

## THE EFFECT OF USING SCIENTIFIC E-COMIC LEARNING MEDIA ON CRITICAL THINKING SKILLS IN EARTH AND SOLAR SYSTEM MATERIALS

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**Abstract:** *This study aims to determine the effect of using scientific e-comic learning media on students' critical thinking skills in Earth and Solar System subjects. The type of research used is a pre-experiment with a One Group Pretest-Posttest design. The research subjects were 29 students in class VII-B of SMP Negeri 2 Berbek, selected through purposive sampling. Data were collected through critical thinking ability tests, student response questionnaires, and documentation, and then analyzed using a quantitative approach with inferential statistical tests. The results of the study showed an increase in the average score from 65.5 on the pretest to 79.3 on the posttest. Students' responses to learning using scientific e-comics were in the very good category with an average score of 4.2 (84%). The significance test showed a significant effect of the use of this media on the improvement of critical thinking skills. This study confirms that scientific e-comics can be an alternative learning medium that is interesting, interactive, and effective in supporting the development of students' critical thinking skills.*

**Keywords:** *Learning Media, Scientific E-comics, Critical Thinking*

Critical thinking is a logical thinking process that emphasizes how a person determines decisions that are trustworthy, acceptable, and accountable (Kurniawan et al., 2021). Critical thinking skills can help students achieve good academic results and serve as a necessary resource, available in every component of education (Wayudi et al., 2020).

Based on preliminary research conducted at SMP Negeri 2 Berbek, it was found that students' critical thinking skills were low, as indicated by an average score of <60. (Rosmalinda et al., 2021) Classify students' critical thinking skills as low if their scores are  $\leq 60$ , moderate if their scores are between 60 and 75, and high if their scores are above 75.

Although critical thinking skills are recognized as a crucial competency, (Yuniati et al., 2020) states that the level of critical thinking skills among students in Indonesia is relatively low, as evidenced by the results of the PISA study. According to the 2018 PISA results, the average score of Indonesian students was only 396 out of 500 OECD countries. Based on the results of the 2022 PISA study, Indonesia's average score was 383 (OECD, 2024). These results indicate that critical thinking skills in Indonesia are significantly lower than those in other countries.

The suboptimal use of learning media or teaching aids is one of the factors contributing to the low level of critical thinking among students (Hidayati et al., 2021). Teachers need to determine the appropriate and relevant learning media to use in learning activities (Icahayati et al., 2024). The use of monotonous media makes students bored and tired during the learning process. Students need media that not only attracts their interest in learning but also hones their critical thinking skills.

Critical thinking skills are not solely influenced by the use of learning media, but also require the application of appropriate models or approaches in order to achieve learning objectives optimally. One relevant approach to combine with e-comic media is the scientific approach. The scientific approach is designed to help students recognize and understand various concepts in learning materials. Through this approach, students are encouraged to obtain information independently, which can be accessed anytime and anywhere. (Liana, 2020).

Scientific e-comics are one alternative form of digital learning media that combines illustrated stories with a scientific approach. This media is expected to present complex material, such as the Earth and the Solar System, in a simpler, more interactive, and enjoyable way. Through visualization, narration, and scientific steps, students are encouraged to be more active in understanding concepts while practicing critical thinking skills.

Based on the previous discussion, the researcher deems it necessary to conduct a study titled “The Effect of Using Scientific E-Comic Learning Media on Critical Thinking Skills in Earth and Solar System Material for Seventh-Grade Students at SMP Negeri 2 Berbek”.

## **Methodology**

This study used a quantitative approach with a pre-experimental One Group Pretest-Posttest design. The study was conducted at SMP Negeri 2 Berbek in the 2024/2025 academic year. The study population consisted of 113 seventh-grade students, while the study sample was class VII-B, consisting of 29 students, determined using purposive sampling. The research instruments consisted of a critical thinking ability test and a questionnaire. The test was administered before and after the learning process to measure students' critical thinking skills, with five indicators to be measured: 1) identifying problems, 2) developing basic skills, 3) drawing conclusions, 4) evaluating, and 5) solving problems. The questionnaire was used to determine students' responses to the use of scientific e-comics as a learning medium. There are 10 indicators to be measured, such as the attractiveness of the e-comic's appearance, ease of understanding, relevance of the material, appropriateness of the language, student engagement, clarity of the storyline, improvement in critical thinking skills, fostering curiosity, enhancing understanding, and satisfaction with the scientific e-comic. The data were analyzed using inferential statistical tests. Normality tests were conducted to determine the distribution of data, and t-tests were used to test the hypothesis of differences between pretest and posttest results. The unit of analysis in this study was individual students, while the context of the study was learning about Earth and the Solar System using scientific e-comics as a medium.

## **Results and Discussion**

### **Results**

This study aims to determine the effect of using scientific e-comics on students' critical thinking skills. Data was obtained through pretest and posttest, as well as student response questionnaires. Descriptive analysis results show that the average pretest score was 65.5, while the average posttest score increased to 79.3. This increase indicates a positive change after students participated in learning using scientific e-comics. Additionally, the results of the student response questionnaire showed an average score of 4.2 or 84%, which falls into the “very good” category. This indicates that students responded positively to the use of scientific e-comics in science education.

Before conducting the hypothesis test, the data was tested for normality using the Shapiro-

Wilk method at a significance level of 0.05. The test results showed that the pretest and posttest data were normally distributed ( $p > 0.05$ ). To determine the difference in the average critical thinking ability of students before and after using scientific e-comics, a paired sample t-test was conducted. The test results showed a p-value of  $0.000 < 0.05$ , so the alternative hypothesis ( $H_a$ ) was accepted. This means that there was a significant difference between the pretest and posttest results, indicating that the use of scientific e-comics had a positive effect on students' critical thinking skills.

**Discussion**

The use of scientific e-comics as learning media in science subjects, particularly on the topics of Earth and the Solar System, is implemented by integrating the scientific approach into the storyline and engaging visualizations within the e-comics. These e-comics are designed to support the five steps of the scientific approach: observing, questioning, experimenting, reasoning, and communicating. Here is one example of a scientific e-comic:



Figure 1.1. E-comic section Asking questions

In Figure 1.1 above, during the questioning stage, students are presented with visual displays from e-comics and begin to ask questions such as, “What causes the earth to rotate?” and “Why does the earth rotate, but we don't get dizzy?” These questions encourage students to think critically and explore the concepts being studied in greater depth. Students are encouraged to ask questions about what they see, hear, or read after observing. Questions can be factual, conceptual, or hypothetical. Teachers assist students in thinking critically and deeply (Musriah & Kuntoro, 2019).

Based on statistical testing results, the average student score increased from 65.5 to 79.3. The application of learning using scientific e-comics media obtained a higher score than learning without using media. At the pretest, the majority of students showed abilities that were classified as low to moderate. However, after the intervention (treatment), the post-test results showed a significant improvement, shifting to the “Good” and “Very Good” categories. The factors influencing the increase in post-test scores compared to pre-test scores include the e-comics providing visual representations of natural phenomena in a realistic manner, such as Earth's rotation, revolutionary movements, and lunar phase changes. According to (Raisal et al., 2024) Stating that the use of visuals in e-comics is effective in simplifying complex scientific concepts and supporting the strengthening of critical thinking skills.

The questionnaire results reinforce the post-test data, which shows an increase in students' critical thinking skills after learning using scientific e-comics. Based on the questionnaire recapitulation containing 10 indicators with 2 statements per indicator, it shows that scientific e-comics received very positive responses from students, with an average score of 4.2 (84%) which is in the “Very Good” category. This shows that students' positive responses to the media are in line with the improvement in student learning outcomes.

Based on the results of data analysis using statistical tests with a paired sample t-test, which showed that  $H_0$  was rejected and  $H_a$  was accepted, there is an effect of the use of scientific e-comics on students' critical thinking skills, with a significance value of Sig. (2-tailed) of

0.000, which is less than 0.05 ( $0.000 < 0.05$ ). Therefore, the alternative hypothesis ( $H_a$ ) can be accepted while the null hypothesis ( $H_0$ ) is rejected, indicating a statistically significant difference.

In the research results, the discussion in this study refers to the research questions outlined above. Based on the first research question, how does the application of scientific e-comic learning media affect students' critical thinking skills in Earth and Solar System topics? The use of scientific e-comic media in science education on Earth and Solar System topics is designed by integrating scientific approach steps through storylines, experimental illustrations, and exploratory dialogues. A questionnaire distributed to 29 seventh-grade students showed positive responses, with 83% finding the e-comic visually appealing, 80% finding the material easy to understand, and 86% feeling encouraged to think critically. These findings indicate that scientific e-comics are effective in supporting conceptual understanding while enhancing students' critical thinking engagement. According to (Yuniati et al., 2020) Scientific e-comics are effective in stimulating students to think critically because they present real-world problems and encourage students to investigate solutions through the storyline.

The second research question is: How does the ability to think critically change before and after using scientific e-comics as a learning medium? Statistical test results show an average increase in students' scores from 65.5 to 79.3, with a shift in categories from low–moderate to good–very good. This improvement is influenced by the visualization of e-comics, which facilitates the understanding of abstract concepts such as Earth's rotation, revolution, and lunar phases, while also fostering critical thinking skills through narrative plots and scientific conflicts. The application of scientific steps (observing, questioning, experimenting, reasoning, and communicating) in e-comics has been proven to facilitate active learning, increase enthusiasm, and create a flexible and enjoyable learning experience. These findings align with previous research confirming the effectiveness of e-comics in enhancing students' conceptual understanding and critical thinking skills.

The third research question is how does the use of scientific e-comic learning media affect students' critical thinking skills? The results of the study indicate that the use of scientific e-comic media has a significant effect on improving students' critical thinking skills in Earth and Solar System material, as evidenced by a paired sample t-test with a significance value of 0.000 ( $< 0.05$ ). This improvement aligns with survey results indicating very positive responses (average score of 4.2/84%), particularly in terms of engaging visuals, ease of understanding, and encouragement for critical thinking. The effectiveness of e-comics is further supported by previous research (Purborini et al., 2019; Qomariah, 2023; Wati et al., 2024) this demonstrates that science-based comics can facilitate higher-order thinking skills through the 5M steps. The visualization, narrative, and scientific conflicts presented in e-comics have been proven to simplify abstract concepts such as the rotation and revolution of the Earth, while also increasing students' interest and motivation to learn. Thus, scientific e-comics not only serve as an engaging learning medium but are also effective in fostering students' critical thinking skills in a tangible way.

## **Conclusion and Recommendations**

### ***Conclusion***

Based on the results of research and discussion regarding the influence of learning using scientific e-comics on the critical thinking skills of seventh grade junior high school students on the subject of Earth and the Solar System, the following conclusions can be drawn:

1. The use of scientific e-comics as part of the learning process makes lessons more enjoyable and easier for students to understand material about the Earth and the Solar System. Using an engaging scientific and visual approach, these scientific e-comics have been proven to increase student engagement and attention in learning activities and improve critical thinking skills through activities that involve observation, reasoning, and conclusion.

2. Students' critical thinking skills before using scientific e-comics were in the low to moderate range. After learning with scientific e-comics media, students' critical thinking skills showed a significant improvement. This is demonstrated by the results of the hypothesis test, which show that Sig. (2-tailed) < 0.00, i.e.,  $0.000 < 0.05$ , meaning that  $H_a$  is accepted and  $H_o$  is rejected, as Sig. (2-tailed) is below 0.05. Thus,  $H_o$  is rejected and  $H_a$  is accepted. Since  $H_a$  is accepted, it can be concluded that there is an effect of using e-comic media on students' critical thinking skills in Earth and solar system material in Grade VII at SMP Negeri 2 Berbek.
3. The use of scientific e-comic learning media has a positive and significant effect on students' critical thinking skills. Based on statistical test results, there was a significant increase in scores between the pretest and posttest, proving that this media is effective in helping students improve their critical thinking skills in Earth and Solar System subjects.

### ***Recommendations***

Based on the results of research and discussion regarding the influence of learning using scientific e-comics on the critical thinking skills of seventh grade junior high school students in Earth and Solar System subjects, the following conclusions can be drawn:

1. For Teachers and Schools  
The use of scientific e-comics in science education is recommended as a fun and effective alternative medium to help students understand abstract material and improve critical thinking skills.
2. For Researchers  
This study only covers one class and one topic. Future researchers can expand the scope of the study to different subjects or levels by using experimental methods with control groups to obtain more comprehensive results.
3. For Media Developers  
For developers of scientific e-comics, continue to improve the visual quality, interactivity, and narrative that are appropriate for students' characteristics so that this medium becomes more effective in supporting scientific-based learning.

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