

Dynamic Electrical Subject for Senior High School: Developing Interactive Tutorial Method Animation

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Abstract

In recent years the need for digital technology in various fields is in great demand, including in education fields. This is due to digital technology which makes it easier for students to understand the material and increase learning interest. To increase students' understanding and interest in learning about dynamic electrical material, the Interactive Tutorial Method Animation (ITMA) was developed using Adobe Flash Professional CS6. This research was conducted at the SMA (Senior High School) Laboratory at Islamic University Sunan Kalijaga, Yogyakarta. This model refers to the elaboration research procedure by Borg and Gall. Data were collected using a questionnaire instrument which contained: validation, response, and assessment sheets. Qualitative assessment data from 7 experts on ITMA quality were used as a reference for initial product revisions. Then the qualitative data of student responses were determined using the Guttman statement scale. Ideal percentage and agreement were used to analyze the data of preliminary and main fields, respectively. The results of the experts' evaluation showed very good results, each of which was 92.8% for the material aspect, 91.6% for the media aspect, and 95.2% for the learning aspect. The final product of ITMA received a good response from students with a 96% approval rate. Therefore, it is suggested that the development of ITMA has increased students' interest in dynamic electricity subject.

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INTRODUCTION

The development of digital technology in the era of globalization increases in almost all areas of life. One of those affected is the education sector. Digital technology has a positive impact on teachers and students as well as learning tools. According to (Patmanthara, 2014), Technological developments are not only useful in education but also to anticipate changes in the education system in the future. Technology also has a positive impact on student learning as it encourages students to be more engaged and motivates them to retain more information (Costley, 2014). Learning devices, especially learning media, are an important component in the learning process. Utilizing learning media in the learning process can generate new desires and interests, can

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motivate and stimulate students learning, and even bring psychological effects on students. Learning media can also be used in various forms of teacher-student interaction in the classroom and to give instructions or explain a concept outside the classroom (Upadhyay, 2017). In addition, teachers must also be able to design appropriate learning media to create a learning atmosphere that encourages and motivates students to participate actively during learning (Gunawan et al., 2017). The use of computer animations in education enables rich and relevant depictions of dynamic processes that are typically difficult to comprehend through direct instruction (Rotbain et al., 2008). Therefore, the development of learning media is needed to improve the efficiency and effectiveness of the learning process.

Currently, the Adobe Flash Professional CS6 program is widely used to create animations by combining various media such as audio, text, video, images, and others. The use of this type of animation has a good influence on student learning outcomes (Dewi et al., 2018). Recent studies have been carried out in the form of applications and innovations such as videos and animations to encourage better learning outcomes (Soika et al., 2010), increase motivation (Ahmad et al., 2021) students' concept understanding (Rosdiana & Ulya, 2021) and stimulate student interest as a complement to learning (Xiao, 2013). If information technologies are used in the educational process, students or learners may benefit and acquire more, one such technology is animation (Kainz et al., 2013).

Based on the results of the distribution of the questionnaire, as many as 86% of the X science students in Senior High School Lab prefer to use computer-based learning media as a learning resource rather than using books. In addition, the teachers have difficulty in explaining dynamic electricity subjects because these subjects are abstract or cannot be visualized. Therefore, media that is suitable to overcome these problems is interactive animation media that can show phenomena, provide feedback directly to students, and also does not require internet facilities to run to be more effective and efficient. In previous research, animation media has been used to visualize microscopically the concept of particle-wave dualism concerning the photoelectric effect event (Mandagi et al., 2021), learning gravity physics and Kepler's laws (Munawaroh et al., 2021), and energy source materials (Sunaryo et al., 2021).

In addition, around 70% of the students also prefer to study outside the classroom than inside the classroom. Therefore we need a learning method that helps students learn anywhere. One method that can be used is the tutorial method. This method can be applied using computer technology, so it can help teachers in the learning process. In addition, this tutorial method can improve the student learning experience, student achievement, and develop student group work skills (Ferreira, 2013). Previously, (Khan & Vlacic, 2006) also explained that the tutorial method can help students to consider and discuss basic concepts. Previously, The tutorial video is very suitable for the learning process (Heinemann & Möller, 2016; Meij & Jan, 2014). However, the tutorial video is weak on the direct learning interaction of the students.

In previous research, animation media has been successfully used in learning as in research (Hapsari et al., 2020; Mandagi et al., 2021; Munawaroh et al., 2021; Rosdiana & Ulya, 2021). However, no one has integrated it with learning methods. Therefore, the novelty of this research is to develop animation with an interactive tutorial method.

Based on the above review, the development of the Interactive Tutorial Method Animation (ITMA) using the help of computer technology is needed to help visualize dynamic electrical materials in an attractive, easy, and quality way. In this article, ITMA was developed using the Adobe Flash Professional CS6 program and the quality of ITMA is discussed to explain why ITMA is highly recommended to increase student interest in the subject of dynamic electricity.

METHOD

The ITMA, in this study, was developed using the Research and Development (R&D) by Borg and Gall. Research and Development is a series of processes or steps to develop new products or complete products that have been made so that they can be accounted for (Gall et al., 1996). This study uses a procedural model to produce an ITMA product that descriptively follows the stages

which include literature study, planning, initial product development, initial field test, main product revision, main field test, and final product as shown in Figure 1.

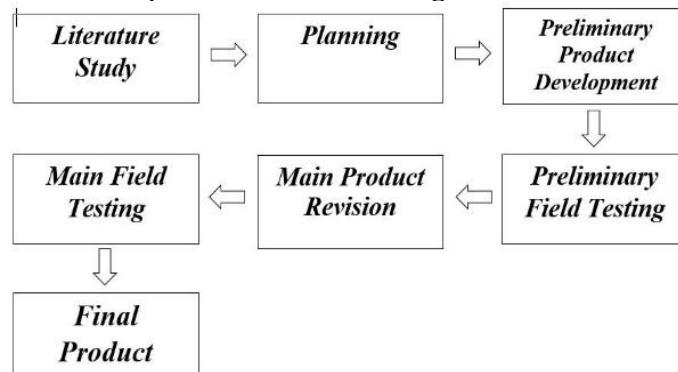


Figure 1. Procedural model stages

In the first stage, various information was collected through direct observation and interviews with physics teachers at Senior High School Lab at UIN Yogyakarta. Observations were made by making direct observations in the school environment. The interviews conducted included students' interest in learning, the learning process, and the learning support facilities available at the school. The second stage is planning, dynamic electrical materials and Adobe Flash Professional CS6 was selected to develop ITMA. In the initial product development stage, the product results are validated by a team of experts consisting of material experts and media experts who will later provide input and suggestions for improvement of the initial product. In the initial field test stage, the product is assessed by an assessment team consisting of 3 subject matter experts, 3 media experts, and a physics teacher. The results of the assessment consist of product quality, input, and suggestions used for major product revisions. The next stage is the main product test, the product is tested in small groups consisting of 5 students. After that, the test was carried out in large groups consisting of 30 students in class X science 1 and 30 students in X science 2 to get results that refer to the final revision to produce the final product.

The analysis technique is carried out on qualitative data which is input, advice, and assessment from material experts, media experts, and physics teachers. Then the qualitative data is converted into quantitative data. The average score is calculated from each aspect. Next, the average score is made up of intervals to be converted into qualitative data to determine product criteria such as table 1.

Table 1. ITMA product assessment criteria by experts (Saputra et al., 2018).

Average Score Range	Product Criteria
$3,25 < X \leq 4$	Excellent
$2,5 < X \leq 3,25$	Good
$1,75 < X \leq 2,5$	Poor
$1 \leq X \leq 1,75$	Very poor

If the results of data analysis show the product criteria are very good or good, then the product can be said to be of high quality and can be continued to the next stage. Meanwhile, if the results of data analysis obtained sufficient criteria or less, it needs to be revised according to suggestions and input from experts and students. Then the ideal percentage is calculated according to equation 1 as follows (Widoyoko, 2012):

$$\text{Ideal percentage (\%)} = (\text{Total Score} : \text{Maximum Score}) \times 100\% \quad (1)$$

Student response sheets were analyzed to determine their responses to ITMA products using the Guttman's scale (Andrich, 2002). Qualitative data is converted into a score with the provisions of a score of 1 = agree and 0 = disagree, as shown in Table 2.

Table 2. Criteria for assessment of student responses to ITMA by the Guttman's scale

Average Score Range	Product Criteria
$0,6 < X \leq 1$	Agree
$0 \leq X \leq 0,6$	Disagree

The product can be used in a large group test if the analysis of the average score obtained agrees criteria. Then if the analysis of the average score is obtained by the criteria for disagreeing, the product can be revised according to the suggestions and inputs given by the experts. Furthermore, the results of the large group test analysis, if the agreed criteria are obtained, the final product can be used as a learning medium. And vice versa, the product can be revised according to the suggestions and inputs are given before it becomes the final product. The percentage of approval is calculated according to equation 2

$$\text{Agreement percentage (\%)} = (\text{Total Score: Maximum Score}) \times 100\% \quad (2)$$

RESULT AND DISCUSSION

ITMA was developed using Adobe Flash Professional CS6 is combined with the tutorial method, so that students are expected to be able to learn independently. The ITMA developed not only contains information about the material but also contains experimental animations and questions for the dynamic electrical material competency test. It may be claimed that Adobe Flash is appropriate multimedia because the information included in Adobe Flash is encoded in two modalities, visual and auditory, referred to as double coding (Astuti & Nurcahyo, 2019). In addition, the analysis of assessments from experts and student responses will also be discussed. The display of ITMA products is shown in Figure 2.



Figure 2. Display of ITMA: Introductory Page (a); Menu Page (b); Curriculum Pages (c); and Content Pages (d)

Figure 2a shows the introduction page of the ITMA. To attract students' attention during the learning process, the front display is made as attractive as possible before entering the main menu page as seen in figure 2b. The next menu presents all menus in ITMA which includes the first sub-material, the second sub-material, experiments, competency tests, and profiles. On this menu page, students can choose any menu they want. In addition, menu descriptions are also added to make it easier for students to understand when using them. As we can see in figure 2d, the menu subject contains descriptions of current, voltage, resistance, and circuits. This menu not only explains the description in text form but also through animation. In the experiment menu, students can conduct experiments to understand Ohm's law with experimental guidance. The program's planned design would have an area for teacher-student interaction in which students can move, drag, and throw objects, as well as a side panel containing all of the available objects that are intended to be related to important physics topics (Thomas, 2009). Next is the practice menu which is made as an independent competency test that contains multiple-choice questions that can be selected. The results of student answers from answering questions can be seen directly. The competency menu contains an explanation of standard competencies and basic learning competencies related to dynamic electricity materials.

The validation process involves three validators such as instrument experts, media experts, and material experts. Feedback and suggestions from the validation results are then studied for improvement. The results of the feedback and suggestions are as follows: the experimental menu table must be justified, the practice questions must have a navigation button to the start menu, and the equation formula must be adapted to scientific writing in italics. So that after repairs this product is declared valid by the validator.

The product assessment was carried out by 3 material experts, 3 media experts, and a physics teacher. The results of the expert's assessment are in the form of product quality data and suggestions which are then used as the basis for revising the product as shown in Table 3.

Table 3. ITMA Assessment results by experts

Assessment	Average Score	Ideal Percentage (%)	Product Criteria
Subject Aspect	3,71	92,8	Excellent
Media Aspect	3,67	91,6	Excellent
Learning Aspect	3,8	95,2	Excellent
Average	3,73	93,2	Excellent

As shown in Table 3 above, the assessment of product quality by physics experts and teachers gets very good criteria with an average score above 3.5 and a percentage above 90%. To determine the quality of the product based on the suitability of the subject matter with the competencies achieved. This is in line with the Curriculum's objectives are to promote fluency, reasoning ability, and problem-solving ability. Enhancing students' reasoning skills enables them to draw on their prior knowledge and experiences to solve new challenges (Lapkin et al., 2010).

The subject expert assesses the conformity with the curriculum, the correctness of the concept, and its implementation, the results of which are shown in Table 4. The aspect of conformity to the curriculum has the highest percentage compared to other aspects. This is because ITMA provides tutorial methods that are following competence. The result above is supported by some research from (Aswirna et al., 2020) that regular learning combined with tutorial learning resulted in a considerably greater rate of use in groups of students with a slow ability (slower student). On the other hand, the material expert's assessment on the implementation aspect has the lowest percentage because ITMA is still not good at providing feedback to students on the experimental menu and competency tests. Furthermore, the aspect of the truth of the material concept has an ideal percentage of 93.75%. Although this percentage is classified as very good, it still needs to be improved because the concept of dynamic electricity requires a better explanation. Overall, both the score and the percentage obtained fall into the very good category.

Table 4. Assessment results from subject experts

Assessment	Average Score	Ideal Percentage (%)	Product Criteria
Compliance with Curriculum	3,84	95,84	Excellent
Concept feasibility	3,75	93,75	Excellent
Execution	3,34	83,34	Excellent
Average	3,71	92,80	Excellent

Media experts assess several aspects including program aspects, display aspects, and linguistic aspects. Assessment is done by filling out a questionnaire. The data from the assessment by three media experts are presented in Table 5. When viewed as a whole, the ideal percentage obtained is 91.6% and produces a score of 3.67 with very good criteria. The display aspect has the lowest ideal percentage, which is 83.33%. According to the feedback result statement, this is because the selected text size is too small, and the selected font is not clear when read. Meanwhile, the language aspect has a higher score than the appearance aspect because ITMA has a communicative and interactive language. In addition, the chosen sentence is still too formal and leads to less interest. Another aspect shows that ITMA is easy to control and there are no errors in identifying the program.

Table 5. Assessment results from media experts

Assessment	Average Score	Ideal Percentage (%)	Product Criteria
Program Aspect	3,87	96,67	Excellent
Display Aspect	3,33	83,33	Excellent
Language Aspect	3,92	97,92	Excellent
Average	3,67	91,60	Excellent

The physics teacher assesses overall aspects of the material and overall aspects of the media. Assessment is done by filling out a questionnaire for physics teachers. The data from the assessment results are shown in Table 6. The overall ITMA aspect has very good criteria with an ideal percentage of 95%. Compared to the previous expert assessment, the implementation aspect improved significantly because the teacher contributed directly to the learning process. In addition, the appearance aspect is significantly improved because of ITMA's visual displays, such as animations which can be illustrated well enough on abstract concepts to attract students' interest. And one of the primary advantages of working with Flash is the ease with which animations can be created. It is also feasible to create animations that appear and behave like the real object with a little ActionScript and some physics (Ramtal & Dobre, 2011). Meanwhile, the programming aspect has decreased because teachers have a little difficulty controlling ITMA. In addition, the feedback results stated that the images on each menu should be more varied according to the content. So, based on the results of the ITMA assessment, it can be concluded that ITMA is ready to be used for the next stage and has been improved according to suggestions and input from experts.

Table 6. Results of the teacher assessment

Assessment	Average Score	Ideal Percentage (%)	Product Criteria
Curriculum suitability	3,8	98	Excellent
Concept feasibility	3,8	97	Excellent
Execution	3,6	92	Excellent
Program Aspect	3,8	94	Excellent
Display Aspect	3,8	92	Excellent
Language Aspect	4	97	Excellent
Average	3,8	95	Excellent

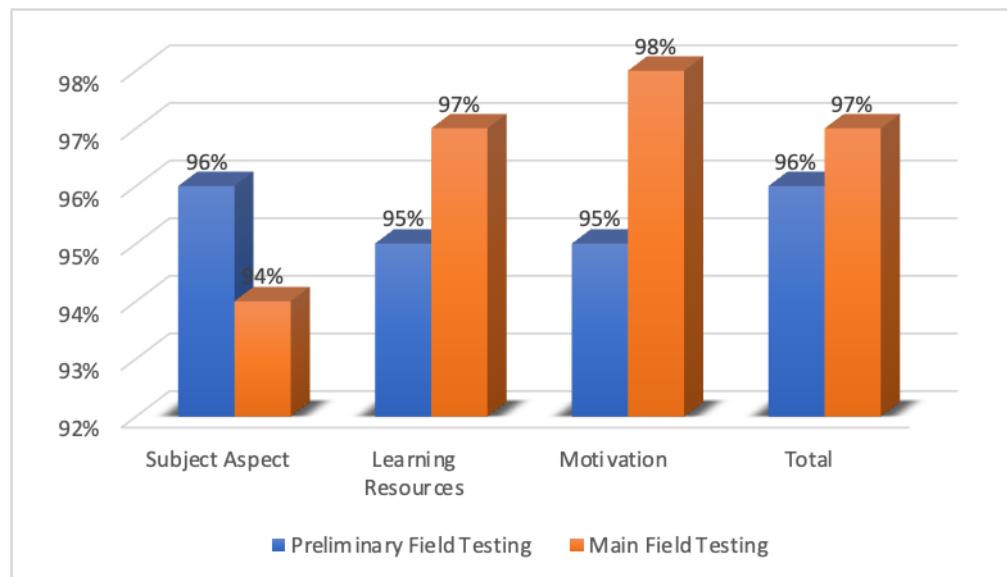


Figure 6. Percentage of approval of each aspect assessed by students.

The results of students' responses are divided into two stages, namely as the results of the initial field test or small group test, and the main field test or large group test as illustrated by the graph in Figure 6. As we can see that overall, the small group test results have a lower percentage of student responses, namely 96% compared to the large group test results of 97%. All aspects of the large group test results have a higher percentage than the small group test results except for the material aspect. In the large group test, the percentage of material aspects decreased from 96% to 94%. In this case, the researcher chose students who liked computer-based media on a small-scale test, while when tested on a large scale, it turned out that around 8% of students had difficulty understanding and remembering the material and even had difficulty using ITMA. According to the results of the feedback, students on the large-scale test also seemed to dislike dynamic electrical material. The percentage of learning aspects in the small group test and large group test obtained a percentage of 96% and 97%, respectively. The increasing percentage of learning aspects is caused by students assuming that ITMA can be used as independent teaching material. In addition, the students concluded that ITMA makes the learning process more enjoyable. This refers to the results of the feedback with the percentage of approval of the motivational aspect of 95%. Previous results showed that the students found the animations useful for improving conceptual understanding (Kohnle et al., 2012). Meanwhile, 5% of students concluded that ITMA could not encourage students' interest in learning. Overall, a large percentage of approvals were obtained. So, it can be concluded that students express their agreement for every aspect of the assessment of the ITMA.

CONCLUSIONS

ITMA was developed using Adobe Flash Professional CS6 according to the procedural model stages. ITMA is assessed by experts and students for feedback, input, suggestions, quality data, and feedback. The results of the assessment generally showed very good criteria with an average score of 3.71, 3.67, and 3.8 respectively by subject matter experts, media experts, and teachers. Furthermore, ITMA has been tested on students in small groups and large groups. The results of student responses for each aspect assessed as a whole show that ITMA has agreed to the criteria with a percentage of approval of 96% in the small group test and 97% in the large group test. ITMA products have been revised and improved at every stage so that the final ITMA products can be used in the learning process.

However, what also needs to be considered is that to reduce the potential for a decline in program aspects, teachers need to be equipped with the ability to control ITMA first. So that the implementation of ITMA in the classroom runs optimally and as expected. Finally, a key

recommendation for future research would be to address points of dispute. This occurs when numerous users attempt to interact with the same object concurrently.

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