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Application of Learning Media in Improving Higher Order Thinking Skills in Electronics Teaching Materials

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Abstract: This research aims to create a learning multimedia application that can be used by students in learning. The method used is development research from Jan Van De Akker with formative evaluation from Martin Tessmer. The research stage consists of four stages, namely the preliminary research stage, prototype, summative evaluation, and systematic reflection and documentation. Based on user assessment, the learning multimedia is practical to use with a practicality level of 83% and is included in the good category. The effectiveness of multimedia at the summative evaluation stage is based on the post-test results. The results of the student posttest stated that 9 out of 12 students scored ≥75, meaning that 75% of the participants passed and this multimedia is effective. The results showed that the learning multimedia application can improve the higher-order thinking skills of students.

Keywords: Effective; Higher order thinking skill; Multimedia learning; Practical

Introduction

Teachers must use learning media to be more effective in helping students develop their thinking patterns in understanding learning material known as interactive multimedia by using school computers. This is because media has become an essential part of the learning process along with current technological developments (Smaldino et al., 2008; Syafti et al., 2021). The utilization of technology, such as computer-based learning materials, can increase students' motivation to generate original ideas, making it a highly successful teaching tool (Becker et al., 2020; Mantoviana et al., 2023).

While many educators are adept at using instructional materials, the majority are not able to create learning resources that meet the needs of their pupils. Certain educators believe that educational resources can be delivered in any format, including digital ones. Actually, everything ought to be viewed in the context of the circumstances and conditions that permit everything to function as best it can. Learning media is one tool that teachers can use to help students learn at a higher quality. Anything that can be used to channel messages and encourage students' learning is considered learning media. The use of media facilitates effective learning. A collection of instruments or supplements that educators use to interact with students is known as learning media. Students will find media and packaged materials to be more engaging, comprehensive, and clear (Frasnyaigu et al., 2023).

In general, there are two types of media technologies: those meant for learning and those meant for teaching. Eady and Lockyer have compiled a list of numerous digital or media learning resources (2013). According to Guan et al. (2018), a number of studies have shown how beneficial media technologies are for education and how widely used they are. Multimedia applications are commonly utilized in education due to their numerous benefits, which make technology a common component of multimedia (Almara'beh et al., 2015; Pea et al., 1992).

Learning media's primary purpose is to enable students to comprehend the actual meaning of the content being presented. Additionally, this results in a decrease in the students' comprehension of the teacher-

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delivered material. As a medium for communicating the content of the material during the learning process, learning media is crucial (Bakhri et al., 2023).

Learning media that can improve students' higher-order thinking skills need to be applied to electronic materials. The time available in class is also not enough for learners to be able to grasp a correct understanding of electronic material. Analytical skills belong to the category of higher-order thinking skills in Bloom's taxonomy. For this reason, learning media on electronic materials are needed (Kwangmuang et al., 2021).

The development of learning media that can improve the higher-order thinking skills of learners is very important. The use of higher-order thinking skills in the right context will teach students the habit of thinking deeply, the habit of living life with an intelligent, balanced, and accountable approach (Djamas et al., 2021; Zulhelmi et al., 2023).

The learning media developed has added value compared to previous research. The learning media developed can be effective in improving the higher-order thinking skills of students (Daryanes et al., 2023; Hutahaean, Solihin, et al., 2022; Sulistyanto et al., 2022). People with the capacity for thought the goal of high level, or HOTS, problem solving is the ability to process and apply new knowledge or information. It is expected of the person to be able to use higher-order thinking skills to solve problems that are complex or that cannot be solved with a traditional approach. Since every person has unique problems, there will be variations in the solutions or approaches taken that students must possess the HOTS problem-solving skills in order to meet obstacles in their daily lives that call for advanced thought (Sani, 2019).

A learner should be proficient in critical thinking, or HOTS, as well as other fundamental skills like reading, memorization, and counting (Ayubi et al., 2023). Students will eventually need to embrace rapidly advancing technology and possess higher order thinking skills, or HOTS (Heong et al., 2011; Maskur et al., 2020). The ability to think logically and rationally is known as high-level thinking skills, or HOTS. Students can then use this ability to perform a variety of skills, including analyzing, questioning, evaluating concepts, and drawing conclusions (Dewi et al., 2019; Wardana, 2010).

The learning media has characteristics: using a scientific approach, providing higher-order thinking practice questions, and creating meaningful learning. Through training on questions that measure higher-order thinking skills, students will get used to thinking deeply to solve problems that require higher-order thinking skills (Coskun et al., 2022; Hutahaean & Lubis, 2022). Researchers see that there is a need for the development of learning media to be able to improve higher-order thinking skills (Ahmad et al., 2020; Sumarwati et al., 2020).

Method

Development research conducted by researchers is research that aims to produce an effective product for use in the world of education. This research uses a development studies model because researchers aim to produce a product that can solve problems in schools using pre-existing knowledge. The steps in the development studies research model according to Akker are preliminary research, prototyping stage, summative evaluation, systematic reflection, and documentation (Koliasa et al., 2021).

Prototyping Stage

The prototype stage is the stage of making and perfecting a product prototype that will be used to solve the problems found. This prototype stage consists of designing design guidelines, prototype optimization, formative evaluation, and revision (Dalal et al., 2013). Design guidelines is researchers choose electronic materials because of the problems and potential to improve higher-order thinking skills. Then researchers examine the learning outcomes of the material to be able to produce appropriate learning objectives. The developed media has its own characteristics in terms of appearance and content. Media design developed in terms of display is equipped with explanations in the form of text, images, animation, video, audio (music and dubbing), storylines on perception, sample questions, and evaluation questions. To form higher-order thinking skills, media learning media are designed using a scientific approach, train evaluation questions that require higher-order thinking skills and make learning meaningful in learning media. The media design to be developed can look like the following picture:

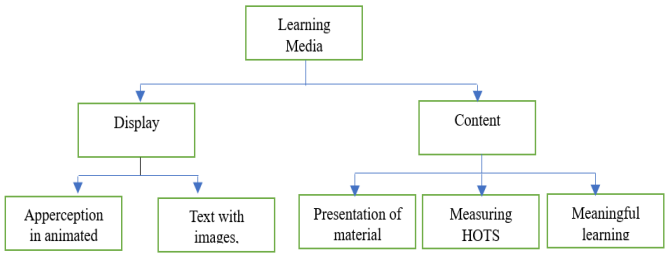

Figure 1. Learning media design guidelines

Media software design

Media software design has certain characteristics. The main page is a page in which there are buttons that can be selected by the user. These buttons are selection

buttons for user instructions, learning objectives, concept maps, materials, evaluation questions, references, and media creator profiles. The instructions for use button contains how to use the media.

Learning media made using a scientific approach to make students more active when using media. When the user selects the material button, the media will display perceptions in the form of conversations from two cartoon characters to stimulate students' curiosity. Then students will enter the first stage of the scientific approach, namely observing (Sakkinah et al., 2022).

Result and Discussion

Implementation Aspects

The aspect of ability to be carried out obtained a percentage of 76% and is in the very good category. This aspect includes ease of understanding media instructions, ease of using media, and intensity of media use. The results of the assessment of each indicator on the aspect of ability to be implemented can be seen in the following figure:

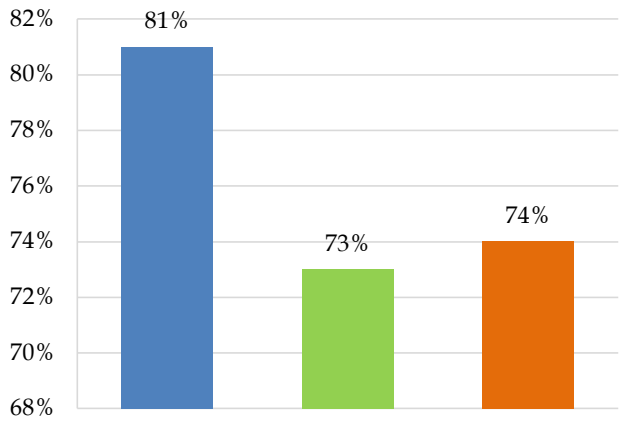

Figure 2. Assessment results of each indicator on the aspect of ability to be implemented in field tests

The chart above shows that the ease of understanding indicator instructions for use gets the highest percentage of 81%. Indicators of ease of using media, and intensity of using media respectively get percentages of 73% and 74%.

Sustainability

The sustainability aspect obtained a percentage of 80% with a total value of 288 out of 360 and was in the good category. Sustainability aspects include media resilience, ease of media maintenance, and future use of media. The assessment results of each indicator on the sustainability aspect can be seen in the following figure:

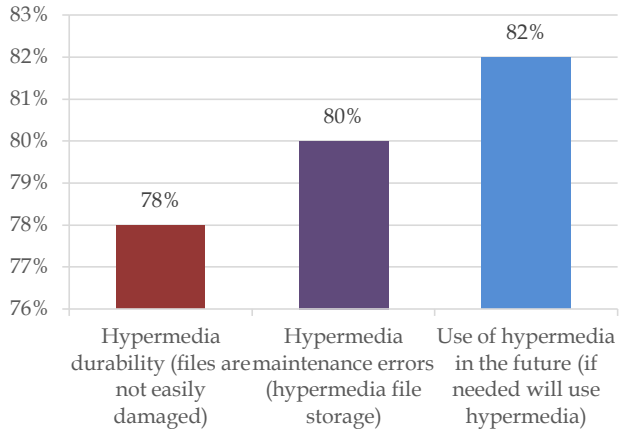

Figure 3. Graph of the assessment results of each indicator on the aspect of sustainability in field tests

The graph above shows that the indicator of future media use gets a percentage of 82%, ease of media maintenance gets a percentage of 80% and media resilience gets a percentage of 78%.

Aspects of Compatibility with the Environment

The aspect of compatibility with the environment obtained a percentage of 78% and was in a good category. This aspect includes the ease of using media anywhere and the ease of using media at any time. The assessment results of each indicator on the aspect of suitability with the environment can be seen in the following figure:

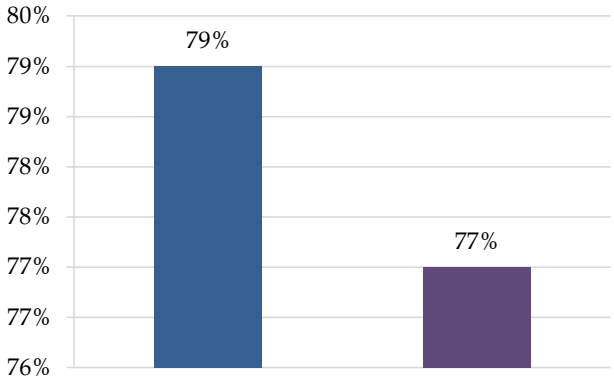

Figure 4. Graph of the assessment results of each indicator on the aspect of suitability with the environment in field tests

The chart above shows that the indicator of ease of using media anywhere gets a percentage of 79%, and the indicator of ease of using media at various times gets a percentage of 77%.

Acceptance

The aspect of acceptance and attractiveness is in the good category with a total score of 484 out of 600. Aspects of acceptance and interest include interest in

basic electronic materials through media, comfort in learning to use media, ease of understanding material through media, desire for media in other materials, and the ability of media to generate interest in electronic lessons. The assessment results of each indicator on the aspects of acceptance and attractiveness can be seen in the following figure:

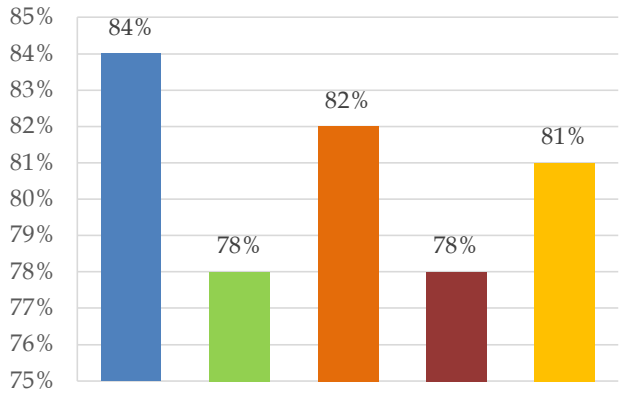

Figure 5. Graph of the assessment results of each indicator on the aspects of acceptance and attractiveness in field tests

The graph shows that the indicator of interest in optical materials through media gets the highest percentage at 84%, indicators of comfort learning to use media, and the desire for media in other materials gets the lowest percentage at 78%. Indicators of ease of understanding the material and ability to generate interest in physics lessons respectively get a percentage of 82% and 81%.

Conclusion

The procedure used for the development of learning media is to use development research from Akker which consists of 4 stages, namely preliminary research, prototype, summative evaluation, systematic reflection, and documentation. Media feasibility is assessed by experts consisting of media experts, learning design experts, and material experts. Media experts stated that learning media is very good and suitable for use (89.7%). Learning design experts stated that learning media is very good and suitable for use (87.2%). Material experts stated that learning media is good and suitable for use (76.7%). The learning media developed is very effective (83.5%) in improving higher-order thinking skills. Users say learning media is very practical to use (83%).

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Author Contributions
All authors contributed to the study. MS participates in research in the form of data collection and manuscript writing. MDS to participate in media research and design development. MI is compiled, participates in data analysis as well as helps compile manuscripts. HDH participates in media development and script editing

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Conflicts of Interest
All authors in this study stated that they did not have competing interests for all parties.

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