

Web-Based Interactive Learning Medium to Foster Students' Understanding on Magnetic Theory Using the Tutorial Method

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Abstract – Technology, particularly in the form of web-based learning resources, aided education during the COVID-19 outbreak. In responding to the condition, this study aims to (1) develop a web-based interactive learning medium application of magnetic material with tutorial method; (2) describe the feasibility of a web-based interactive learning medium for students using magnetic material and a teaching technique. The model used in this study was the ADDIE model. Total of 29 students junior high school in Banjarmasin participated in this study as subject for implementation product. Data collection techniques in this study used validity assessments, questionnaires and tests. The results of the study showed that: (1) HTML, CSS, Javascript, JSON, and Firebase were utilized in the development, and (2) based on these findings, it can be stated that a web-based interactive learning medium for students using magnetic material and the tutorial approach is feasible for use in learning since it meets the criteria of validity, practicality and effectiveness.

Keywords – magnetism, tutorial method, web-based learning medium.

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1. Introduction

Worldwide education system nowadays emphasizes critical thinking and problem solving skills [1]. In order to meet the need of being critical and problem solvers, teachers are required to be able to use creative, varied and innovative learning methods to help students become more engaged in learning activities. Learning activities are teaching and learning processes between teachers and students to achieve learning objectives [2]. Good learning is learning that is innovative in which one of the supporting components is realized by using technology. In fact, technological developments have grown rapidly and have affected almost all aspects of life, including education [3]. They are coupled with the availability of wireless communication technology that increases the effectiveness and efficiency of the education system [4].

The advancement of technology amid the epidemic of Coronavirus-19 (COVID-19) is essential since people have to limit their move. COVID-19 has impacted nearly all sectors, including education. Currently, the involvement of technology is needed to be incorporated into education or better known as educational technology [5] because technology and information at this time have a great influence on high school and university students [6]. Since the outbreak of the COVID-19 in Indonesia on March 2020, various forms of policies have been issued by the government and universities in Indonesia to continue to carry out learning activities referring to protocols to reduce the spread of the virus [7]. The Ministry of Education and Culture of the Republic of Indonesia issued circular letter number 15 of 2020 concerning Guidelines for Organizing Learning from Home in an Emergency Period for the Spread of Corona Virus Disease. This study from home policy is carried out in order to fulfill the rights of students to obtain educational services even in the midst of the COVID-19 pandemic.

The COVID-19 pandemic cannot be used as an excuse for students not to study because education is one of the important keys in the development of human resources [8]. Although online learning is considered quite inconvenient, especially for subjects that do require practice, one material that seems abstract and requires practice is magnetic material. In this material there are various things that need to be explained in a concrete form. Due to the limited space to practice the material, students are prone to being sluggish to study. To combat this, a variety of technological options can be used, one of which is web-based learning media. This type of learning media can be an alternative to carry out learning activities from home.

Among many materials taught at junior high school, magnetic material is a lesson taught to the ninth grade that includes material on magnetic properties, how to make magnets, the earth has magnetic properties, magnetic fields around electric currents, and the use of magnetism in technology products. These materials need to be explained using a method that is able to link theory and application in stages. The tutorial method is a learning method that provides a presentation in the form of lessons using step by step stages to understand a material [9]. This method is best suited to be applied to magnetic materials.

In a nutshell, based on the underlying background, this present research study was conducted entitled "Web-Based Interactive Learning Medium to Foster Students' Understanding of Magnet Theory using the Tutorial Method". This medium allows students to study online from home.

Learning media are any things that can be used to channel messages from senders to receivers so that learning objectives can be achieved [10], [11]. To maximize learning, the media need to be presented interactively, so that users and systems can interact actively with each other. Interactive learning media can support portability, connectivity, social inactivity, context sensitivity and can be adapted for individual learners [12]. Interactive learning media can be a combination of texts, images, graphics, sound, videos, animations, and simulations that are integrated synergistically that allow users to interact with the program [13].

Web based learning media is a learning medium that teachers can use to teach magnetism [14]. The web is a network-connected system for accessing, manipulating, and downloading hypernautical documents [15]. The utilization of web-based learning media can help students learn more effectively by creating an engaging, dynamic learning environment and motivating them to learn [16].

The advantages of using the internet as a learning medium include: 1) Students can learn autonomously, increasing and expanding their knowledge; 2) Students are engaged in additional learning activities, as they do not only listen to the teacher's descriptions, but also they are engaged in other activities such as observing and trying, and 3) web-based learning media provide additional learning resources that can be used to enrich learning materials [17].

2. Method

The ADDIE development model was used to undertake the current research and development (R & D). This model is designed to deal with learning issues in a systematic way that is adapted to the needs and characteristics of the students. Figure 1 shows the steps in the ADDIE model namely: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation [18], [19], [20], [21]. In the analysis stage, three aspects are analyzed, namely general analysis, content and technology. At the design stage, the design of the presentation of teaching materials was carried out, the design of the application design, the interface design, and the design of the database design. At the development stage, coding was carried out from the design into a complete program. At the implementation stage, field trials were conducted. Then, for the evaluation stage, it was carried out at the end of each of the previous stages.

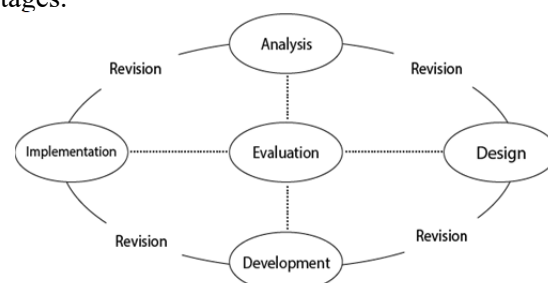


Figure 1 ADDIE Model

The feasibility of the medium was measured by assessing the validity, practicality and effectiveness of the media that has been developed. Validity was obtained from the results of a questionnaire filled out by material and media experts. Practicality was obtained from the results of a questionnaire filled out by students and teachers. Meanwhile, the effectiveness was seen from students' learning outcomes after using the interactive learning medium. The students involved in the online learning tryout using an interactive learning medium were 29 students from the ninth grade of SMP Negeri 33 Banjarmasin.

The learning outcomes of the students who joined the learning outcomes tests or evaluations were then analyzed using descriptive statistics.

3. Result

The Development Results

The results of the development are based on a development operational framework consisting of five steps of the ADDIE development model. This development has resulted in a product in the form of a web-based learning medium for magnetic materials for the ninth grade junior high school students. The details of the activities carried out at each stage are as follows.

Analysis

The analysis carried out in this study was divided into three parts, namely general, content, and technology analysis. In the general analysis, the results of field studies and literature were presented. The field study was obtained from the results of discussions with subject teachers while the literature study resulted in a literature review that stated that an interactive learning medium is a tool in the learning process [22], [23].

Meanwhile, the content analysis activities consisted of five activities as shown in Figure 2, namely analysis of material coverage, content characteristics, digital content presentation, media display design, and application of tutorial methods.

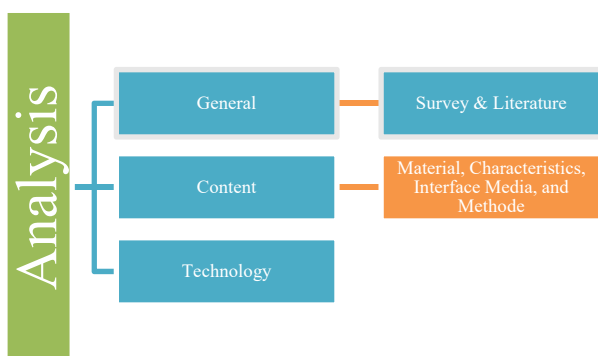


Figure 2 Learning Media Analysis

Based on general analysis and content analysis, several technologies were needed to produce the interactive learning medium. The results of the technology analysis are given in Table 1.

Table 1 Technology Analysis Results

Technology	Need
HTML	Display the learning content in the form of texts, images, and learning videos. In addition, make the pages interrelated.
CSS	Organize and design the display of learning media so that it becomes responsive.
Javascript	Make the learning media pages interactive, create JSON configurations to display questions on quizzes and evaluations and create Firebase configurations for data storage. as well as for the application of the tutorial method.
CapCut	Edit the learning videos.
JSON	Save questions and answer choices to be displayed on the quiz and evaluation page.
Firebase	Save the results of doing quizzes and user evaluations.
Gitlab	Save the source code.
Netlify	Web hosting integration from gitlab.

Design

At the design stage, several activities were carried out including making the design of the presentation of the teaching materials, the design of the application design, the interface design, and the design of the database design. In making the design, the presentation of the teaching materials consists of learning objectives, materials, exercises, quizzes at the end of each sub-chapter and evaluation at the end of the chapter. The design of the application design consists of two activities, namely designing flowcharts and use case diagrams. The interface design is based on the results of the interface design analysis that has been made previously. Meanwhile, at the database design stage, the database schema will be drawn up. The databases used for this learning media are JSON and Firebase.

Development

The development results in this step resulted the web-based interactive learning medium. Learning media is developed using software technology from the results of technological analysis and is made based on all designs at the design stage. This development starts from developing the learning medium, presenting the content using tutorial methods, developing the databases, and publishing the learning medium. The following is the interface of the learning media that has been developed.

a) The Main Page



Figure 3 The Main Page of the Learning Medium

Figure 3 shows that the main page of the learning medium showing three menus, namely: (1) Core Competence (Kompetensi Inti or KI) and Standard Competence (Kompetensi Dasar or KD), (2) Materials, and (3) Information.

b) The Material Page



Figure 4 The Learning Medium Material Page

Figure 4 shows that the learning medium material page contains objectives, materials, exercises, quizzes, and learning evaluations.

c) Evaluation Page

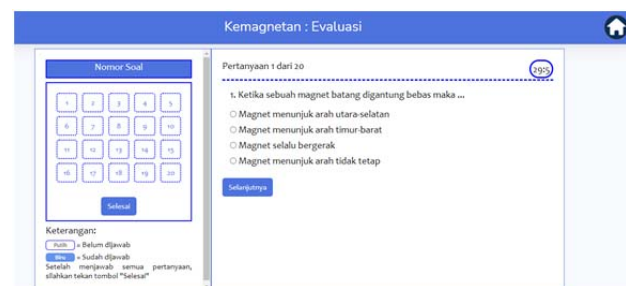


Figure 5 The Learning Medium Evaluation Page

Figure 5 shows that the evaluation page contains the number of questions, processing time, questions and answer choices.

Implementation

Implementation activities were carried out online because the Government implements distance learning.

During the trial process, the students used the online learning medium from their respective homes while teachers and researchers were at school. In addition, two online learning support applications, WhatsApp and Google Classroom, were also used to help monitor the learning implementation. The implementation of the learning using the developed learning medium was carried out three times based on the results of discussions and agreements with the teacher.

Evaluation

Evaluation in this study was carried out at almost every previous stage. At the analysis stage, several things were evaluated, including:

- 1) The use of supporting technology which was previously in the form of presentation slides was changed to video and an observation table was added for students' work.
- 2) Firebase as a technology to store data in real time were added.

Furthermore, the evaluation at the design stage contains several things including: adding user manual features and quiz features to the design. Evaluation at the development stage was carried out after the program was completed, and resulted in several improvements including:

- 1) Correction of sentence writing on multiple choice questions;
- 2) Addition of color as an indicator of passing and not passing on the quiz score page;
- 3) Improved hint sentences to answer questions on some media pages.

Evaluation at the implementation stage is carried out after getting all the data from the test results. In this evaluation, a review of each received data is carried out, including the separation of data that is appropriate and not in accordance with the criteria.

Eligibility of the Learning Medium

The feasibility of the interactive learning medium includes several aspects, namely, assessment of validity, effectiveness and practicality. The results of the assessment of the feasibility of learning media are as follows:

Validity

a) Material Expert Validity Results

The results of the validity of the material experts can be seen in Table 2.

Table 2 Material Expert Validity Results

Aspect	ES	AS		PA	Validity
		V. 1	V. 2		
Instructional Design	110	48	50	89	Very high
Language	30	12	12	80	Very high
Total of Achievement	140	60	62	87.14	Very high

Note: ES = expected score; AS = achievement score; PA = percentage of achievement; V.1 = validator 1; V.2 = validator 2.

b) Media Expert Validity Results

The results of the validity of media experts can be seen in Table 3.

Table 3 Media Expert Validity Results

Aspect	ES	AS		PA	Validity
		V. 1	V.2		
Feedback and Adoption	16	7	6	81.25	Very high
Presentation Design	56	21	21	75	High
Interaction Usability	24	11	9	83.33	Very high
Total of Achievement	96	39	36	78.12	Very high

Note: ES = expected score; AS = achievement score; PA = percentage of achievement, V.1 = validator 1; V.2 = validator 2.

Practicality

Practical data was obtained from student and teacher responses. The results of the student responses are seen in Table 4, and the results of the teacher's responses are given in Table 5.

Table 4 Student Response Questionnaire Results

Aspects of assessment	Percentage	Criteria
Ease of Use and Navigation	97%	Very Practical
Cognition Content	94%	Very Practical
Scope of Knowledge and Presentation of Information	89%	Very Practical
Aesthetics	94%	Very Practical
Overall Function	92%	Very Practical
Ease of Learning	88%	Very Practical
Total	92%	Very Practical

Table 5 Teacher Response Questionnaire Results

Aspects of assessment	Percentage	Criteria
Ease of use and navigation	100%	Very Practical
Cognitive content	93%	Very Practical
Knowledge space and information presentation	96%	Very Practical
Aesthetics	95%	Very Practical
Overall function	95%	Very Practical
Ease of learning	100%	Very Practical
Total	96%	Very Practical

Table 4 shows that the percentage is 92% and Table 5 establishes that the percentage is 96%. From the results of the questionnaire responses from students and science teachers, it can be concluded that interactive web-based learning media with magnetic materials with tutorial methods can be said to be practical.

Effectiveness

Based on Table 6, the percentage of students' completeness is 86.21 %. This percentage of completeness is above the minimum completeness of the effectiveness of the learning media, which is 75%. From the analysis of student learning outcomes, the interactive web-based learning medium with magnetic material using the tutorial method is an effective criterion.

Table 6 Analysis of Student Learning Results

Maximum Score	95
Minimum Score	65
Number of Completed Students	25
Number of Students Not Complete	4
Average Score	80.69
Completeness Percentage	86.21%

4. Discussion

The developed interactive learning medium has the ability of interactivity, which is a two-way communication between users and the interactive learning medium. The web-based interactive learning medium developed can be accessed or used by users anytime and anywhere. The web-based interactive learning medium developed took the material of magnetism by applying the tutorial method in presenting the material. It was built with several technologies, namely, HTML, CSS, Javascript, JSON, Firebase and CapCut. The interactive learning medium that has been developed can be said to be feasible if it meets the eligibility criteria for a product that is determined from the level of validity, effectiveness, and practicality.

The results of validation, as determined by two scientific learning material specialists, a science education study program lecturer, and an MA

Darussalam Awayan Science teacher, were extremely high, with an achievement rate of 87.14 percent. The information delivered using the tutorial technique is considered acceptable since it incorporates and promotes the accomplishment of basic competence at the junior high school level.

The consistency with which content linked to everyday occurrences is presented is thought to aid kids in learning magnetism. Words and sentences that adhere to enhanced spelling rules ensure that messages are delivered clearly and in accordance with kids' intellectual development. As a result of these factors, two material experts have deemed the learning materials generated to be genuine.

Furthermore, the results of the validation by two learning media specialists, namely two lecturers from the FKIP ULM Computer Education study program, revealed that the validity requirements were quite high, with an achievement rate of 78.12 percent. Since the interactive learning medium responds well to user input, it is considered to be legitimate. If the layout of content on the interactive learning medium is user-friendly and acceptable for distribution, it is considered legitimate. The color choices, text clarity, video quality, and picture quality on the learning media are all acceptable so that the material on interactive learning media can be read and recognized effectively. Users will find the buttons and navigation in the learning media to be simple to use, making interactive learning media a breeze to utilize. Two media experts have deemed the interactive learning medium that has been produced to be valid as a result of these factors. Based on the findings of two media experts and two material experts, the learning media generated is legitimate. Setyadi dan Qahar [17] support this by stating that the legitimacy of web-based interactive learning media is dependent on the outcomes of material and media experts' evaluation.

Based on the results of the questionnaire response of 29 students to the interactive learning medium, the percentage was 92%, so the criteria for interactive learning media were very practical criteria. In addition, the results of the questionnaire response of the science teacher to the interactive learning medium obtained a percentage of 96%. Therefore, the criteria for the interactive learning medium are very practical criteria. The web-based interactive learning medium on learning magnetism with the tutorial method is stated to be very practical.

In Husein dan Rusimamto [24], it is stated that interactive learning media can be considered practical if the student and teacher response questionnaire shows a high percentage of practical or very practical responses.

According to the results of a survey of students' responses to interactive learning media, 92% of students are able to learn independently with web-based interactive learning media in magnetism learning, 96% are able to increase their interest in

learning magnetism, and 82% of students respond more positively to the presentation of magnetic learning materials via interactive learning media.

This is reinforced by the research of Divayana, Suyasa, & Sugihartini [25] stated that using web-based learning media makes it easier for teachers to transfer material and train students' abilities in independent learning.

The learning outcomes are derived through learning evaluation; it is known that up to 25 students out of a total of 29 are deemed complete with KKM scores. The percentage of completion derived from students' learning outcomes is 86.21%. As a result, the produced interactive learning media might be considered successful. According to Widjayanti, Masfinatin, and Setyansah [26], the success of interactive learning medium is determined by the proportion of student learning completion, specifically the minimum completion rate of 75%. Factors that affect student mastery is the tutorial method that is poured into learning videos. These learning videos can help students understand the material. Based on research by Diansyah [27] that states that the application of an interactive multimedia tutorial model is proven to be effective in increasing student understanding. Furthermore, Daryanto [28] suggests that the advantages of using instructional video media will make the message conveyed more appealing, and that this element of attention is important in the learning process because attention will stimulate or motivate students to learn and make them concentrate more.

Another factor that affects students' completeness is the questions that are presented interactively. Students are becoming accustomed to it, easy and skillful in comprehending and solving various types of questions as a result of a sequence of interactive questions, ensuring that students' learning outcomes match the minimum completeness criteria. According to Dwiqi, Sudatha, and Sukmana [29], media that combines multiple components, one of which is interactivity, can make the learning process more fascinating and effective since it incorporates more than one sense in learning, resulting in favorable student learning outcomes.

The utilization of interactive learning media in the classroom is a key aspect in obtaining KKM-compliant students' learning outcomes. According to Fauziah's study [30], the usage of interactive multimedia has been shown to improve students' motivation and learning results. Furthermore, Research Dwiqi, Sudatha, & Sukmana [29] found that the usage of multimedia in learning would undoubtedly be able to grab students' attention, making the information simpler to understand.

5. Conclusion

The following conclusions are drawn based on the findings and discussion on the development of the web-based interactive learning medium in the ninth grade on magnetism using the tutorial method:

1) The research and development carried out has produced a product in the form of web-based interactive learning media for class IX magnetism with the tutorial method which was developed using the Research and Development Research and Development (R&D) method with the ADDIE development model. Using the Research and Development Research and Development (R&D) approach with the ADDIE development model, a product in the form of the web-based interactive learning medium for the ninth-grade students on magnetism using the tutorial method was built. The technologies used in the development of this web-based interactive learning medium are HTML, CSS, Javascript, JSON, Firebase, CapCut, Gitlab and Netlify.

2) Based on the results of the validity assessment by material and media experts, the web-based interactive learning medium for the ninth-grade students on magnetic material with the tutorial method has been declared valid, practical, and effective in terms of the percentage of complete learning outcomes of students who have met the minimum completeness criteria. This medium meets three eligibility requirements, namely validity, practicability, and effectiveness. As a result, this web-based interactive learning medium is suitable for use in education.

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