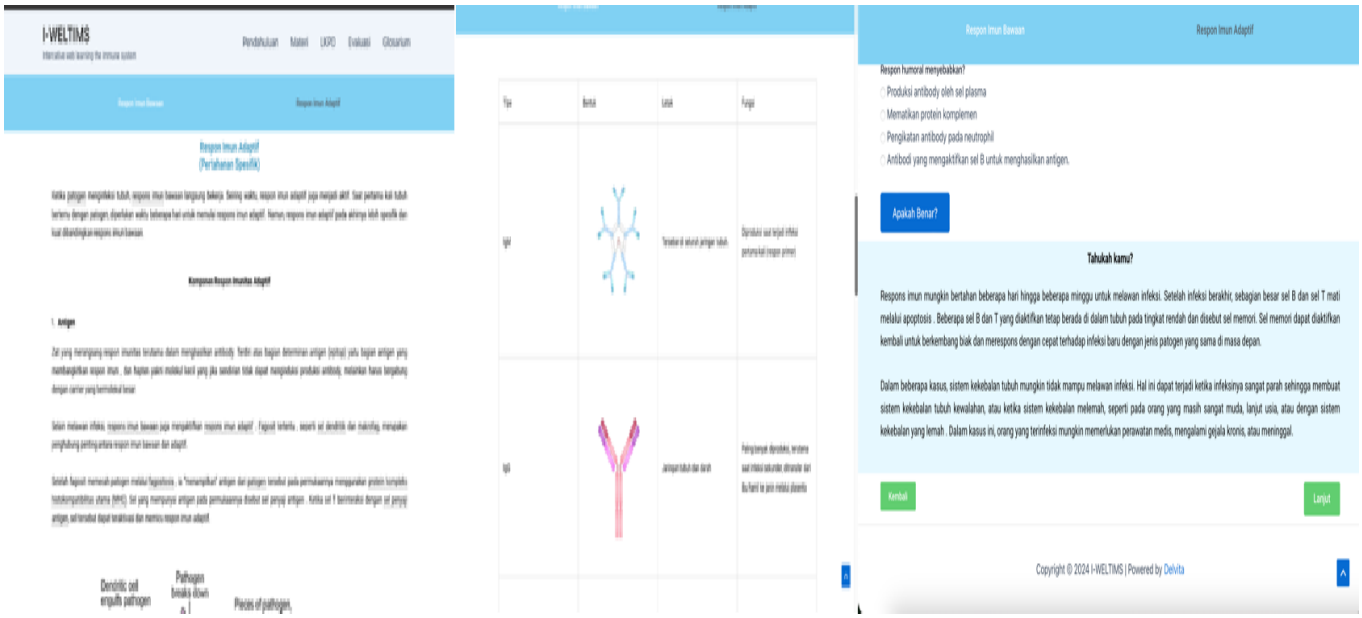

Figure 6. Various supporting features for learning adaptive immune system material

On this page, part discusses material from the Adaptive Immune System. Adaptive Immune Response is also explained in the table to explain component reagent immunity adaptively. The table type, form, location, and function of antibodies. Also added to the page Is a Photo To help visualize the system's immune adaptive. Additionally, on the same page, the fact is given as unique in the column ' Did you know?' This aims to provide interesting information to students to help them comprehend material learning.

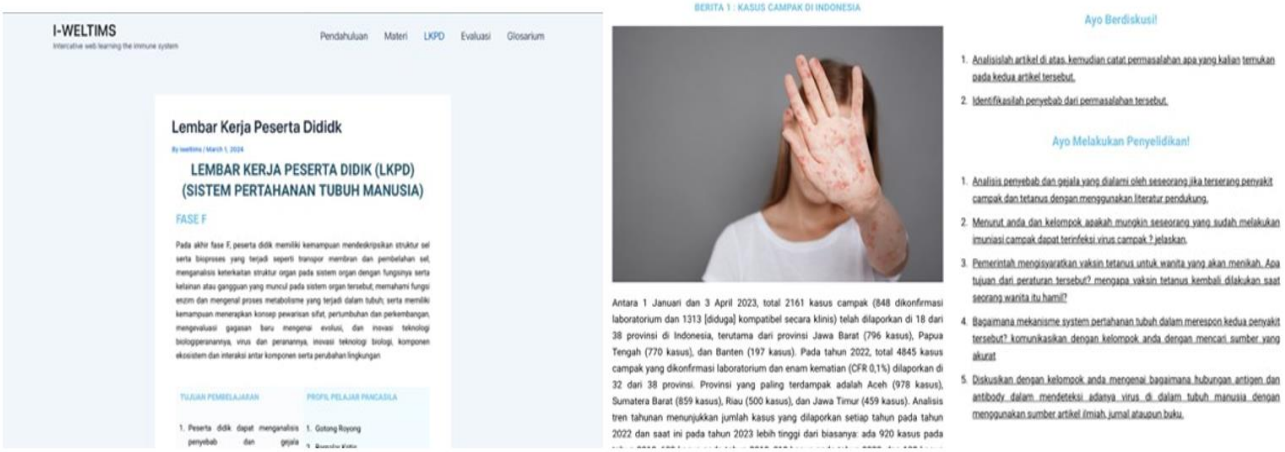

Figure 7. LKPD page display

In this LKPD, objective learning and the expected profile of students from Pancasila are explained. Student requested to read two purposeful pieces of news to synchronize material learning with life each day. The LKPD sheet provides tools for thinking critically with four columns of questions: 'Come on, discuss'; Do research; Develop and present results work; Analyze and evaluate the solving process problem.'

Discussion analysis is used for students to explore the issue found in the article above. An in-depth thinking analysis is also provided with the column page 'Let's do the investigation!'. On the page, are students too requested to develop and present results work per results discussion and investigation in the column 'Developing and Presenting Work Results'? Students are also asked to evaluate the splitting process problem in the ' Analyzing and Evaluating the Problem-Solving Process 'column.

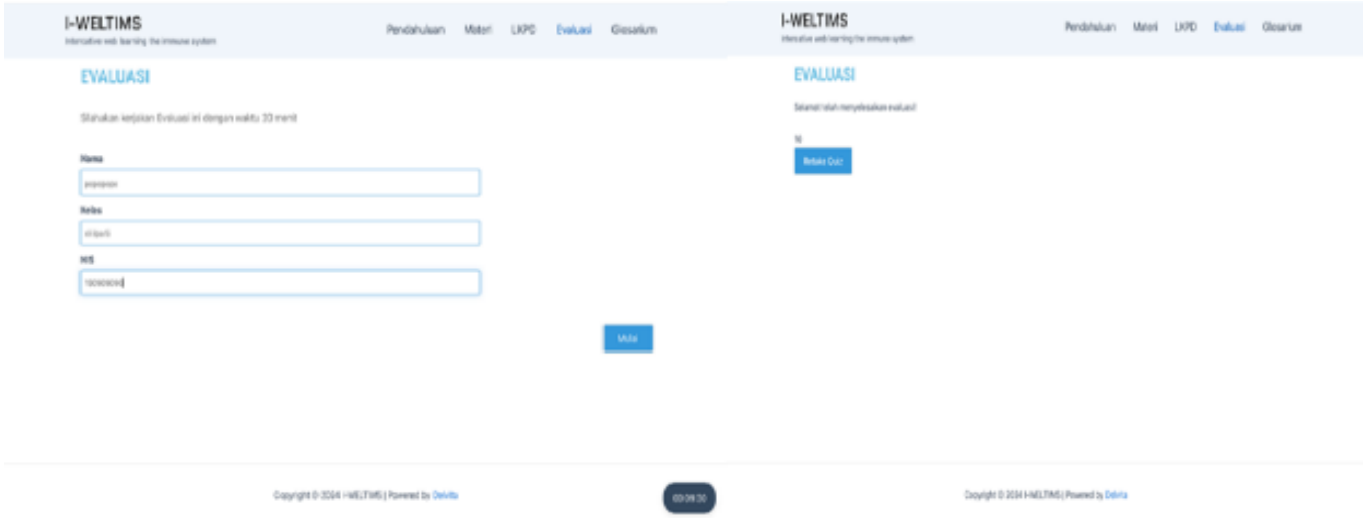

Figure 8. Evaluation display

The page focused on evaluating how to understand students with the immune system. Evaluation system immune this started with filling in identity, class, and number of parent students. After students fill in personal data, the participants can click the knob to start. The questionnaire for evaluation totaled ten items in 10 minutes. Each score for every item question is 10 points. When students click the knob start, then the timer will walk. After students finish the evaluation, score grades will appear obtained by students. If the student is unsatisfied, the student can repeat the quiz by clicking 'Retake Quis.'

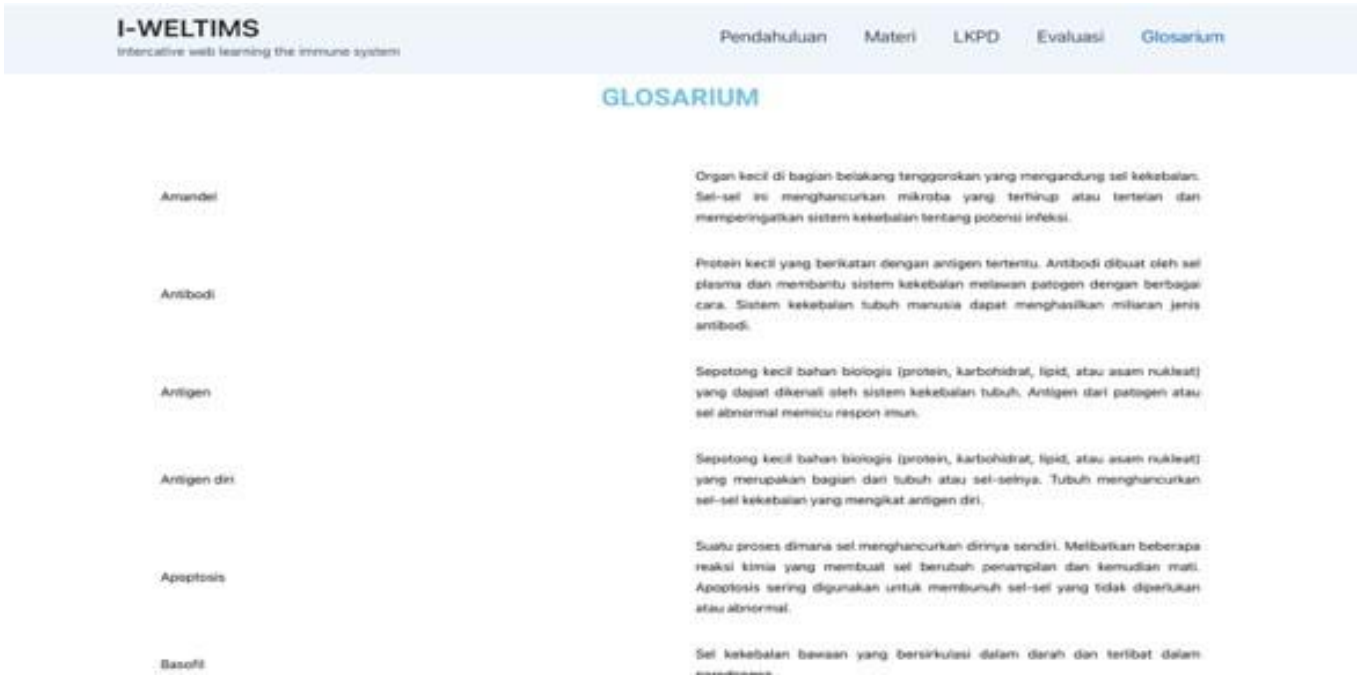

Figure 9. Glossary view

This page load-working glossary makes it easier for students to know the meaning of every vocabulary material they learn.

b) Development Results Instrument

The instruments that will be used in support study can be seen as following: (1) Instrument test form questions and questionnaires. (2) Instrument validation for expert material and media experts. (3) Instrument device learning ie, teaching module. (4) Questionnaire evaluation practicality for biology teachers. (5) Questionnaire evaluation practicality for students. (6) Implementation sheet learning.

c) Validation Results Appropriateness Interactive Media Products Website Based

Validation results eligibility by expert material

This instrument stated that for measuring the ability to think critically declared valid, as follows is the table 11.

Table 11. Results of Validation of Critical Thinking Instruments by Experts

Aspect	Quality Score	Criteria
Contents	4	Very Valid
Construction	4	Very Valid
Language	4	Very Valid
Average	4	Very Valid

Validation results appropriateness interactive media products website- based by media experts

Table 12. Product Feasibility Validation Results

Aspect	Quality Score	Criteria
Aspect Technical Feasibility	4	Very Worth It
Truth and Accuracy of Language	4	Very Worth It
Software engineering	4	Very Worth It
Aspect Quality Interaction	4	Very Worth It
Average	4	Very Worth It

Validation results instrument

a) Test item results Skills think critically that has been validated by the lecturer's expert

Table 13. Validation Results of Critical Thinking Skills Instruments

Aspect	Quality Score	Criteria
Contents	4	Very Valid
Construction	4	Very Valid
Language	4	Very Valid
Average	4	Very Valid

b) Validation test results teaching module

Table 14. Results of Validation of Independent Curriculum Teaching Modules by Experts

Aspect	Quality Score	Criteria
Complete Identity	100%	Very Worth It
Initial Competency	100%	Very Worth It
Learning Hours	100%	Very Worth It
Pancasila Profile	100%	Very Worth It
Facilities and infrastructure	100%	Very Worth It
Target Students	100%	Very Worth It
Selection of Learning Models/Methods	100%	Very Worth It
Learning Activities	100%	Very Worth It
Assessment Evaluation	100%	Very Worth It
Average	100%	Very Worth It

Limited Scale Test

a) Rating result practicality of learning media interactive by biology teacher and students

Table 15. Results of Teachers' Assessment of the Practicality of Website-based Interactive Learning Media

Evaluator	Teacher Assessment		Student Assessment	
Aspect	Quality Score	Criteria	Quality Score	Criteria
Aspect	100%	Very Practical	100%	Very Practical
Material	100%	Very Practical	95%	Very Practical
Language	100%	Very Practical	100%	Very Practical
Media	100%	Very Practical	93%	Very Practical
Software engineering	100%	Very Practical	94%	Very Practical
Average	100%	Very Practical	96%	Very Practical

b) Validity and reliability test of question items and questionnaires

Table 16. Validity Results of Critical Thinking Ability Questions

Question No.	Pearson Correlation	R Table	Sig. Value	Conclusion
Question 1	.696	0.3061	.000	Valid
Question 2	.397		.030	Valid
Question 3	.732		.000	Valid
Question 4	.440		.015	Valid
Question 5	.556		.001	Valid
Question 6	.474		.008	Valid
Question 7	.750		.000	Valid
Question 8	.712		.000	Valid
Question 9	.734		.000	Valid
Question 10	.464		.010	Valid

All questions were declared valid based on the validity results using the correlation output of 10 critical thinking items.

Table 17. Reliability Results for Critical Thinking Ability Questions

Variable	Cronbach's Alpha	R Critical	Information
Critical thinking	.795	0.70	Reliable

Based on the reliable test of critical thinking skills, all question items obtained consistent, and the results is reliable.

Implementation Results

One of the aims of developing website-based learning media is to determine the effectiveness of the media in improving the critical thinking skills of class XI MIPA students at SMAN 1 Cangkringan. This effectiveness test was carried out at the implementation stage, which consisted of several stages, starting with descriptive statistical tests, N-gain tests, prerequisite tests, and T-tests with maximize additional media, namely SPSS 26. Test this using two classes for obtaining data, i.e., class experiments and control. The medium class control only uses PowerPoint for class experiments that are given treatment in the form of interactive learning media websites. However, before treating students, the necessary things to do are pre-tests and post-tests in the second class.

To determine whether there is no difference between them, the pre-test and post-test data were analyzed using the t-test in line with Buser et al. (2018) the t-test was used to look for a significant difference statistically between the averages—statistical value at 90% and size sample with level significance set by 5%. However, before the T-test is carried out, there is a prerequisite test, namely the Shapiro-Wilk Test. The Shapiro-Wilk test was performed to determine whether data is usually distributed or not.

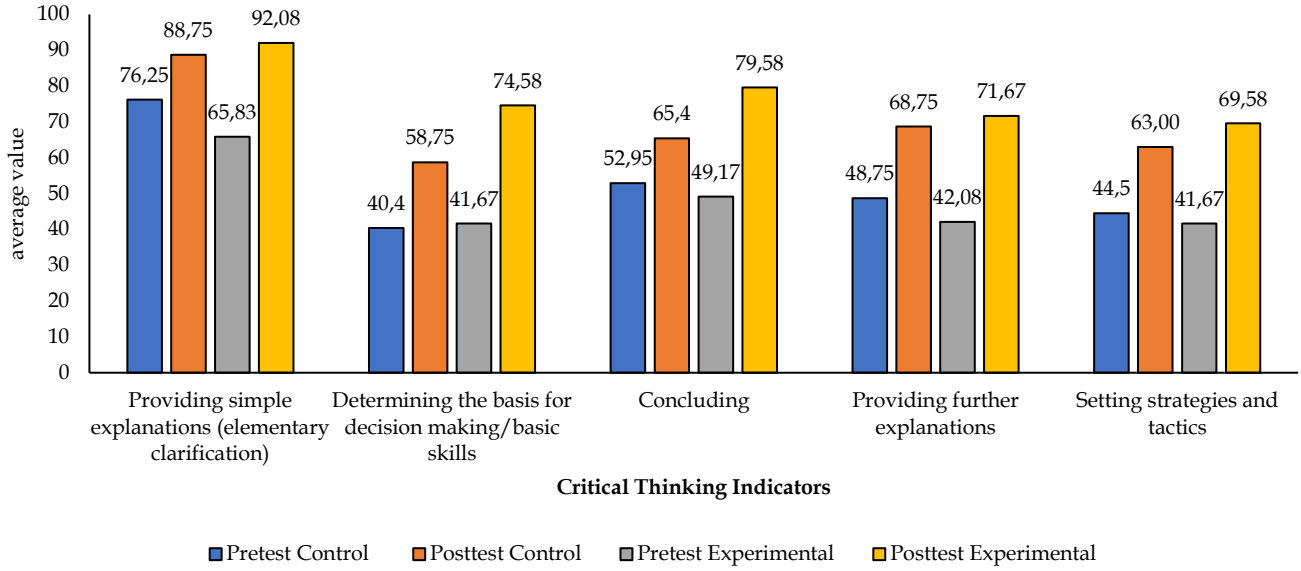

Figure 10. Critical thinking ability assessment results

Table 18. Shapiro Wilk Critical Thinking Test Results

Variable	Class	Data	Df	Sig.	Decision
Critical thinking	Experiment	Pre-Test	30	.077	Normal
		Post-Test	30	.391	Normal
	Control	Pre-Test	30	.099	Normal
		Post-Test	30	.094	Normal

The Shapiro-Wilk test (Pre Test Experiment) obtained a sig.077 value of>0.05 (normal distribution). (Post Test- Experiment) was obtained sig.391 value >0.05 (normal distribution). Pre-Test Control was obtained sig.099 value >0.05 (normal distribution). Post Test-Control was obtained sig.094 value >0.05 (normal distribution). So, it can be conclude that good class experiments and class control have data generally distributed according to the results from the Shapiro-Wilk test.

Table 19. Critical Thinking Homogenity Test Results

Variable	Levene Statistics	Sig.	Decision
Critical thinking	5.071	.002	Inhomogeneous

After carrying out a normality test, homogeneity was tested again. Test this. To see if every group data sample is taken from a population with the same variance. Levene statistical homogeneity test results on the ability to think critically obtained sig.002 value <0.05.

So, it can be conclude that variance in the ability to think critically is not homogeneous. If the data is usually distributed and not homogeneous, then the statistical test for free data using the t-test (Independent Sample t-test) with assumption secondly, Equal Variance Not Assumed or t-test (Paired Sample t-test) for paired data When possibility sig value. > 0.05, then variance of two or more group populations or sample data viz homogeneous. If the data is usually distributed and homogeneous, test the statistics for free data using the t-test (Independent Sample t-test) with Equal Variance Assumed or the t-test (Paired Sample t-test) for paired data.

After finding the results of the prerequisite tests to find the effectiveness of website-based interactive media on critical thinking skills, the author will explain the influence of the effectiveness of website interactive learning media on critical thinking skills.

Table 20. Critical Thinking N-Gain Test Results

Class	Average value		Score N-gain	Effectiveness	Information
	Pre-Test	Post-Test			
Experiment	48	78	0.56	56%	Moderate and Fairly Effective
Control	53	69	0.26	26%	Low and Ineffective

Learning using website-based learning media facilitates students to think critically about the body's defense system material. The results of the index research showed that there was an increase in individual student learning outcomes and the overall classical average. The comparative student learning outcomes increased after the pre-test and post-test. This was proven based on the N-gain test in assessing critical thinking skills using website-based learning media for the experimental class and control class; the results of the N-gain in the experimental class were 0.56 in the medium category, while the control class was 0.26 in the low category.

Table 21. Critical Thinking Hypothesis Test Results

Variable	Class	Df	Sig. (2-tailed)	Decision
Critical thinking	Experiment	29	.000	H0 is rejected Ha accepted
	Control	29	.000	H0 is rejected Ha accepted

After carrying out the N-Gain test, a further statistical test was carried out to see the effectiveness of website-based learning media on critical thinking skills, namely the Paired Sample T-Test, and the results obtained from this test in the experimental class were sig. (2-tailed)<0.05, and in the control class, the results obtained were sig. (2- tailed)<0.05. So, there is an average difference between pre-test and post-test learning outcomes in improving critical thinking skills in the experimental class. Meanwhile, there was no average difference between pre-test and post-test learning outcomes in strengthening critical thinking skills in the control class.

Table 22. Critical Thinking T-Test Results

Variable	Df	Sig. (2-tailed)	Decision
Critical thinking	58	.003	H0 is rejected Ha accepted

Next, an independent sample t-test was conducted, and a sig (2-tailed) <0.05 was obtained for critical thinking skills. Thus, the result of the hypothesis was H0: rejected and Ha accepted, which means there is a significant (real) influence on students' critical thinking skills in the experimental and control classes. Based on this hypothesis, it can be stated that there is a significant difference between students who take part in learning using website-based interactive learning media and students who take part in learning without using media to improve their thinking skills.

Table 23. Effect Size Test Results

Variable	Number of Samples	Cohens'd	Category
Critical Thinking	30	0.8	Large Effect

The analysis of the effect size value on critical thinking skills strengthened it, receiving a value of 0.8, which is based on the effect size value category by Lenhard et al. (2017). Thus, it can be concluded that the use of website-based interactive learning media has a big influence on improving critical thinking skills.

Evaluation Results (Evaluation)

This stage is carried out at every stage of product research and development. The evaluation process stages are contained in the ADDIE development model.

a) Evaluation at stage analysis done based on input and suggestions by lecturers' mentor like. 1) Evaluation of curriculum and competency analysis; 2) Evaluation of instructional analysis; 3) Evaluation of the analysis of needs and characteristics of educators.
b) Evaluation at stage design carried out when writer create learning media interactive based on the iweltims website with developer in the form of 1) Evaluation of learning media; 2) Evaluation of the

product framework; 3) Evaluation of the design of learning material content; 4) Evaluation of the learning activity evaluation design.

c) Evaluation at the development stage is carried out based on results. Initial product production, validation, practicality, trials limited, trial field, and evaluation end. For example, is the product already worthy? It is said practical, yes, correctly said worthy, and done. Can it be tested for effectiveness in increasing students' ability to think critically? Evaluation in the form of this stage form, 1) Initial production results of website-based interactive learning media; 2) Results of feasibility validation by expert lecturers; 3) Limited scale test results of learning media assessment by teachers; 4) Results of learning media assessment by students.
d) Evaluation at the implementation stage is carried out based on input from supervisors and other statistics expert lecturers. This evaluation aims to provide another point of view in processing results and data regarding website-based interactive learning media research.
e) Evaluation after implementation and before product launch. Evaluation is done when the stages of the study have ended. After passing the stage of assessment, continue the improvement process that has been carried out and revised previously, aiming for the future developed products Ready For use both by teachers and students, especially the material system defense body as well as product can launched as a form of learning media student.

Discussion

Website-Based Interactive Learning Media Development

This development research produces the final product as a website-based interactive media using the ADDIE development model. The reason the researcher chose ADDIE as the model for this research is that the development pattern is not too complicated; the stages in making it are more straightforward and more systematic and effective in producing a product; this is in line with Siregar's (2019) statement which states that development using the ADDIE model has advantages, namely such as a simple, systematic structure, and having analytical stages so that the product developed becomes the right solution to learning problems that suit the needs and characteristics of students. Apart from the analysis stage, this model also has an evaluation stage, which allows for the minimization of errors and deficiencies in the product developed by the researcher.

Website-based interactive learning media was developed based on identifying and analyzing problems during observations, interviews, and distributing questionnaires regarding the needs of teachers and students at SMA Negeri 1 Cangkringan. The analysis of the student needs questionnaire showed that 77.5% of biology learning was enjoyable, but 92.5% of students found biology learning difficult. However, during learning, 87.5% of students experienced boredom. The cause of student boredom is that the learning process could be more varied. The learning methods are not varied, and 67.5% of students said that boredom arises because teachers only use the lecture method during the learning process. Teachers tend only to use PowerPoint as a learning medium.

Based on the results of these observations, it can be concluded that biology learning at SMA Negeri 1 Cangkringan still applies teacher-centered learning. A teacher center is learning where the teacher dominates every activity while students are only passive objects who receive what is conveyed by the teacher, so learning like this tends to trigger students to feel bored and can have detrimental effects on student learning outcomes. This is in line with the statement (Astuti et al., 2022), which says that if teachers teach using the same method continuously (monotonously), it can result in students' lack of interest in learning. Also, using lecture methods and inappropriate learning media that do not involve students can reduce their learning outcomes.

The solution to this problem is designing a lesson that can help students be more active and have a pleasant learning experience with the help of interactive learning media that utilizes technology and information systems. One of the uses of technology in learning is using students' smartphones. The solution offered by researchers is the development of interactive learning media, with various features such as images, learning videos, inclusion of news/cases, and material related to today's life. In line with research from Taufiq et al. (2014) and Silaban et al. (2019), which explains that learning using media can help students search for and find diverse information from various perspectives, media can also help students understand concrete but challenging to visualize. Of course, learning from various existing sources will increase the insight into learning (Adzkiya et al., 2021).

In this interactive media, students can change the learning process from a teacher center to a student center, where educators play a role in accompanying students when operating the learning program. Active student involvement in interactive learning activities can improve their critical thinking skills and scientific attitudes. Students can respond in depth to activities or newly received knowledge (Fitriani et al., 2020).

Feasibility of Website-Based Interactive Learning Media Products

In determining the product's suitability, the author first validated it with expert lecturers to obtain input and suggestions regarding the media created and developed. Material experts carry out the first validation. This validation aims to ensure the suitability of the learning media with the learning material, including aspects of appropriateness and accuracy of the material, aspects of presentation, material, correctness, and accuracy of language and characteristics. The results of the product feasibility test by material expert lecturers obtained an average quality score of 3.9 with very feasible criteria, according to Sugiyono (2018)

Then, the second validation was carried out by media experts in the fields of learning media and software engineering. This assessment aims to measure the suitability of the media in terms of technical feasibility, language correctness and accuracy, software engineering, and interaction quality aspects. The test results on the feasibility of this media obtained an average quality score of 4.0 with very feasible criteria. This refers to Sugiyono (2018), who stated that the learning media was declared very suitable for testing on a limited scale by input and improvements that were directly carried out at the time—validation process.

Next, the third validation, namely validation of the evaluation instrument by expert lecturers, where this evaluation instrument is looked at from 3 aspects, namely content, construction, and language. The purpose of validating this evaluation instrument is to determine whether the questions are valid by the variable indicators and the learning material before being tested on a limited scale. As for the validation results of the evaluation instrument on critical thinking skills, the average quality score was 4, with very valid criteria. This aligns with the statement by Riyani et al. (2017), who said this evaluation instrument is valid and can be tested on a limited scale. Next is the validation of the teaching module. The validation of this teaching module aims to detail the learning stages in the class. It consists of several aspects: completeness of identity, initial competencies, learning hours, Pancasila profile, facilities and infrastructure, target students, selection of learning models/methods, and learning activities. And assessment evaluation. The results of the validation of the teaching module obtained an average quality score of 100% with very adequate criteria.

Practicality of Website-Based Interactive Learning Media Products

To find out the practicality of the product, the author made a test of the practicality of the product. The product practicality test tested the learning media for teachers and students in class XII. This test was carried out to obtain responses and comments from teachers and students regarding the learning media being developed. The assessment includes material, language, media, software engineering, and learning. The assessment was carried out by administering a questionnaire to respondents. The results of assessing the practicality of website-based interactive learning media by biology teachers obtained an average score of 100% with efficient criteria for testing in wide-scale trials (field tests). The results of assessing the practicality of website-based interactive learning media by students obtained an average score of 96% with efficient criteria to be implemented in wide-scale tests (field tests). Apart from the practicality test, the thing that must be done before the effectiveness test is testing the validity of the evaluation instrument questions on 30 class XII students. The choice of class the results of the limited scale validity test using the output correlation of 18 questions were declared valid and based on reliable results with a Cronbach's alpha value >0.70 obtained, making it reliable to be used as a measuring tool for students' critical thinking abilities.

Effectiveness of Website-Based Interactive Learning Media Products

From the implementation of the use of website-based interactive learning media, it is clear that the results of this research cannot be separated from several factors. First, this website-based learning model can improve students' critical thinking skills because students are interested in learning. When given the application of interactive media in learning activities, students are enthusiastic to participate because learning focuses on students. Student-focused learning programs are innovative learning that will provide active learning conditions for students (Choi et al., 2014; Karepesina et al., 2023). Website-based learning makes students enthusiastic about solving the problems given. With the enthusiastic enthusiasm of students, website-based learning media can improve students' critical thinking and help students develop problem-solving skills (Lukitasari et al., 2019). This website-based learning educates students to think critically (Wulandari, 2024). This website-based learning model also involves all students actively and comprehensively to increase students' activeness in absorbing the information available on the media. This model can also increase students' enthusiasm for learning (Herzon et al., 2018).

Second, website-based learning media can improve critical thinking skills because it is easier for students to understand the body's defense system learning material. The many features and ease of absorbing material information create an active learning model that will make it easier for students to learn the material

(Abdurrozak et al., 2016; Putra et al., 2020). Features and conveniences such as image features, videos, and real-life news can train students' abilities to solve real-life problems and stimulate students to think critically (Asyari et al., 2016; Saputra et al., 2019). Thinking abilities will also make it easier for students to understand learning material. Website-based learning media uses a stimulating learning system so that problem-solving strategies and places students have an active role in this learning media (Stiadi, 2024).

From this research, it can be concluded, in line with other research, that website-based learning media can increase students' motivation to learn so that it can improve students' critical thinking abilities (Karepesina et al., 2023; Lukitasari et al., 2019). The advantages of this website-based learning media are that it improves critical thinking skills, motivates students to learn, and provides opportunities to apply students' knowledge to the real world (Marlina et al., 2023; Nasution et al., 2018).

The results of this study confirm the conclusions of previous research, which shows a positive correlation between the use of technology, especially website-based interactive learning media, and the level of critical thinking skills (Khoiriyah et al., 2021; Noone et al., 2018; Palavan, 2020; Song et al., 2024). The improvements observed in experiments in the experimental and control classes highlight the effectiveness of educational technology in developing students' cognitive skills, especially critical thinking abilities. This finding is consistent with the author's previous conclusions; this research proves the positive role of digital as an essential tool in learning outcomes, in this case, website-based learning media (Karo-Karo et al., 2018; Kusmaryani et al., 2019; Norouzi-Gheidari et al., 2012; Srilaphat et al., 2018).

Conclusion

Based on the research results above, it can be concluded that the development of interactive learning media based on the website for the main material of the body's defense system is very feasible, effective and practical to use to improve critical thinking skills. In addition, based on the results obtained, this study can be used as reference material and study on learning media that utilize technology, computers, and mobile phones, as well as reference studies on problem-based learning models, and can be used as consideration for educators to use website-based learning media to improve critical thinking skills.

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