

DESIGN LEARNING MEDIA OF GLOBAL WARMING BASED ON INTERACTIVE MULTIMEDIA WITH SCIENTIFIC APPROACH TO IMPROVE CRITICAL THINKING SKILLS

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Abstract

The magnitude effects that can be caused due to global warming, encourage all parties to undertake mitigation and adaptation. Understanding of global warming is expected to form a behavior to reduce the impact. Critical thinking skills need to be developed in the learning process of global warming as a base to criticise various symptoms and problems that arise. The learning process in 2013 curriculum for all levels of education carried out by using a scientific approach with one of the criteria is to encourage and inspire students to think critically, analyze, and precise in identifying, understanding, problem solving, and apply the learning materials. The purpose of this study is to design Learning media of global warming based on interactive multimedia with scientific approaches used to improve students' critical thinking skills. The method used in this research is the development research methods models by Borg & Gall. The results of a questionnaire distributed to 30 students and 3 teachers of physics at SMAN 2 Pringsewu found that: (1) the students' understanding of global warming is limited; (2) teachers and students need interactive learning media in the teaching and learning process of global warming in order to make the learning process more effective and able to improve students' critical thinking skills. By giving stimulation of natural phenomena through interactive multimedia in the form of simulation cause and effects of global warming will increase the students' critical thinking skills.

Keywords: critical thinking, global warming, interactive multimedia, scientific approach

INTRODUCTION

Global warming is not a new think in our society. It is commonly discussed as the wide impact in various parts of the world. In Indonesia, we can see the climate change and the indefinite season which is the impact of global warming. Another impact that also happen in Indonesia is the changes in the intensity and frequency of rainfall, disruption of plant system, raising the sea level causing flooding, increased rainfall and strong winds that triggered landslides and land subsidence. These climate changes may affect precipitation system, severe and extreme weather events (Shepardson, Niyogi, Choi & Charusombat, 2011).

As human activities continue to add greenhouse gases, carbon dioxide, methane, and nitrous oxides—to the Earth's atmosphere, global temperatures are expected to rise, causing the Earth's climates change (Shepardson, et al., 2011). The magnitude of the impact that can be caused by global warming, encourage the various parties to undertake adaptation and mitigation measures. In order to change the behavior of individuals to

reduce greenhouse gas emissions, it is likely that it will take a multidisciplinary approach, education is an important component in this regard (Skamp, Boyes & Stanisstreet, 2009).

Findings of Yazdanparast, et. al. (2013) showed that Tehran students is not well informed about the phenomenon of global warming. According to his research of only about 5% of the students were able to explain the greenhouse effect completely and correctly, while more than half of the students did not answer questions. Taber & Taylor (2009) stated that it needed an effective teaching strategies for students about global warming. If the public's knowledge about the environment in general increased, then they will behave in ways that avoid environmental degradation (Yazdanparast, et. al. 2013).

Global warming subject matter in the 2013 curriculum is one of topic in the Physics subjects in class the XI grade. The learning process in the 2013 curriculum for all levels of education carried out using the scientific approach which should touch the three domains, namely attitude, psychomotor, and knowledge. One of the criteria of scientific approaches that encourage and inspire students to think critically, analyze, and precise in identifying, understanding, solve problems, and apply the learning materials.

In the learning process needs to be developed critical thinking skills, which is a mental activity to acquire knowledge. As stated by Kartimi and Liliyasi (2012) critical thinking is required by each person to solve problems in their life. By having critical thinking, one can adjust, adapt, alter, or improve his/her mind to be able to give a proper reaction. The same thing also expressed by Susilowati (2013) that students need to be equipped with critical thinking skills as provisions to criticize various symptoms, problems that arise in the surrounding. The development of critical thinking skills should trained through the giving of stimulus that requires a person to think critically, which can be done in any learning one of them is in learning physics.

Interactive multimedia can be used as an alternative to providing a stimulus to improve students' critical thinking skills. The use of interactive multimedia in learning physics greatly assist learners in understanding the concepts of physics. According McKagan (2008) learners will more easily understand abstract concepts with the help of interactive software. Wiyono (2009) stated that the concepts of special relativity abstract can be understood by students with the help of interactive multimedia-based learning model. Multimedia can improve learning ability and offer best practices (Huang, 2005).

However, the needed media is not well developed yet in Indonesia. Reflect to the aforementioned problems and needs in Indonesian teaching and learning physics, the research question addressed here is "*how to design interactive multimedia of global warming that can improve students' critical thinking skills using a scientific approach?*" To overcome this problem, this research aims to design interactive multimedia of global warming with a scientific approach that is used to enhance students' critical thinking skills.

THEORETICAL FRAMEWORK

Interactive Multimedia in Learning

Multimedia is a combination of text, graphics, images, sound, video and animation that can produce a product with interactive capabilities. Multimedia in education is learning, media of computer-based. These media combine and synergize all the media, which consist of: text, graphics, pictures, video, animation, music, narration and interactivity are programmed based on learning theory (Munawar, 2012).

One form of interactive multimedia computer-based learning is a simulation. According to Lee (1999) simulation is defined as a computer program which temporarily creates a series of points by means of the program and then they are linked together through causality. While De Jong and Van Joolingen (1998) defines specifically that computer simulation is a program that contains a model of the system (natural or artificial, for example, equipment) or a process. When the simulation is used as a learning objective, a narrower definition stated that simulation learning allows students to bridge the gap between reality and abstract knowledge discovery method, to increase motivation and improve students' learning with active interaction (De Jong, 1991).

In various fields of activity can be found of problems that require observation, research and experimentation as an input in determining solutions to problems. Only in the implementation of the observations, research and experiments are often confronted with various obstacles and barriers in various ways such as cost, time, risk and fixtures. By using artificial systems, the cost is relatively cheaper because they do not use real materials and equipment as used on observation, research and field trials. The operation of the simulation system is also very short compared to the time period required on observation, research and real experiments. As well as the simulation system also does not have the risk of fatal and does not cause major losses due to damage to components.

According to Chang, Chen, Lin & Sung (2008) in computer simulation based learning has five categories of support in learning, namely: providing background knowledge; helping students to make hypotheses; helping students to conduct experiments; helping students to interpret the data and help students to organize learning process.

Critical Thinking Skills in Learning

Critical thinking skills needed by students as a capital base to understand things, diantaranya understand the concepts in the discipline (Joyce, 2009). Critical thinking skills, including one high-level thinking skills. Critical thinking skills is essentially a problem-solving skills (problem solving). According Tawil and Liliasari (2013) Critical thinking is a process of discipline in intellectually active and skilled conceptualizing, applying, analyzing, synthesizing, and or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action.

Critical thinking can be implemented in learning physics is to adjust the indicators of critical thinking skills with character subject matter physics. According to Ennis (in Tawil

and Liliasari, 2013) Indicators of critical thinking skills are divided into five groups: (1) elementary clarification; (2) basic support; (3) inferring; (4) advanced clarification; (5) strategies and tactics.

Critical thinking skills need to be developed in students because through critical thinking skills that students can more easily understand the concepts in greater depth, sensitive to the problems that occur so as to understand and resolve the problem and are able to apply the concepts in different situations (Wiyono, 2009). On the matter of global warming physics students are required to be able to solve the problem of global warming in a creative and logical thinking to produce proper consideration and decision. This means critical thinking skills is necessary so that students are able to solve the problems of global warming.

Scientific Learning Approach

The scientific approach is an approach to learning implemented in curriculum 2013. The lesson with scientific approach must touch three areas, namely: attitude, knowledge and skills. The realm of attitudes meant that the students know about the 'why' that is obtained through the activity of "receiving, running, respect, appreciate, and practice". The realm of skills meant that the students know about the "how" that is obtained through the activity of "observe, ask, try, reasoning, menyaji, and create". Meanwhile, the realm of knowledge meant that the students know about the "what" that is obtained through the activity of 'remember, understand, apply, analyze, evaluate, and create". The steps of learning with a scientific approach referred to include observing, ask, reasoning, tried, forming networks (serving, conclude, and create).

METHODS

The method used in this study adapting the research and development Borg & Gall (2003) combined with a model of ADDIE model of instructional media development. Figure 1 shows the stages of ADDIE models namely Analysis - Design - Develop - Implement - Evaluate.

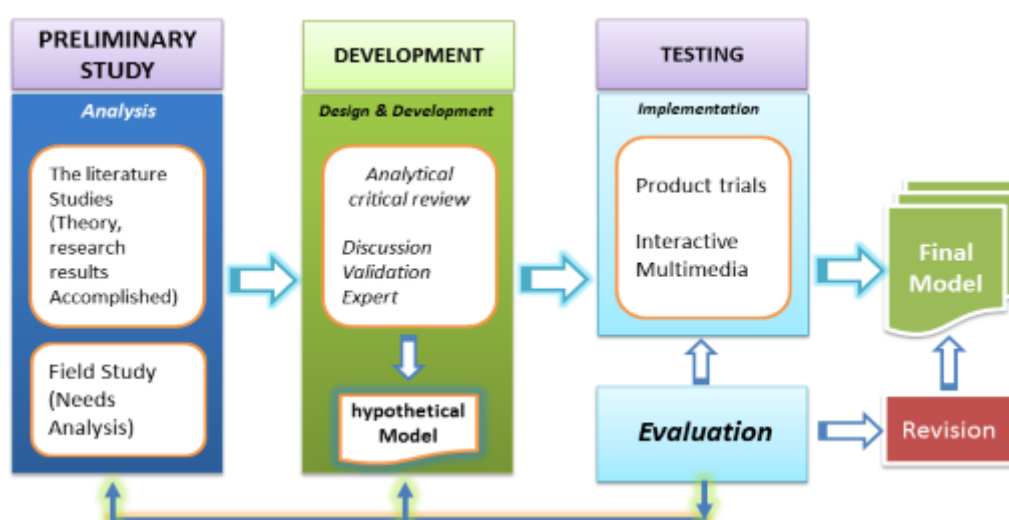


Figure 1: Research Stages based on ADDIE Models

The development of research in this paper are:

1. Analysis

Preliminary studies done either through literature and field research with empirical studies. This preliminary study was conducted in advance with the study of literature, namely by reviewing the literature with regard to the theories, concepts and research findings that are relevant to support preliminary studies in the field. The literature is about global warming is related to the study of global warming materials, instructional media, interactive learning media.

The empirical studies conducted by field studies through interviews with three physics teachers at SMAN 2 Pringsewu and by spreading the questionnaire to 30 students to obtain preliminary information related to the reality of global warming in school learning.

2. Model Development

The development phase is done with the material basis of the information obtained in the preliminary study phase. The activities covered in this development phase is to conduct a critical review of analytical and comprehensive review of all information / data. Critical analytical studies conducted involving learning experts, counselors, teachers and researchers. The involvement of these parties is done in the form of a roundtable discussion or discussion together. The whole discussion is directed at the establishment of a model adjusted for study purposes. This phase includes the design of interactive multimedia global warming with a scientific approach that is used to enhance students' critical thinking skills.

RESULT AND DISCUSSION

Stage has been done in this development is a preliminary study, include:

1. Analysis

This stage begins by analyzing the needs, literature review and study the content of the material. Results of an informal interview with one physics teacher at SMAN 2 Pringsewu, suggests that students looked upon global warming is a matter not only of material difficult global warming is a matter of memorizing so that makes it interesting. Teachers also have got the material revealed although global warming is still a lot of students who behave without considering the impact of the behavior associated with global warming. One example is the students prefer to use a motor vehicle to school than on foot or riding a bike. From these interviews revealed that it takes interactive learning media to support the learning process so as to make this material more attractive, and at the same time to improve students' critical thinking skills towards the solution overcome the consequences of global warming.

From the analysis of students 'conceptions questionnaires about global warming conducted at SMAN 2 Pringsewu obtained data showing that the students' understanding of the global warming is very limited. Students' understanding about global warming can be grouped into three, namely: causes, impacts and solutions of global warming.

- a. The cause of global warming associated with increasing the average temperature of the earth's surface due to the increase in greenhouse gas emissions. Greenhouse gases cause a phenomenon called the greenhouse effect. The incidence of global warming as a greenhouse effect can be illustrated when we are in the "greenhouse" or in a closed car parked in hot areas. Figure 2 provides the information that students have experienced the events of "greenhouse effect", but they were not able to explain exactly why it could happen.

a). Pernahkah Anda berada di dalam "rumah kaca" atau di dalam mobil tertutup yang diparkir di tempat yang panas? (Ya/Tidak) Pernah

b). Apakah Anda berpikir akan lebih hangat atau lebih dingin di dalam rumah kaca/mobil dibandingkan dengan di luar rumah kaca atau mobil? (hangat/dingin /sama/tidak tahu) lebih hangat

c). Dapatkah Anda memikirkan alasan mengapa hal itu dapat terjadi? Silakan tulis alasan Anda di tempat yang disediakan.
karena jika di dalam mobil yang tertutup yang diparkir di tempat yang panas udara tdk bisa keluar dan akan menyebabkan suhu mobil panas atau hangat.

as if in a closed car parked in the hot place the air can not get out and will cause in a hot car or warm

Figure 2: Students' Responses to the Event Illustrated the "Greenhouse Effect"

Greenhouse gas emissions should be considered dangerous that can be controlled include: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), O₃, CCL₂F₂, CCl₂F₂, and sulfur hexafluoride (SF₆). From Figure 3 seen various student responses regarding greenhouse gases are considered dangerous. From the students' responses illustrate that students do not understand exactly gases triggers the greenhouse effect

CFC, CO SO₂, CO, CO₂, CFC

CFC, CO₂, ... karbonmonoksida

Figure 3: Student's Responses About Greenhouse Gases

- b. Students understand that the greenhouse effect will have an impact on global warming that will be followed by climate change, such as increased rainfall in some parts of the world, causing flooding and erosion. Meanwhile, in the other hemisphere will experience a prolonged dry season due to the temperature rise. However, students have not been able to explain exactly how the greenhouse effect affects climate change as seen from students' responses in Figure 4.

Iklim nya jadi gak pasti, karena semakin menipisnya atmosfer di bumi. dan matahari semakin panas

the climate is so uncertain, due to the depletion of the earth's atmosphere and the sun is getting hotter

Figure 4: Student's Responses to the Impacts of Global Warming

- c. Most students feel are concerned the existence of global warming. Various measures as a solution to overcome the consequences of global warming would they do such seemingly in Figure 5. Only sometimes they forget that the simple act they could do to prevent global warming among other things: walk or ride to school sepeda, turn off the lights to study after study completion thus saving power consumption, saving paper usage, and others.

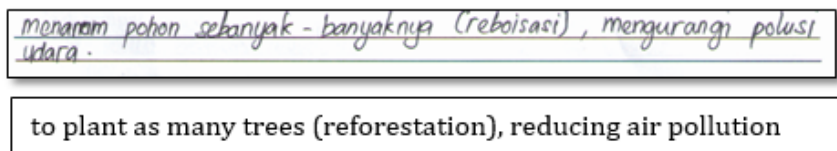


Figure 5: The Response of Student As a Solution to Global Warming

From the analysis of the questionnaire conducted at SMAN 2 Pringsewu, we obtained information that the learning materials to global warming, teachers tend to use media images associated with global warming are shown in the power point. Relating to the development of instructional media global warming, through this questionnaire also obtained information that all teachers and students agree that global warming made learning media featuring: images associated with global warming, video associated with global warming, the voices accompanist (narration, songs, and sound effects), simulating the cause of global warming, global warming simulations and simulation solutions to overcome the effects of global warming and are willing to use them in learning.

2. Model Development

Results of this phase is the design of interactive multimedia global warming. Interactive multimedia designed to consider the steps of learning with a scientific approach include observing, ask, reasoning, tried, forming networks (serving, conclude, and create). The design of interactive multimedia is also oriented to the improvement of students' critical thinking skills through activities that can be done in an interactive multimedia development, Figure 6.

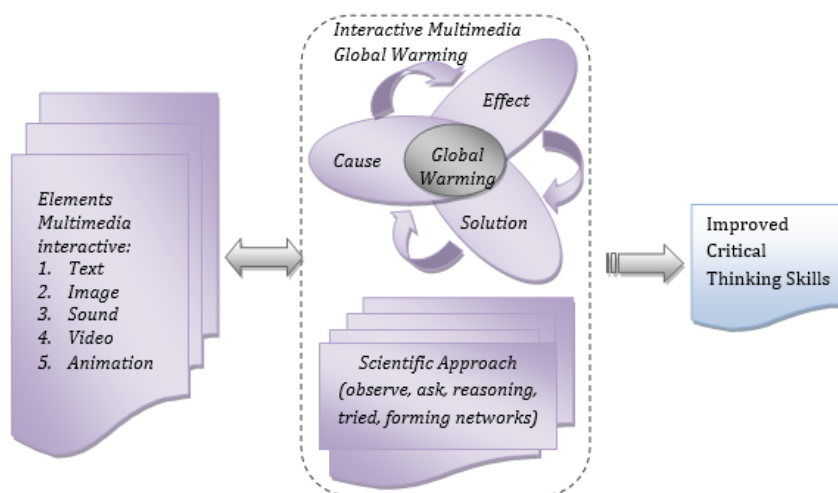


Figure 6: Hypothetical Models Interactive Multimedia of Global Warming With Scientific Approach to Improve Critical Thinking Skills

Simulating the cause-effect designed to create some activities that should be conducted of students, among others: the first activity, students are introduced to learning the overall purpose of the simulation is built. They see short video clips or images as an introduction to the phenomenon of global warming. In the second activity students learn about the amount of gas involved in the greenhouse effect by watching the visualization in the form of a number of gas involved in the greenhouse effect. In the third activity, students use more complex visualizations to learn about how the population levels of greenhouse gas emissions and global warming impacts is to see changes in ambient temperature. This visualization including a slider bar that allows students to manipulate the rate of the number of gas involved in the greenhouse effect. The fourth activity, students create a plan to reduce greenhouse gas emissions by planned behavior.

The activities of students in the form of a draft election activity or solution that has been provided which can reduce the level of greenhouse gas emissions population. The fifth activity in the form of an evaluation of the learning global warming. Integration of scientific approaches and critical thinking skills in the design of the simulation activities students can be seen in Table 1

Table 1: Integration of the scientific approach and critical thinking skills

Activity	Scientific Approach	Indicators of critical thinking skills
Introduction	Observing	elementary clarification, basic support
Visualization of greenhouse gases	Questioning	elementary clarification, basic support
Changing variables greenhouse gases	Associating and Experimenting	inferring
Make a plan of action evaluation	conclude	advanced clarification, strategies and tactics

CONCLUSION

The phenomenon of global warming is a study that is very important to know the community. Students' understanding about the causes, effects and solutions to global warming is very limited. Students looked at the matter of global warming is a matter not only of material difficult global warming is a matter of memorizing so make unattractive. Awareness of students to behave taking into account the impact of the behavior associated with global warming are still lacking.

The use of instructional media was minimal global warming. Teachers tend to use global warming learning media in the form of images of the phenomena associated with global warming. All teachers and students require instructional media global warming featuring: images associated with the phenomenon of global warming, video associated with global warming, the voices accompanist (narration, songs, and sound effects), simulating the cause of global warming, the simulation result global warming, the

manipulation of human activities that produce greenhouse gas emissions as a cause of global warming and its effects, and simulation solutions overcome the consequences of global warming.

From the results of the literature study showed that administration of stimulus in the form of the phenomenon of global warming would encourage the growth of critical thinking skills. Interactive multimedia-based learning media in the form of simulation can be used as an alternative option stimulus to improve critical thinking skills. Simulation is used as a stimulus in the form simulating the cause-effect of global warming that is designed to make some of the activities that must be performed students in learning through a scientific approach.

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