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Video Technology Media based on Heat and Temperature to Improve of Learner Critical Thingking

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Abstract. Science and technology advances provide space for teachers to be able to create a variety of learning media that can be used in the learning process This study is aims to determined the process of implementation of learning and improvement of students learning critical thingking with video technology media based on heat and temperature at class XI MIPA of MAN Serdang Bedagai. Video technology media based on heat temperature is a form of learning media that can accommodate student learning needs in accordance with the critical thingking of students. The method is quasi experimental type of research while subject of this research are students of class XI MIPA 1 dan XI MIPA 2 academic year 2019 / 2020 which consist of 60 students. Data collection techniques is test with the instrument of written test of essay that consist of 15 questions. The stages in this research are preliminary study, video design, research implementation and conclusions.

1. Introduction

Education is an effort to develop humans towards maturity, both intellectual, social, and moral maturity. Therefore, the educational process does not only develop intellectually, but includes all the potential possessed by students. So that interactions in learning must be built in full for the development of student behavior and potential. In the whole educational process, learning activities are the most important and dominant activities. This learning process can occur because of the interaction between a person and the learning environment so learning can happen anytime, with anyone and anywhere. Berhasil tidaknya pencapaian tujuan pendidikan tergantung pada proses belajar yang dialami seseorang[1]. Video technology media is a learning media that can attract students' interest in learning, because the presentation is in the form of films or moving images accompanied by sound. The use of temperature and heat based video technology media aims to make the concept of temperature and heat material difficult to reach can be visualized properly and make it easier for students to learn the concept. This is consistent with Catlin Tuckers statement [2] stating that the use of video technology media can encourage students in investigations that make abstract concepts far more meaningful.

Video technology is one of audiovisual media, where it combines from several human senses. Students not only listen to what the teacher explains but also see what events are displayed by the teacher in the media. According to Cheppy Riyana [3] video is able to capture 94% of voice message or information entry channels into the human psyche through the eyes and ears and is able to make



people generally remember 50% of what they see and hear from program shows. Messages delivered through video media can influence strong emotions and can also achieve quick results that are not possessed by other media. So that this video technology media can be applied and optimize students critical thinking skills.

According to Indonesia Dictionary [4] video is interpreted as a recording of a live image or television program. In other words, video is a moving image display accompanied by sound. Video technology media is an audio visual media that involves the sense of hearing and vision in a process. Cecep, et al stated that the video presentation facilitates and presents information, explains complicated concepts, teaches skills, extends time and influences attitudes. The relationship between video technology media and learning objectives is as follows[6]: 1) Providing unexpected experiences to students, 2) Showing something that cannot be seen initially, 3) Displaying case studies about real life that can trigger discussion, 4) Demonstrating the use of tools or tools, 5) Providing experiences to students to feel a situation.

The advantages of video technology media according to Munadi [7] are as follows: 1) Overcoming limitations in distance and time, 2) Video can be repeated if necessary adding clarity, 3) Messages delivered are fast and easy to remember, 4) Developing students' thoughts and opinions, 5) Clarifying things - abstract things and give a more realistic picture, 6) Influence a person's emotions, 7) Very well explain a process and skills, 8) All students can learn to use video, 9) Cultivate motivation and interest in learning.

Besides the advantages of video technology media according to Arfi Sadiman [8] as follows: 1) Can attract the attention of students, 2) A large number of viewers can get information from experts, 3) Demonstrations that can be difficult to prepare and direct beforehand so that when teaching teachers can focus attention on students, 4) Save time and record can be repetition repeatedly, 5) Lack of sound can be adjusted and adjusted, 6) Can observe objects that are moving or dangerous objects, 7) Videos can be stopped to be observed carefully, 8) The room does not need to be darkened for its presentation.

Critical thinking is the ability to give reasons in an organized manner and evaluate the quality of a reason systematically. Thought that states the reason regularly and systematically comes from the findings he had experienced [9]. The ability to think critically is someone's skill in using his thought process to analyze arguments and provide interpretations based on valid perceptions through logical analysis, assumptions and interpretations [10].

The ability to think is basic in a learning process [11]. Critical thinking allows students to analyze their thoughts in making choices and draw conclusions intelligently. If children are given the opportunity to use thinking at a higher level at each grade level, in the end they will get used to distinguishing between truth and lies, appearance and reality, facts and opinions, knowledge and beliefs. According to Ennis [12] critical thinking skills are reflective and reasoned thinking that is focused on making decisions to solve problems. Thus, this mental process will bring up the ability of students' critical thinking to be able to master physics in depth.

Understanding temperature and heat material requires thinking and reasoning in order to solve problems. At the level of higher education, critical thinking includes: 1) understanding arguments and believing them, 2) evaluating arguments critically and believing them, and 3) developing and defending arguments by supporting strongly and confidently [13]. The development of critical thinking according to Ennis suggests that "critical thinking is reasonable, reflecting thinking that is focused on deciding what to believe or do" which means as rational and reflective thinking focused on what is believed or done. Basically critical thinking skills are developed into indicators - indicators that critical thinking skills consist of five large groups, namely: 1) Providing simple explanations, 2) Building basic skills, 3) Summing up, 4) Providing further explanation, and 5) Managing strategies and tactics. From each group of critical thinking above, it is broken down into sub critical thinking abilities and each of them is written in table 1.

Table1. Indicators of Critical Thinking Ability

Indicators of Critical Thinking Ability	Subcapability Critical thinking	Aspect
1. Give a simple explanation	1. Focus the question	<ul style="list-style-type: none"> a. Identify / formulate a question b. Identify / formulate possible answer criteria c. Keep your mind on the situation at hand
	2. Analyze Arguments	<ul style="list-style-type: none"> a. Identifying conclusions b. Identify the stated reasons c. Identify reasons not stated d. Look for similarities and differences e. Identify and deal with irrelevance f. Look for the structure of an opinion / argument g. Sum up
	3. Asking and answering clarifying questions and challenging questions	<ul style="list-style-type: none"> a. Why ? b. What are the main reasons? c. What do you mean by? d. What is an example? e. What is not an example? f. How to apply the case? g. What is the difference? h. What are the facts? i. Is this what you say? j. What else do you say about that?
2. Building basic skills	1. Consider whether the source can be trusted or not?	<ul style="list-style-type: none"> a. Expertise b. Reducing interest conflicts c. Agreement between sources d. Use existing procedures e. Know the risks f. The ability to give reasons g. Careful habits
	2. Observation and consider the results of observation	<ul style="list-style-type: none"> a. Reducing presumptions b. Shorten the time between observation and report c. Reports are made by the observer himself d. Take note of things that are very necessary e. Possible strengthening f. Good access conditions g. Competent in using technology h. The observer's satisfaction with the credibility of the criteria

1. Conclude	1. Deduce and consider deduction	<ul style="list-style-type: none"> a. Logic class b. Condition logic c. Interpret statements
	2. Induce and consider the results of induction	<ul style="list-style-type: none"> a. Generalize b. Hypothesis
	3. Make and review the values - the results of consideration	<ul style="list-style-type: none"> a. Facts background b. The consequences c. Apply concepts (principles, laws and principles) d. Consider alternatives e. Weigh and decide
4. Make further explanation	1. Define the term and consider the definition	<ul style="list-style-type: none"> a. Form: synonym, clarification, about, the same expression, operational, examples, and non examples b. Definition strategy, content
	2. Identify assumptions	<ul style="list-style-type: none"> a. Unspecified reason b. Assumptions needed for argument reconstruction
5. Strategy and Tactics	1. Decide on an action	<ul style="list-style-type: none"> a. Define the problem b. Choose possible criteria as a solution to the problem c. Formulate alternatives for solutions d. Decide what to do e. Review f. Monitor implementation
	2. Interact with other people	<ul style="list-style-type: none"> a. Give a label b. Strategic logical c. Rhetoric Strategy d. Present a position both in writing and writing

Sumber [14]

2. Method

This research was conducted in MAN Serdang Bedagai with research subjects in class XI MIPA 1 as an experimental class that was taught with video technology media and XI MIPA 2 as a control class that was learned without video technology media. This research is a quasi-experimental study. 1) The initial stage of the research includes a preliminary study / literature, preparing learning tools, video technology media, and compiling instruments. 2) The implementation phase of the research includes the selection of population and sample, implementing pretest, applying video technology media to students, and ending with posttest. 3) The final stage of the study includes conclusions and suggestions.

3. Result and Discussion

The results of this study are video technology based on temperature and heat. This temperature and heat-based video technology media contains temperature and heat material which includes expansion, the effect of heat on body temperature, the Black Principle, and heat transfer.



Figure 1. Heated balloon



Figure 2. Water is heated with Bunsen containing spirits



Figure 3. Convection event



Figure 4. water of different temperatures mixed **Figure 5.** Black principle events

In video 1, the phenomenon of expansion is presented: a balloon is inserted into the tip of the mouth of the bottle and then the bottle is placed on a heating furnace. After a while, the hot bottle is put into a basin filled with cold water. Events that occur when a balloon is inserted into the tip of the mouth of a bottle and placed on a heating furnace is the expansion of the gas due to the influence of heat marked balloon ballooning. The event that occurs when a bottle that has been heated is then put into a bucket filled with water is a shrinkage of the gas marked by the shrinking of the balloon. Every substance (object) will expand if heated and shrink if cooled. Expansion occurs because substances receive heat. Expansion that occurred in this experiment is the expansion of the volume that is expansion of the gas which is affected by heat. Changes in the appearance of objects when the objects are heated or cooled. Heat changes affect the process of expansion and shrinkage of objects.

In video 2, it contains the phenomenon of the effect of heat on the temperature of an object, which is the comparison between heating water using Bunsen containing spiritus and Bunsen containing kerosene. In the video, it is seen that water heated with Bunsen which contains spirits boils faster than water that is heated with Bunsen containing kerosene. Water that is heated by using spiritus has a different temperature than water that is heated with kerosene. Comparison of the temperature of the two water can be seen in table 2 below :

Table 2. Comparison of water heated with Bunsen containing spiritus and kerosene

Type of Fuel	Initial Temperature ($^{\circ}\text{C}$)	Final Temperature ($^{\circ}\text{C}$)	ΔT ($^{\circ}\text{C}$)	Warm up time (s)
Spiritus	29 $^{\circ}\text{C}$	85 $^{\circ}\text{C}$	56 $^{\circ}\text{C}$	14 minute
Kerosene	29 $^{\circ}\text{C}$	49 $^{\circ}\text{C}$	20 $^{\circ}\text{C}$	14 minute

Within 4 minutes, the temperature of water heated with kerosene was 20 $^{\circ}\text{C}$, while the temperature of water heated with spirits reached 56 $^{\circ}\text{C}$. This means that the heat given by spiritus is far greater than the heat given kerosene. The heat energy provided by spiritus and kerosene is as follows:

Known :

$$m = 0,1\text{kg}$$

$$c = 4200\text{J} / \text{kg} \cdot ^{\circ}\text{C}$$

$$\Delta T = 56 \text{ }^{\circ}\text{C} (\text{spiritus})$$

$$\Delta T = 20 \text{ }^{\circ}\text{C} (\text{ker osene})$$

Asked : Q in spiritus and ker osene...?

Answer :

In spiritus

$$Q = m \cdot c \cdot \Delta T$$

$$Q = 0,1\text{kg} \cdot 4200\text{J} / \text{kg} \cdot ^{\circ}\text{C} \cdot 56 \text{ }^{\circ}\text{C}$$

$$Q = 23520 \text{ J}$$

In ker osene

$$Q = m \cdot c \cdot \Delta T$$

$$Q = 0,1\text{kg} \cdot 4200\text{J} / \text{kg} \cdot ^{\circ}\text{C} \cdot 20 \text{ }^{\circ}\text{C}$$

$$Q = 8400 \text{ J}$$

Water that is heated using spritus fuel is more heat than water that is heated using kerosene. The temperature of water heated with spirits is higher than the temperature of water heated with kerosene.

Video 3 is the Azas Black phenomenon which is mixing low temperature water with higher temperature water. After being mixed, the hot (high temperature experiences the release of heat and the cold temperature (low) experiences heat absorption so that both of them reach thermal equilibrium. In the process there is heat transfer from high temperature to low temperature. The results of mixing the two water can be seen in table 3 follows:

Table3: The temperature of the mixture of the two different water temperatures

Substance	Mass (m)	Initial Temperature (T_1)	Final Temperature (T_2)	Temperature Change
Cold water	100	34 $^{\circ}\text{C}$	54 $^{\circ}\text{C}$	43 $^{\circ}\text{C}$
Hot water	100	91 $^{\circ}\text{C}$		

When two substances of different temperature are mixed, the heat exchange will occur. Substances that are high in temperature will cause heat exchange. High-temperature substances will release heat while low-temperature substances will absorb heat until the temperature is the same.

While in video 4, the phenomenon of heat transfer by convection is water that is heated to boiling and visible movements of water particles that rotate. The convection event is heat transfer followed by particles. Hot water will rise to the top and cold water will go down, resulting in a process of continuous displacement which causes a circular motion. Heat transfer is divided into 3, namely: 1) Conduction is heat transfer without being followed by particles. Example of a spoon heated by a candle. 2) Convection is the heat transfer followed by the particle. Heated water on the stove. 3) Radiation is heat transfer caused by electromagnetic waves and without passing through an intermediary. Example: sunlight. In this video, seen in the first minute, the water that is heated has no reaction. In the third minute, the air bubbles rise. In the fourth minute, convection is the movement of water flow in a circle. In the seventh minute, the movement of water flow will be faster because the temperature is increasing. The convection event occurs in the fourth minute, when the water is heated longer, the temperature will increase and affect the flow of water will be faster.

4. Conclusion

This temperature and heat-based video technology media can help in the teaching and learning process to understand the concepts of temperature and heat so as to enhance students' critical thinking skills. This video technology media also received appreciation and very good interpretation from students.

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