The Development of Web-Based Interactive Multimedia in Static Fluid at the Senior High School

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Abstract. The research aims to develop web-based interactive multimedia using fluid static motion material that is valid, practical and effective. The research method used is a development research method based on the ADDIE (Analysis, Design, Development, Implementation, Evaluation) development model. The results of research using the ADDIE model at the analysis stage require web-based interactive multimedia. In the design stage, material designs, Student Worksheets and tests are obtained. In the development stage, valid web-based interactive multimedia was produced by media experts and material experts. In the implementation phase, web-based interactive multimedia was obtained which was very practical for users (teachers and students). In the evaluation stage, students obtained effective web-based interactive multimedia. The conclusion from the results and discussion is that web-based interactive multimedia is valid, practical and effective.

Keywords: ADDIE, Analysis, Design, Development, Implementation, Evaluation.

1 Introduction

The rapid development of information and communication technology has triggered changes in the learning system in schools. Some of the things that have changed as a result of information technology are the availability of abundant learning resources on the Internet, learning applications that make it easier for students to learn, enabling the learning process to be done anywhere, anytime, and so on [1].

Technologies play a role in improving the quality of learning through teaching media so that it can increase students' interest in learning. A variety of learning media to support physical learning has been available on the Internet. Some studies show that the use of such learning media can improve students' learning outcomes and interest in physics [2].

Physics is one of the sciences that studies all the physical events and symptoms that occur in nature. Physical knowledge is acquired and developed on the basis of a series of researches that physicists conducted in search of questions what, why, how of the natural symptoms and

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their applications in everyday life [3]. Physics as a subject requires teachers to demonstrate real phenomena through direct observation or experiment so that students understand the whole concept comprehensively The development of interactive and innovative media can optimize and improve the effectiveness and efficiency of learning activities [4].

Based on the results of observations at State High School 11 Field, it is known that the physical learning media made by teachers is less variable, innovative and does not make it easier for students to learn. It affects students in understanding physics subjects that contain abstract teaching material and many formulas. Low Physics students obtained average scores of students at each exam still below the Minimum Graduation Criterion (KKM) of 75. Students are not much involved in teaching learning activities and less active classes are largely dominated by teachers so teaching teaching activities in the classroom are less attentive and students are less enthusiastic. Teachers have time constraints in learning activities. Teachers rarely perform laboratory activities in schools due to the availability of inadequate and unusable practical tools. Internet use less used by teachers in the learning process [5].

Computer and information technology has become one of the options in the provision of multimedia to support the education system so that learning activities are more efficient and optimal. Computers connected to the Internet will provide web services that function to help students and teachers in the learning process. The Internet is capable of stimulating teachers to create web-based learning media that students can access anywhere and anytime [6]

Based on problem analysis, the needs of teachers, students and schools need to be developed web-based interactive multimedia. Web-based interactive multimedia can be exploited through an effective approach in learning activities. The development of web based learning media can facilitate the learning process of teaching and may facilitate students in understanding physical material [7]

2 Research Methods

Research and Development (R&D) is the process used to develop and validate educational products. The orientation of research and development is the learning software (software) product in the form of web media. Web media is computer-based and android-based interactive multimedia that can be accessed by students through the Internet network. The development model on the research follows the development model adapted from the ADDIE instructional design model that includes the phases of analysis (analysis), design (design), development (development), implementation (implementation) and evaluation (evaluate). The process of development of interactive multimedia based on the web physics subjects is adapted to the model of development ADDII which includes phases analysis (analyse), design, development (development) implementation and evaluate. The stages of development are described in Figure 1.

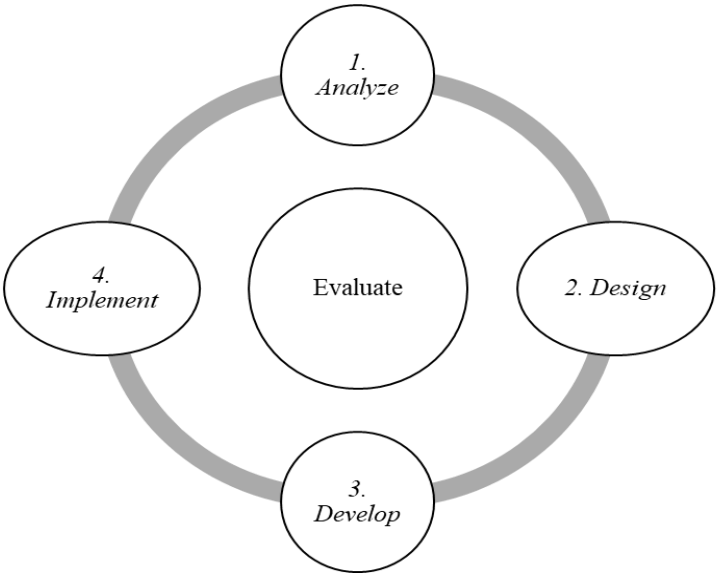

Fig.1. ADDIE's development stages

The stages of web-based interactive multimedia development are detailed as follows **table 1**

Table 1. stages of web-based interactive multimedia development

No	Stage	Description
1	Analysis (analysis of problems and learning components)	• Basic competencies analyze and conduct hydrostatic pressure experiments and pascal principles as well as archimedes laws. • The media used in learning is only human-based media (teachers) and printed media (textbooks). • Teachers do not make much use of technology, while pupils have known and able to operate computers and the Internet well. • Wifi networks in schools are available but are not well used in the learning process.
2	Design	Web-based interactive multimedia product design is the systematic preparation, presentation of material, illustration, visualization as well as the design of evaluation tools.
3	Product Development	• Validate the learning parameters developed. • Writing text, creating navigation buttons, creating and installing images, creating simulations, searching and installation of videos, web building, creating, and installation of databases for testing.
4	Implement	• Make a record of the shortcomings and constraints that occur when the product is implemented. • Give a lift of practicality to the student.
5	Evaluate	Evaluation in the research is carried out at each stage of the ADDIE model through the provision of a test post to determine the effectiveness of the media. If there are revisions before and after the implementation then the improvements are made but if not all the activities are completed.

Table 1. stages of web-based interactive multimedia development

The data analysis techniques used in research are two: quantitative data analysis and qualitative descriptive data analysis. Quantitative data analysis is used to analyze the data collected from the lift while qualitative descriptive analysis is utilized to process the results of the data from the critical lift and the advice of the learning media and the material expert.

a. Media validity analysis

Expert validity questionnaire data was analyzed using the percentage score of the learning media developed. The formula used to calculate the percentage of expert validation questionnaires [8] is

$$P = \frac{f}{N} x100\% \quad (1)$$

P = Score percentage (rounded)

f = Number of scores obtained

N = Maximum score

Table 2. Product validity criteria [9]

Criteria	Validity Level	Description
81.00% - 100.00%	Very valid	Can be used without revision
61.00 – 80.00%	Valid	Can be used with minor revisions
41.00 – 60.00%	Invalid	It is recommended that it not be used due to major revisions
21.00 – 40.00%	Not valid	Should not be used, needs major revision
00.00 – 20.00%	Very Invalid	Must not be used

b. Media practicality analysis

The practicality of the media is measured through teacher and student response questionnaires. The subjects who carry out truth testing (validators) on the practicality of learning media are teachers and students. Data obtained from the questionnaire were analyzed using the following formula:

$$A = \frac{T_{SEV}}{S_{Max}} x100\% \quad (2)$$

Table 3. Product practicality criteria

Criteria	Categorical
81.00% - 100.00%	Very practical
61.00 – 80.00%	Practical
41.00 – 60.00%	Inpractical
21.00 – 40.00%	Not practical
00.00 – 20.00%	Very inpractical

c. Media Effectiveness Analysis

A web-based interactive multimedia effectiveness is designed to be analyzed from a student learning test consisting of 20 topics with double choices. The learning test results can be seen from the percentage of students who are able to a minimum KKM score of 75. Permendikbud No. 23 Year 2016 on educational assessment standards stated that the results of assessment of knowledge and skill aspects were in the form of numbers on a scale of 0 – 100, then the student answer scores were made in a form of figures on the scale 0 – 100. Web-based interactive multimedia effectiveness calculation formula [10]

$$\mathrm{KB} = \frac{\mathrm{T}}{\mathrm{T}_t} \mathrm{x}100\% \quad (3)$$

3 Result and Discussion

Web-based interactive multimedia development

The product of development research is interactive multimedia on static fluid material. Developed web-based interactive multimedia is defined as quality if it meets the category of valid, practical and effective. The process of producing quality interactive media follows the five-stage ADDIE instructional design model. A presentation of each step of the development model used as follows.

1. Analysis

The analysis phase aims to identify possible causes of performance gaps or problems that occur in learning. The general procedures associated with the analysis stage are as follows.

a. Learning analysis

Learning analysis is aimed at identifying and clarifying issues in learning activities so as to obtain solutions in the form of development of learning products or improvement of learning management. The results of learning analysis obtained curriculum used in the school is K13, teachers only use print media and less use the role of information technology in delivering teaching material that makes students tend to be passive, bored in teaching learning activities and not interested in the materials delivered.

b. Determination of Instructional Objectives

The result of the instructional analysis obtained is that web-based interactive multimedia is acceptable to teachers and students.

c. Student needs analysis

Students needs analysis results are obtained from the study of literature and information collection through National and International journals.

2. Design

The design phase aims to verify the desired learning with the appropriate test methods. The web-based interactive multimedia design phases include material design and flowchart display design. The web-based interactive multimedia content chart can be seen in Figure 2

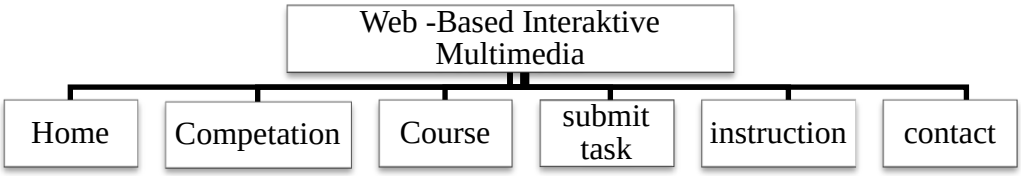

Fig. 2. The web-based interactive multimedia content chart

3. Development

a. Media Validation Results

Construction validation is carried out by media experts against web-based interactive multimedia. Media experts in development research involved two media experts in physics learning. Assessment is done using a media validation sheet that covers several aspects of display, programming, usability and language. A summary of the results of media expert validation analysis in some aspects is also shown in Figure 3.

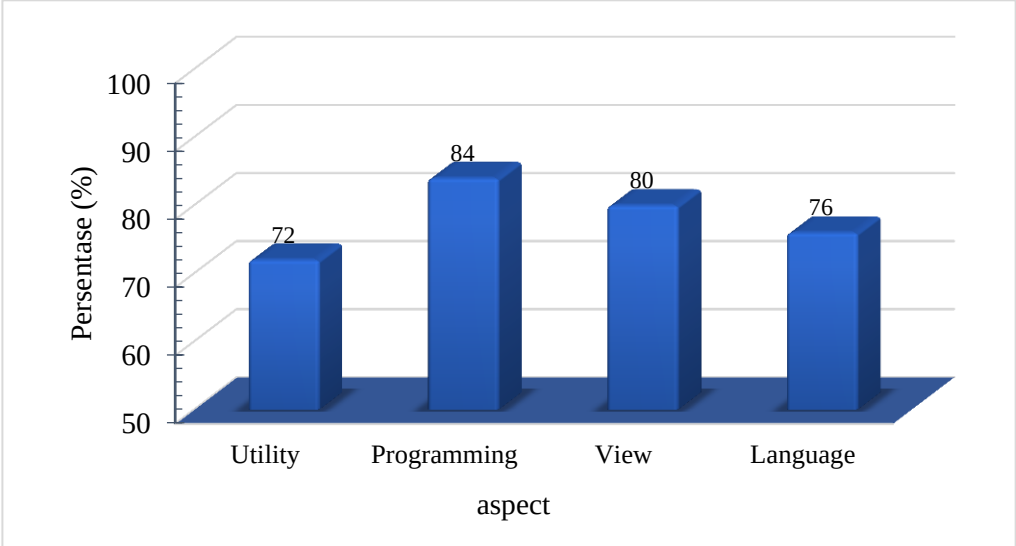

Fig. 3. The results of media expert validation analysis in some aspects

b. Validation Analysis by Material Expert Content

Validation is carried out by the material expert on web-based interactive multimedia. The material expert commented on a material validation sheet that covers several aspects of it: appearance, quality of learning material, content/ content, availability and language. A summary of the results of validation analysis by material expert in each aspect is presented in Figure 4.

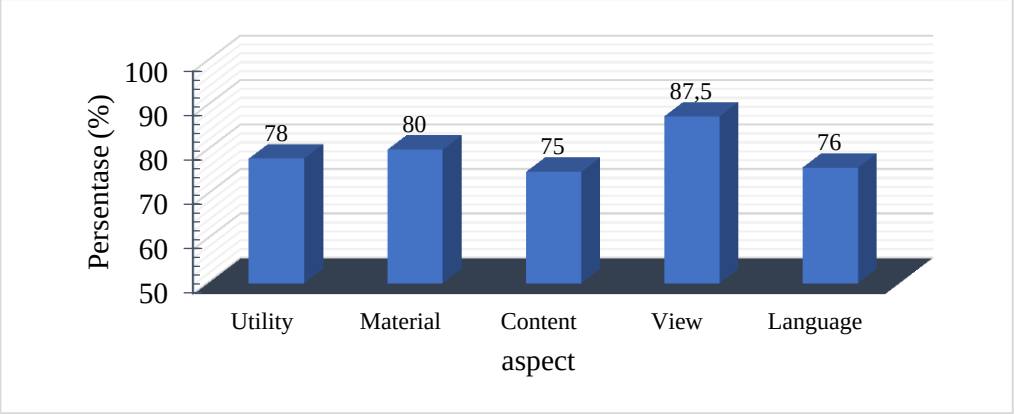

Fig. 4. The results of validation analysis by material expert in each aspect

4. Implementation

Multimedia that has been evaluated and deserves to be used is then applied to classroom learning. The implementation phase aims to analyze the practicality of web-based interactive multimedia that has been developed.

1) Web-based Interactive Multimedia Practicality by Teachers The web-based interactive multimedia practicality is measured using a teacher's response lift covering the aspect of ease, clarity, relevance, appearance and relevance.

Table 4 Percentage teacher response

Aspec	Percentage	Categorical
Facilities	87.50	Very practiced
Clearness	92.00	Very practiced
Appropriation	90.00	Very practiced
View	90.00	Very practiced
Interested	97.14	Very practiced
Mean	89.00	Very practiced

2) Student Web-based Interactive Multimedia Practicality The web-based interactive multimedia practicality is measured using a student response lift that covers the aspects of convenience, clarity, relevance, display and elegance. A small group consisted of 10 students in XI MIA class and a limited group consisting of 20 students in 11 MIA.

5. Evaluate

The evaluation stage aims to assess the quality of web-based interactive multimedia and the learning process before and after implementation.

1) Effectiveness of Web-Based Interactive Multimedia

The effectiveness of web-based interactive multimedia can be seen after the product developed is declared valid and practical. The effectiveness of the product being developed can be seen in the classroom learning process on static fluid material. The effectiveness of web-based interactive multimedia is seen from the consistency between the curriculum and the products developed and the learning objectives achieved. The results of data analysis on the effectiveness of using web-based interactive multimedia for class XI MIA students are described in Table 5

Categorical	**Small group**		**Big group**	
	Pretes	**Postes**	**Pretes**	**Postes**
Number of Completed Students	0	9	0	18
Incomplete Number of Students	10	1	10	2
Average Student Grade	30,5	83,5	26,75	84,0
Classical Completeness (%)	0	90	0	90

Data on completeness of learning outcomes in Table 4.10. shows that classical completeness is 90.00%. The Department of Education and Culture states that a class is said to have completed learning if the PKK is ≥85%. Sugiyono (2011) stated that if learning completeness is 81% < KB ≤ 100% then it meets the criteria for very good effectiveness.

4 Conclusion

Based on the results of the analysis and discussion described in the previous chapter, several things can be concluded as follows.

1. The web-based interactive multimedia developed is included in the valid category by media experts with an average of 75% and material experts with an average of 78%.

2. The web-based interactive multimedia developed was categorized as very practical by teachers with an average of 91%, small group students (trial I) with an average of 80% and limited group students (trial II) with an average of 87% .

3. The developed web-based interactive multimedia is effective in terms of the achievement of learning objectives, namely a minimum of ≥ 85% of students who take part in the learning are able to achieve a score of ≥ 75 with classical completeness obtained at 90.00%.

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