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Developing STEM-Based PowToon Animation Videos to Enhance Critical Thinking Skills in Elementary School Students

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Abstract

This article examines the utilization of the PowToon animated film, integrated with the STEM (Science, Technology, Engineering, and Mathematics) approach, in enhancing the critical thinking skills of primary school students. Employing the ADDIE model methodology, this research involved 20 students as its subjects. Data collection techniques included observation, questionnaires, and evaluation of critical thinking skills. During the analysis phase, expert validation served as the foundational consideration, and the results of the students' critical thinking skills test were subsequently analyzed comparatively. The findings revealed that the PowToon animation with the STEM approach received positive feedback from experts, with scores of 92.50% from subject matter specialists, 89.50% from media experts, and 91.00% from linguistic authorities. When the topics of temperature and heat were presented through this animation, a significant improvement in the students' critical thinking abilities was observed. In conclusion, the STEM-based PowToon animation demonstrates its potential as an innovative and effective educational tool.

Keywords: Video development, PowToon, STEM, critical thinking skills

INTRODUCTION

The development of STEM-based PowToon animation videos to enhance the critical thinking skills of elementary school students is the focus of this study. In the contemporary educational landscape, the acquisition of critical thinking skills is recognized as a fundamental competence for students to navigate the challenges of the 21st century (Ratnsari et al., 2023). These skills empower students to analyze information, delve deeper into concepts, and make logical decisions (Amalia et al., 2023; Juliyantika et al., 2022).

Despite the acknowledged significance of critical thinking, there are challenges in integrating it into the elementary school curriculum and facilitating its development through effective teaching methods. This research seeks to address these challenges by exploring the potential of technology, specifically PowToon animation videos, in conjunction with the STEM (Science, Technology, Engineering, and Mathematics) approach to enhance the critical thinking abilities of elementary school students (Shrestha et al., 2008).

This study takes into account the ideas of famous educator Ki Hajar Dewantara, who said that education should help students develop their character, their intellect, and their ability to live in harmony with their surroundings (Kholis, 2014; Farida, 2015; Listari, 2021). It also acknowledges that the learning process should help students reach their full potential by developing their attitudes, skills, and knowledge (Hidayah et al., 2022; Bahiyah & Juhji, 2023).

In light of these considerations, the study posits that student-centered learning environments can effectively cultivate critical thinking skills (Juhji & Mansur, 2020; Juhji & Suardi, 2018). However, the reality often sees an overemphasis on curriculum objectives at the expense of individual students' abilities and interests (Napsawati, 2020; Barlian & Iriantara, 2021). To equip students with the vital Four Cs—creative thinking, critical thinking and problem-solving, communication, and collaboration (Widodo & Wardani, 2020; Juhji et al., 2022, 2021; Muin et al., 2022)—the research investigates the potential of STEM-based PowToon animation videos in improving students' critical thinking skills.

The goal of the study is to improve education quality by utilizing cutting-edge teaching strategies and technology. It recognizes the role of educators in motivating and guiding students towards relevant learning experiences and knowledge acquisition (Juhji, 2016). Furthermore, the research takes into account the existing challenges observed in elementary school settings, such as limited visual media usage, a lack of learning updates, and suboptimal critical thinking skills among students. It underscores the importance of incorporating varied and engaging learning media to foster critical thinking skills.

Drawing on previous research findings that highlight the positive impact of animation media on critical thinking skills (Sri Wahyuni et al., 2018; Tiwow et al., 2022; Kresnandya, 2020), this study aims to explore the specific influence of PowToon-based STEM video animation media on the topic of temperature and heat in elementary education. In summary, this research endeavors to develop and implement STEM-based PowToon animation videos to enhance the critical thinking skills of elementary school students, with a particular focus on the subject of temperature and heat.

METHOD

This study used a research and development (R&D) approach, a commonly used method for creating new products (Purnama, 2016; Oktavia et al., 2022). The principles of objectivity, comprehensibility, logical structure, conventional structure, clear and objective language, format, formal register, structure, balance, precise word choice, and grammatical correctness were considered throughout the study. The ADDIE Model, a systematic instructional design approach for developing learning media that is suitable for both online and face-to-face environments, was applied (Juhji et al., 2022). The ADDIE Model consists of five sequential phases: analysis, design, development, implementation, and evaluation (Ambarwati et al., 2019).

The subject of this research was Islamic Elementary School An-Nur, situated in Jalan Kiajurum, Banjarsari Village, Cipocok Jaya District, Serang City, Banten Province. The school's selection was based on its advantageous placement beside a main road that permits convenient accessibility for both two-wheeled and four-wheeled vehicles, rendering it the appropriate site for executing our media. This study entailed twenty fifth-grade students from SD Islam An-Nur, composed of twelve females and eight males. The scientific matter portrayed in the animated video concerned temperature and heat. Purposive sampling was utilized for subject selection, which included all fifth-grade students in the elementary school, with attention given to specific considerations. Data was collected through observation, surveys, and tests using validated instruments. To determine the enhancement of critical thinking skills, data analysis comprised expert validation tests and comparing average scores, utilizing N-Gain values.

RESULTS

The STEM-based PowToon animation video developed covers temperature and heat material in grade 5 elementary schools. There are 5 (five) stages that are carried out according to the model developed, namely: analysis, design, development, implementation, and evaluation. The five stages are described as follows. First, the analysis stage. At this stage, researchers collected information and data from observations made at An-Nur Islamic Elementary School related to students' critical thinking skills and the media that had been used by teachers. The information and data were then analyzed, including needs analysis, content of learning materials, and curriculum.

Second, the design stage, where researchers design the media developed with the aim of getting the results of a media design that is able to improve the critical thinking skills of students in grade 5 elementary school in science learning. The manufacturing steps include: designing the initial concept of STEM-based PowToon

animated video media, setting criteria, and designing the initial animation video. The initial design of the developed media can be seen in Table 1 below.

Table 1

The initial design view of STEM-based Powtoon animation video before and after revision

Before revision	After revision
	
	
	
	
	

Based on Table 1 above, there are differences in the animation media developed between before and after revision. Revisions were made based on input from experts so that it appeared that the PowToon animation media developed was more interesting and able to increase students' interest in learning.

Third, the development stage. In this stage, the animation video developed is validated by 6 (six) experts consisting of material experts, media experts, and linguists. After validation, the animated media developed was revised based on the experts' input. The percentage of validators on the feasibility of the developed STEM-based PowToon animation media can be seen in Table 2 below.

Table 2

The feasibility test results of STEM-based powtoon animation video

Validator	Media Feasibility Percentage			Interpretation
	(%)	(%)	(%)	
Material Expert 1	91	92,50	91,00	Very Feasible
Material Expert 2	94			
Media Expert 1	87	89,50		
Media Expert 2	92			
Language Expert 1	97	91,00		
Language Expert 2	85			

Based on Table 2 above, the STEM-based PowToon animation media developed was 92.50% declared very feasible by material experts, 89.50% declared very feasible by media experts, 91.00% declared very feasible by linguists. Overall, 91.00% of STEM-based PowToon animation media on temperature and heat material is declared very feasible by experts by grade 5 elementary school students.

Fourth, the implementation stage. Implementation of STEM-based PowToon animation media was carried out in class 5 Hasan bin Ali Islamic Elementary School An-Nuur Banjarsari, Kec. Cipocok Jaya Serang City Banten Province. A total of 20 students consisting of 12 girls and 8 boys were involved in this study.

Fifth, the evaluation stage. This stage aims to analyze the implementation of science learning using the STEM-based PowToon animation media that has been developed. In the learning process carried out, a pre-test was first conducted on students before they did learning using the STEM-based PowToon animation media. At the end of the learning, a post-test was conducted to see changes in students' critical thinking skills. Figure 1 below shows the learning outcomes of grade 5 elementary school students before and after learning using STEM-based PowToon animation media.

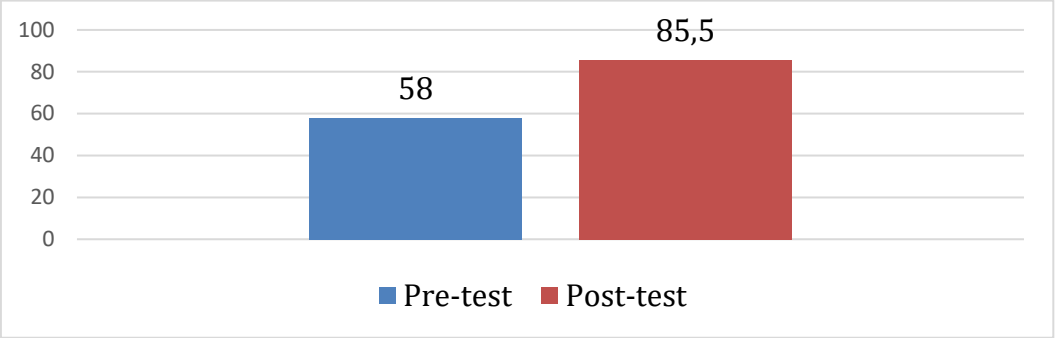

Figure 1

Learning Graph of Learners Before and After the Use of Video

Based on Figure 1, the pre-test score achieved by students before utilizing the STEM-based PowToon animated film on temperature and heat material was 58.00 (very low), with a percentage of learning completeness of 25.00% (not very good). However, the average post-test score was very high at 85.50. The average difference between the pre-test and post-test was quite large. This shows that the average post-test score is higher than the average pre-test score, with a percentage after adopting the STEM-based PowToon animated video media of 90.00%, while before PowToon animated video media was installed it was 25%.

Based on these findings, the critical thinking ability of Hasan bin Ali 5th grade students in the subject of temperature and heat has increased by 65.00% which seems to be a considerable increase. The pre-test and post-test data obtained an N-Gain value of 0.70. According to the requirements, if the N-Gain is more than 0.3 then it is included in the medium group. Thus, the data shows a change before and after the use of PowToon animated films, meaning that the PowToon animation media produced is very successful in improving the critical thinking skills of elementary school children.

DISCUSSION

Based on the research results, the approach to generating STEM-based PowToon animated video media was carried out using the ADDIE paradigm which stands for Analysis, Design, Development, Implementation, and Evaluation. According to Allen (2006), the ADDIE model is thought to be a paradigm that stems from learning systems research, especially in the field of product creation in education (Alcid et al., 2017). As a result, the ADDIE model can be used in research and development to help learners improve their thinking skills.

The first stage is analysis. It is the first stage conducted by researchers before developing a product. A number of related data such as the low critical thinking skills of students, learning needs in the 21st century, the content of science subject matter of temperature and heat in grade 5 elementary schools, and the curriculum

used are also analyzed. This was done in order to get accurate data before the design. This stage is in line with research conducted by Rustandi (2021) that the first thing to do in the analysis stage is a field or literature study. Latip and Permanasari (2016) also stated that in the analysis stage, the potential problems that occur in science learning are explored.

The second stage is design. It is a stage where researchers design after knowing the potential problems as analyzed in the first stage. The design is carried out with the aim of getting the results of a media design that is able to improve the critical thinking skills of students in grade 5 elementary schools in science learning. The steps of making include: designing the initial concept of STEM-based PowToon animated video media, setting criteria, and designing the initial animation video. This is in line with Latip and Permanasari (2016) that design needs to be done by formulating activity steps, objectives, and learning indicators that develop students' critical thinking skills.

The third stage is development. The STEM-based PowToon animation video developed was validated by 6 (six) experts consisting of material experts, media experts, and language experts. After validation, the animated media developed was revised based on expert input. This development stage is the central point where media production is carried out, because in it there are activities to produce animated media and develop it to be suitable for grade 5 elementary school students in improving critical thinking skills. This is in line with Cahyadi's (2019) findings that the ADDIE model development process has at least two main objectives, namely producing and or revising the product to be used and choosing the best product to use.

The fourth stage is implementation. The STEM-based PowToon animation video developed was then tested and applied to grade 5 elementary school students. This implementation trial was carried out on a limited basis given the limited space and time of the research. Implementation is carried out with the aim of analyzing the benefits and usefulness of the developed media so that the learning process achieves maximum and optimal goals, namely improving students' critical thinking skills. Therefore, in the process, students are guided by the teacher in using the animated media by ensuring the occurrence of the thinking process so that their critical thinking skills develop and increase.

The fifth stage is evaluation. It is the last stage in this study where researchers evaluate the development of students' critical thinking through pre-test and post-test activities. From these activities, data were obtained that the average score of students experienced a drastic change before and after using the STEM-based PowToon animated video media. This means that to help improve critical thinking skills, learning using these animated videos can also be applied. Not much different, Permana et al. (2016) also found the effect of using a virtual laboratory based on

flash animation on students' critical thinking skills. This means that students' critical thinking skills can be improved through the learning media used and in accordance with the learning objectives to be achieved.

The effectiveness of using STEM-based PowToon animated video media can also be seen from the results of the pre-test and post-test which showed an N-Gain value of 0.70 in the medium category. The difference in value indicates the effect of using the media used. This is in line with the research findings of Zulhelmi et al. (2017), that the use of interactive learning media can affect students' critical thinking skills. In addition, hasil penelitian ini juga memperkuat hasil penelitian yang menyatakan bahwa penerapan video animasi dapat meningkatkan minat belajar dan hasil belajar siswa (Tiwow et al., 2022; Yulinar et al., 2023; Wafiqni et al., 2021). Thus, these findings indicate a difference before and after using the PowToon animation video so that it can be stated that the PowToon animation video media developed is very effective in improving the critical thinking skills of elementary school students.

CONCLUSION

This research demonstrates the effectiveness of utilizing PowToon animated films integrated with the STEM approach for enhancing critical thinking skills among primary school students. The study's adoption of the ADDIE model provided a systematic framework for the development and evaluation of the educational tool. The positive feedback from subject matter specialists, media experts, and linguistic authorities further supports the potential of this approach. Notably, the application of this multimedia tool in teaching the topics of temperature and heat led to a significant improvement in students' critical thinking abilities. These findings underscore the value of incorporating STEM-based multimedia resources into elementary education to foster critical thinking skills and provide engaging learning experiences.

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