Development of Interactive Learning Media Based on HOTS Material Temperature and Heat

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Abstract. Development of instructional media is very important in learning physics which requires high-level skills to master the concepts. The purpose of this study is to develop interactive multimedia based on HOTS on temperature and heat material. This media is made with Macromedia Flash 8 which consists of 4 main menus namely competence, material, training, and evaluation. This media features several creative animations related to temperature and heat material. The results of this development can be used as an alternative for students and teachers to understand the concepts of physics in fostering low to high level thinking.

1. Introduction

Higher order thinking skills (HOTS) are closely related to scientific literacy skills. Higher order thinking skills are thinking skills that not only require the ability to remember, but also require other higher abilities, such as analytical, synthesis, and evaluation skills. Higher order thinking skills arise when a person receives new information which is then linked to one information with another. The physics curriculum includes natural phenomena, and uses a process consisting of observation, measurement, analysis, and conclusion [1].

Based on the results of the survey, there is an obstacle that is abstract, which emphasizes remembering, understanding, and applying [2]. The ability to think creatively lies in the aspect of asking and answering small questions. The ability to think at a higher level has not been done well. This can be seen from the acquisition of PISA and TIMSS which have not received the correct answer in understanding and reasoning to solve problems [3]. The teacher does not guide students to find the concepts being learned so that the learning process occurs in only one direction. Students can only master what material is conveyed by the teacher, skills are limited to Lower Order Thinking. Low level thinking causes students to be unable to solve problems that require high analysis. Its application, problem solving to the logical solution to the problems given has not been fully integrated, making it difficult for students to solve it [4].

HOTS should be developed because physics problems that require high-level analysis can be overcome by thinking critically and creatively in making decisions and solving problems in new situations [5]. Creative innovation must be done. The elements of HOTS development innovation in the learning process consist of methods, teaching and learning techniques, other supporting things and the teaching materials used [6].

Interactive multimedia has advantages including being able to overcome students’ passive attitudes, difficulty in explaining material, facilitating student understanding, generating attention power (memory), sharpening the senses of exercise and expanding the sense of speed in learning [7]. Through multimedia students can develop thinking through animation, illustrations, and images that can guide problem solving that requires higher-order thinking.
The temperature and heat of the material require high-level concepts and problem-solving skills and understanding, so students need higher-order thinking skills that are supported by the learning process. Crawford [8] how to instill concepts in students has not been done well. Students have difficulty interpreting the concept correctly so that motivation and physics learning outcomes decrease [9]. From this problem, one solution is to use interactive learning media. Based on the research results, application in the teaching and learning process can increase efficiency by 78% [10]. In addition, the use of media through simulation can make it easier for students to capture the learning process for students [11].

The Adobe CS 6 application is a vector image animation development software and the results can be played in the Adobe Flash Player web browser. Therefore, student motivation in understanding the concept can develop by itself through the application of higher-order thinking. Learning media are able to help teachers and students during the physics learning process that can be accessed anytime and anywhere [12].

2. Methodology
This study uses the ADDIE model. The ADDIE stages to be carried out in this study are Analysis, Design and Development shown in Figure 1.

![ADDIE Model](image)

**Figure 1. Research Stage**

Based on the analysis stage, it was found that students were not able to understand the concepts of temperature and heat in answering the analysis questions to solve them. That way interactive learning media plays a role in answering analytical questions with higher-order thinking skills stages. The media design stage consists of 4 main menus, namely competence, material, training and evaluation. The material design stage was designed based on Anderson's and Krathwool's Taxonomy knowledge level consisting of knowledge, application, analysis, evaluation and creation. The concept of physics is imbued with several effects, materials and questions. It aims to help increase interest in developing concepts with higher order thinking skills.

3. Results and Discussion
Figure 2 shows the final results of the media making stage of the ADDIE model consisting of competencies, materials, and instructions for using higher order thinking skills (HOTS) which are arranged based on words of operational knowledge by Anderson & Krathwool's.
| No | Bagian Media | Keterangan |
|----|--------------|------------|
| 1  | in using the Flash application, users must first enter their full name and origin from school to start learning | |
| 2  | The main menu display consists of  <br>1. Competence includes indicators and learning objectives  <br>2. Material contains the subject of temperature and heat. Animations, applications and videos are involved in the application  <br>3. Evaluation includes exercises to test the competency of students' knowledge  <br>4. The instructions contain how users use the application | |
| 3  | The competency menu consists of indicators and learning objectives formulated based on the syllabus. The indicator formulation is taken from the operational indicator word developed by Anderson and Krathwool's starting from the level of knowledge C1 to C6 | |
| 4  | The first meeting material is temperature and thermometer. In addition to the explanation there are questions directed supported animation, images, and videos related to temperature and thermometer material to be answered by students. Next to the picture there is a button to play the animation and a button to choose the answer option | |
| 5  | The preparation of material starts from  <br>1. The introduction menu button consists of videos and animations in everyday life.  <br>2. the discovery menu button contains an explanation of knowledge  <br>3. Application menu button is the application of questions from the | |
4. Button the analysis, compare, and evaluation buttons contain theoretical questions with cases of daily life analysis which are arranged according to the high order thinking (HOTS) category based on Anderson & Krathwohl's cognitive domains.

There are instruction key functions on the media so students and teachers easily operate them.

**Figure 2.** Final results of learning media

Each material is adjusted to indicators and learning objectives from easy, medium, and difficult difficulty levels. With this animation, it is hoped that students will be interested in learning the concepts of temperature and heat and familiarize students with good higher-order thinking skills. Supported by the results of research [13] showed that the development of instructional media was able to improve students' high-order thinking skills in solving problems with the acquisition of a high category average score that was able to provide reasons, think creatively, make decisions, and solve problems.

4. Conclusion

This interactive learning multimedia can be used as a learning tool in conveying the clarity of the concepts of temperature and heat physics. The existence of animation and interactive use makes students feel interested in understanding and analyzing concepts in ways of thinking.

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