Students' Critical Thinking Skills on Temperature and Heat Material through Educational Video Based on Local Wisdom

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Abstract

This research aims to develop learning media products through educational videos based on local wisdom to improve critical thinking skills on temperature and heat. The research type is research and development using the ADDIE model (Analyze, Design, Develop, Implement, and Evaluate). The study subjects were students of class X MIPA SMA Al-Hadi Girikusuma Mranggen Demak. Data collection techniques used are tests in the form of pretest-posttest, questionnaires, and documentation. The results showed that media and material expert validation obtained an average of 95.86% with a very feasible category. Student responses to learning media in the form of educational videos based on local wisdom obtained an average of 71.08% with a very interesting category. Improved critical thinking skills can be seen based on pretest and posttest scores. The results of the pretest and posttest calculations using the Gain Test obtained a result of 0.67 in the medium category. From the results of this study, it can be concluded that educational videos based on local wisdom can improve students' critical thinking skills in the heat and temperature materials developed that meet the criteria of being very suitable for students to use as learning media and can improve critical thinking skills. The implication is that this approach can be used as an effective alternative in teaching and learning that aims to develop students' critical thinking skills. Students can associate abstract concepts with their cultural and environmental contexts by incorporating local wisdom values in temperature and heat learning materials. This can increase their understanding and provide a more meaningful learning experience.

Keywords: Critical Thinking Skill; Educational Video; Local Wisdom; Temperature and Heat

INTRODUCTION

The positive impact of the development of information and communication technology in the 21st century has affected the field of education so science is also developing rapidly (Ozturk, 2023; Ataberk & Mirici, 2022). Science has an important role in the 21st century, where various types of technology have been created; this is the task of the field of science is to form human resources who can understand and think about national

progress by elevating local culture using scientific methods so that they are not eroded by the times (Negoro et al., 2018). Culture is the main position in regulating all life arrangements, such as behavior, conveying ideas, and creating works to transfer them to individuals or other groups in an area (Kharisma, 2017). Java region became one of the centers of culture with various dialects, languages, ethnicities, religions, and skin colors (Rahadini et al., 2022). Apart from intellectual diversity, the Java region also has a variety of local cultures and arts inherent in people's daily lives. Local wisdom support is realized in Javanese heritage works, buildings, clothing, and games. Local culture is a medium for gathering, interacting, and being the axis of local cultural development in character building from an early age (Wahyuni et al., 2020). Local wisdom is a form of response from human relations with the environment, which is in the phase of community life and becomes a real part of the existing environmental etiquette implementation. The preservation of local wisdom in education is needed to develop skills in students (Fitriah et al., 2021; Hartini et al., 2018; Misbah et al., 2020).

One of the basic skills that need to be developed is critical thinking; students must be able to solve problems, formulate problems, provide arguments, and make appropriate decisions (Misbah et al., 2022; Windianovi et al., 2019). Critical thinking is obtained instantly and must be trained by getting used to thinking logically and presenting several questions (Anam et al., 2020; Yani et al., 2021). Critical thinking has benefits in the near to long term, so critical thinking skills are prioritized to explore problems; it is concluded that critical thinking skills must be more mature than other skills. Learning in Indonesia, especially, has not reached the level of critical thinking; in other words, students must be able to understand complex problems accompanied by reasons and solutions.

Teachers' lack of mastery of technology became an obstacle when technological developments began to enter the education sector; it was proven that 27 out of 30 students needed learning media to clarify the material delivered by the teacher (Shavira, 2021). The availability of teaching materials and learning media is very lacking, as evidenced by 12% of teachers using modules, 62.5% using worksheets, 12.5% using encyclopedias while learning only 37.5% using PowerPoint points, and 37.5% of teachers using videos during learning, so there are still many teachers who do not use teaching materials and learning media in the 21st century. In contrast, in the 21st century, students must master 4C skills, including communicative, collaborative, and critical creative skills (Hamida & Desnita, 2020).

Low analytical skills affect formulation, which is important in acquiring problem-solving skills (Susana & Sriyansyah, 2015). Students can only estimate answers, take existing information, imitate without creating something new, and only apply one indicator of critical thinking. Research data on critical thinking skills is still low based on several indicators; as many as 64% of students have low critical thinking skills, and 15% are in the very low category (Darihastining et al., 2021). The study's results to determine students' skills in critical thinking obtained an average of 29.78% of the five indicators, namely interpretation, inference, evaluation, self-regulation, and explanation (Husna et al., 2019). Students' low critical thinking skills encourage educators to think maturely in developing learning media, strategies to teaching materials to support critical thinking skills (Agustine et al., 2020).

Students' critical thinking skills are still relatively low, based on

observations of students who complete practice questions and calculate and analyze the meaning of the answers. Only able to solve problems in the form of calculations without knowing the meaning of the answer, the result of the ability to critically analyze can be used as an evaluation material for educators in further learning (Priyadi et al., 2018). The results of interviews conducted with SMA Al-Hadi Girikusuma indicate that the development of local wisdom based on educational video learning media to improve critical thinking skills on temperature and heat material has never been developed and applied; students only focus on worksheets, work on questions without knowing the application in everyday life and the way of thinking is still relatively low.

Learning media becomes a channel of knowledge to attract students' interest in learning more clearly. Developing instructional media is very important to train students to think critically; it is not immediately obtained but must be honed through learning activities (Wafiroh et al., 2017). The limitations of learning media hinder learning activities (Supandi, Kendek & Wahyono, 2014). The opinions of several teachers at school dominate learning using the lecture method so that students focus on the teacher as the main information provider (Avianty & Cipta, 2018).

Knowing the most prominent learning styles students possess is necessary to make it easier for teachers to convey material to the fullest so that students can receive information more effectively (Sirait, 2018). Likewise, educators are required to be able to create creative teaching materials so that students can develop opinions actively and creatively (Andriani, 2019). As a learning facilitator, the teacher must be able to create learning methods and media that can hone the ability to analyze and evaluate when students encounter problems. However, over time,

technological sophistication in education will shift the teacher's position, such as images, audio, video, and animation used as media to convey learning (Nopriyanti & Sudira, 2015).

The learning styles are broadly divided into visual, auditory, and kinesthetic development. There is an audio-visual learning style, combining visual and auditory learning styles (Irawati et al., 2021). Audio-visual media is one of the efforts to convey learning through material with electronic devices to display it (Syah, 2020). One of the audio-visual learning styles used for learning is video and film. Audio-visual learning media in video makes it easier for students to understand imaginary learning material because video can provide concrete information (Muskania et al., 2019).

Video learning media is one of the learning media that displays audio and visual content learning, starting from concepts, principles, procedures, and application theory to facilitate understanding of a learning material (Prihatini et al., 2017). Video, in its current development, interests students, especially international audio-visual, but there is very little educational content. Situations like this encourage educators to create learning media in the form of educational videos as a concrete solution to making learning more interesting but full of educational values (Habibah et al., 2020). Video can be developed as a learning media combined with local wisdom.

Research on the development of instructional media in the form of local wisdom-based educational videos obtained validation from subject experts of the feasible category obtained from the validation of learning media experts in the very feasible category, the average result of student responses to the use of educational videos as learning media said to be a very practical media. The similarities lie in media in the form of

educational videos with instruments based on local wisdom, while the difference with the research to be conducted lies in the dependent variable and development model (Rahadini et al., 2022).

Local wisdom was chosen because of its effectiveness in improving critical thinking skills, and students know more about the wisdom in their surroundings, even in Indonesia. This is because of today's phenomenon: millennial children are more interested in technological sophistication, the meaning of which is not yet known. Indirectly, students gain new knowledge about local wisdom through educational videos based on local wisdom. One of the efforts to preserve local wisdom that is marginalized amidst technological sophistication is by inserting local wisdom into learning, such as combining local wisdom with science lessons where students can analyze examples of phenomena that are encountered every day.

Learning material temperature and heat must be balanced with a real application; theoretically, students can also analyze and evaluate directly. Heat becomes matter by mastering it, not emphasizing memorizing formulas but understanding concepts, while the concept of heat matter is very close to life. The material of temperature and heat is reviewed in this study because it is one of the important and easy materials in learning physics; if students' ability to analyze and evaluate is low on temperature and heat material, it will be difficult to study material at a higher.

Heat material is one of the materials that is often encountered in daily life related to local wisdom; namely, temperature is an example of the phenomenon of torch wars carried out by local people by striking torches at each other, increasing location rates and torch holders; this becomes very interesting if analyzed using the concept of temperature and heat matter. The existence of temperature and heat materials in everyday life is very suitable for honing local wisdom-based learning and training students' critical thinking skills. Based on the results of observations made at SMA Al-Hadi Girikusuma Mranggen Demak, learning media will be developed in the form of educational videos based on local wisdom to improve critical thinking.

METHOD

Types of Research and Development are research methods that can produce new products (Branch, 2009). Improving existing products, developing new products, and testing product effectiveness could be used in R&D writing (Sukmadinata & Syaodih, 2013). ADDIE research is used as a research design to be developed, and there are five steps to research and development design, including analysis, design, development, implementation, and evaluation (Mulyatiningsih, 2013).

The development procedure used a research and development (R&D) approach. The basic development procedure comprises two main objectives, including analyzing the feasibility of the product created and testing the product's effectiveness in achieving the goal. The development procedure in research using (Research and Development) is integrated with applying the ADDIE model; there are five core phases: Analyze, Design, Develop, Implement, and Evaluate. Development research does not only create products but tests the feasibility, evaluates, and applies them to a subject. The feasibility of educational videos based on local wisdom is validated by material and media experts, and then suggestions and comments are obtained, which are used as material for improvement; data obtained from media experts and the material was analyzed using Aiken's V (Azwar, 2014). The

media eligibility categories are listed in Table 1.

Table 1 Media eligibility category

Rating index (%)	Feasibility category
10 ≤ x < 25	No feasibility
25 ≤ x < 50	Medium
50 ≤ x < 75	High
75 ≤ x < 100	Very high

(Nasir, 2016)

In this case, it states that the results of the data that have been analyzed obtained a percentage that shows the level of feasibility of the material and media expert validator. Student responses were used to analyze opinions on the media that had been developed; 13 questions in the questionnaire were given to students. Interested student response are listed in Table 2.

Table 2. Interested student response

Feasibility score	Category
0 ≤ P < 20	Not interested
20 ≤ P < 40	Less
40 ≤ P < 60	Medium
60 ≤ P < 80	Very high
80 ≤ P < 100	

(Nasir, 2016)

Educational videos based on local wisdom apply indicators of critical thinking and are strengthened by test instruments that are used as pretests and posttests to see the improvement of students' critical thinking skills. Data resulting from improving students' critical thinking skills were analyzed using the *N-Gain* equation (Hake, 1999). Improvement of student's critical thinking skills are listed in Table 3.

Table 3 Improvement of student's critical thinking skills

N-gain Score	Category
N-Gain < 0,3	Low
0.3 ≤ N-Gain < 0.7	Medium
N-Gain ≥ 0.7	High

(Nasir, 2016)

Before being tested, the test instrument was tested for validity, reliability, level of difficulty, and discriminating power on each item, then validated by experts to determine whether the items fulfilled the six aspects of the eligibility.

RESULTS AND DISCUSSION

An educational video was developed to discuss temperature and heat by integrating local wisdom activities in the Jepara district, Central Java. The local wisdom chosen in this educational video includes the process of making Monel Kriyan, the Torch War, and the processing of coffee beans. Monel Kriyan's local wisdom is raised in an educational video to illustrate the relationship between local wisdom and physics. The people of Jepara have carried out the tradition of making pottery from clay for generations. Making Monel Kriyan, related to temperature and heat, wet clay will experience a physical transformation when heated. At a certain temperature, the water in the clay will evaporate, resulting in a phase change from liquid to gas. This heating process requires understanding heat transfer and substances' phase changes.

Another local wisdom is torch war. The Torch War is a tradition carried out by the people of Jepara, commemorating certain traditional holidays and ceremonies. In this context, the relationship between the Torch War and physics relates to the concepts of temperature, heat transfer, thermal energy, and combustion. Another local wisdom is coffee bean processing. In this context, the relationship between coffee bean processing and physics can be seen from various aspects, including using heat, pressure, and phase changes of substances.

In the coffee bean roasting stage, heat is applied to turn the coffee beans into roasted coffee beans. This roasting process involves the physics of heat transfer and phase change. Heating coffee beans results in chemical and physical changes in the beans, including

changes in color, aroma, and taste. The understanding of heat transfer and thermal energy is very relevant to understanding how the heating of coffee beans contributes to changes in coffee characteristics.

The ADDIE phase is a systematic approach to developing learning materials, including making educational videos based on local wisdom to improve students' critical thinking skills on temperature and heat material. The analysis phase in ADDIE involves identifying learning needs and analyzing student characteristics and learning materials. In this study, an analysis was carried out to understand students' needs in developing critical thinking skills in temperature and heat. In addition, an analysis of local wisdom values was also carried out, which could be integrated into educational videos.

The design phase involves planning and designing learning materials, including scripting and educational video concepts. At this phase, the analysis results are used to develop specific learning objectives and design appropriate teaching strategies to improve student's critical thinking skills. The development phase involves making educational videos based on predefined designs. The result of this phase is an educational video combining temperature and heat material with local wisdom creatively and interestingly to stimulate students' critical thinking skills.

The implementation phase involves the application of educational videos in the learning process in the classroom. Educational videos can be used as learning aids that attract students' attention and encourage them to think critically about temperature and heat. The evaluation phase involves collecting data to evaluate the effectiveness of educational videos in improving students' critical thinking skills. The results of this evaluation are used to refine and improve educational videos and validate the

successful implementation of the ADDIE phase in the context of learning temperature and heat.

The final and appropriate local wisdom-based educational video for students must go through several phases of development adapted from analysis, design, and development. The initial phase of development carried out is analysis. The results of the analysis carried out by the researcher were obtained by carrying out the requirements for the achievement of local wisdom-based educational videos which aim to improve students' critical thinking skills in the subject of temperature and heat. One of the things that were done was an interview with a physics teacher at SMA Al-Hadi Girikusuma Mranggen Demak to obtain useful data in product development design Researchers develop educational videos based on local wisdom with materials on temperature and heat as requirements at the analysis phase.

The second phase is the design to the planning of educational videos is carried out according to the structure of educational videos. The researcher contains the structure of the educational video in the form of an introduction, opening show, introduction, video content, and closing.

The third phase in educational videos is developing the audio and video phases produced, material programming, and supporting components. All constituent components for the formation of educational videos are produced in the development phase. The final educational video then enters the fourth phase or implementation; before being used, it must be validated by an expert first. The expert validation instrument component contains two aspects: media and material.

This validation phase is carried out as a review to analyze the feasibility of educational videos based on criteria. The eligibility criteria for the educational

videos used by the researcher are following the eligibility standards for educational videos. After obtaining a feasibility score from the expert validator, the educational video is revised according to the comments and suggestions provided by the validator. This research was validated by two lecturers majoring in physics and one high school teacher in charge of physics. Based on the comments and suggestions of the three validators, there were deficiencies in the initial design of the educational video, which had to be corrected before being tested on students.

After validation by the expert, a value will be obtained for the overall feasibility of educational video products. Two aspects are validated in the form of aspects of media and material obtained by validation. The feasibility of the media aspect was obtained by 95% with a very valid or feasible category, and the material aspect was obtained by 97% with a very valid or suitable category for use as a learning media; the average feasibility validation obtained was 96% by obtaining a very feasible category. The assessment obtained from the validator based on the educational video that was developed must be revised so that the educational video can be better and easier to understand. The same thing was done in developing local wisdom-based educational videos suitable for use as learning media with the acquisition of an assessment from media experts in the very appropriate category and material experts of 80.00% in the appropriate. Overall media feasibility is shown in Table 4.

Table 4 Edu-video eligibility

Aspect	Score (%)	Eligibility
Content	95	High
Media	97	High
Average	96	High

Student responses are used in improving educational videos by providing student response questionnaires. Aspects assessed by

students included video display in the form of language, writing, easy-to-understand sentences used, changes experienced by students after watching the video, and the evaluation of the video. Obtained an average percentage of 72.26% with an attractive category. The development of educational videos on temperature and heat materials obtained positive responses from students with the questionnaire results. Overall student responses are shown in Table 5.

Table 5 Interest student responses for edu video

Aspect	Score (%)	Interest Category
Media interested	73.18	High
Critical thinking skill	72.46	High
Student interaction	71.15	High
Average	72.26	High

The fifth phase is an evaluation, which is the phase of observing the improvement of students' critical thinking skills obtained through the results of completing the pretest and posttest in the form of multiple-choice choices, consisting of 39 questions that are worked out with an allotted time of 90 minutes. Students of class X MIPA SMA Al-Hadi Mranggen Demak carried out the test. The pretest questions were given to students before receiving or watching educational videos based on local wisdom. In contrast, the posttest questions were given after students had watched educational videos based on local wisdom. The results of the Test-Gain analysis were obtained at 0.67 in the medium category. Overall, the increase in students' critical thinking skills is shown in Table 6.

Table 6 Improvement of student's critical thinking skills

Test		N-Gain Score	Category
Pretest	26.35	0.67	Medium
Posttest	75.89		

The development of educational videos discusses the material of temperature and heat by applying local wisdom activities in the Central Java

area, precisely in the Jepara district. The local wisdom raised in the first educational video is the making of Monel Kriyan, the Torch War, and the Processing of Coffee Beans. Research was also carried out to improve critical thinking skills seen from a comparison of the pretest and posttest, an increase meaning that the media developed influenced improving students' thinking skills. The results of learning media in the form of educational videos seek to improve critical thinking skills on temperature and heat material by applying local wisdom activities, which can be seen in Figure 1, 2, and 3.

Figure 1 The opening of an educational video based on local wisdom
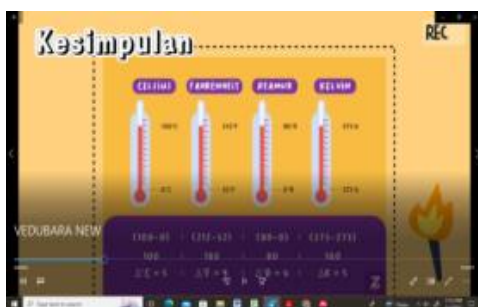

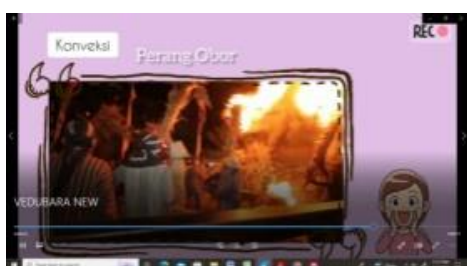Figure 2 Local wisdom-based educational video contents

Figure 3 The content and closing of a local wisdom-based educational video

The product that has been developed is in the form of local wisdom-based educational videos to improve critical thinking skills on temperature and heat materials. It has advantages in terms of content, namely collaborating local wisdom to make it easier for students to analyze and can be accessed online via the YouTube page. It aims to improve students' critical thinking skills through learning through technology. Educational videos based on local wisdom can improve students' skills in analyzing, concluding, evaluating, and providing solutions regarding local wisdom activities.

Learning videos as a medium present audio and visual learning materials on concepts, principles, procedures, and application theory of knowledge to help understand concepts and critical thinking skills (Boschl et al., 2022; Susilawati et al., 2022; Yerimadesi et al., 2023). An interactive and fun learning process can be built with videos that make it easier for teachers to convey material and its context in learning (Kosmaca & Siiman, 2023). The use of video in learning can be presented with appropriate delivery techniques, optimal quality, and video-making skills (Amelia et al., 2022; Sujanem & Suwindra, 2023). Videos can trigger critical thinking skills to analyze arguments, make inferences using reasoning, judge or evaluate, and make decisions or solve problems. In addition, the learning video observations that are presented direct critical thinking skills to analyze, assess, evaluate, reconstruct, and make decisions that lead to rational and logical actions (De Winter & Millar.2023; Wang, *et al.*, 2017).

In implementing critical thinking skills, students can critically accept and analyze knowledge, process information properly to reconstruct mindsets, and make rational decisions in solving problems (Arsal, 2017; Kanmaz, 2022; Sermeus et al., 2021). The way of thinking goes through an intellectual

process of conceptualizing, applying, analyzing, synthesizing, and evaluating various information obtained from the results of observation, experience, and reflection as a basis for decision-making. Critical thinking skills as a problem in more detail, maintaining an open mind with different approaches and views, not easily acknowledging information and data obtained from various sources, both oral and written, and thinking reflectively.

The use of educational videos based on local wisdom in learning temperature and heat can help students develop their ability to analyze information. The video can provide real context that is relevant to students' daily lives so that they can identify facts, data, and concepts related to learning materials. Evaluation and Assessment: Educational videos can encourage students to evaluate the information presented critically. By seeing how local wisdom is integrated with the video, students are invited to examine these values critically and consider the implications of temperature and heat being studied. This allows them to look at issues related to different cultures and perspectives.

Critical thinking skills can be reduced by emphasizing and repeating certain experiences (Chen & Chuang, 2020; Orakci, 2023). Critical thinking analysis skills can train students to look for similarities by providing an integrated understanding of concepts. Inference skills can provide training to students more specifically regarding physics material whose events are often encountered in everyday life (Archer et al., 2023; Membiela et al., 2023; Zhang, et al., 2023). Critical thinking skill factors such as physical condition, motivation, anxiety, intellectual development, and collaborative interactions can affect participants' critical thinking skills. Critical thinking is very important for every student and is useful for solving problems in everyday

life by thinking actively and carefully to analyze all the information students receive so that every action will be taken appropriately.

CONCLUSION

Based on the analysis of results and discussion of the development of local wisdom-based educational videos on temperature and heat at SMA Al-Hadi Girikusuma Mranggen Demak. The validation results provided by the expert validator obtained material expert eligibility data worth 97% in the very feasible category and eligibility as a medium worth 95% in the very feasible category, average eligibility of 96% in the very feasible category. The results of the student response questionnaire to the educational video based on local wisdom showed a positive response by getting the appropriate category at SMA Al-Hadi Girikusuma Mranggen Demak. The results of the average percentage obtained from the student response questionnaire of 72.10% with a very interesting category. The developed educational video product can improve students' critical thinking skills with an N-Gain score of 0.67, which is in the medium category. The implication of critical thinking skills through learning constructs students' skills for interpreting and analyzing, which are used when someone receives new information and stores it for later use or rearranges it for problem-solving purposes based on developmental needs and demands.

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