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Implementation of Interactive Science Ebook Innovation Based on Project-Based Learning (PjBL) to Enhance Students Critical Thinking Skills

Musdalifah[1*], Asri Widowati[2], Suyanta[3], Sabar Nurohman[2], Sri Rejeki[3]

[1] Magister Pendidikan Sains, Universitas Negeri Yogyakarta, Indonesia.
[2] Departemen Pendidikan Sains, Universitas Negeri Yogyakarta, Indonesia.
[3] Departemen Pendidikan Kimia, Universitas Negeri Yogyakarta, Indonesia.

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Corresponding Author:
Musdalifah
musdalifahh0105@gmail.com

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Abstract: The ability to think critically is one of the profiles of Pancasila students that students must possess in the independent curriculum. Critical thinking skills are one of the abilities that students need in solving problems. This research aims to describe the implementation of interactive Science ebooks based on PBL to enhance the critical thinking skills of students in the topic of environmental pollution. The research design used is quantitative descriptive. The research design used a one-group pretest-posttest design. The population of the study is all seventh-grade students of SMPN in Yogyakarta. The sample of this research is the seventh-grade student's one of the junior high schools in Yogyakarta, selected through simple random sampling technique. The research instrument used is a multiple-choice critical thinking test with five indicators. Indicators of critical thinking abilities are explaining, evaluation, concluding, analysis, and designing strategies. The results showed an improvement in critical thinking skills through the N-gain test of 0.8, indicating a high category. The average indicator of students' critical thinking skills who obtained the highest score was the explaining indicator with an average of 90.5%, while the indicator with the lowest average among students' critical thinking skills was the analysis indicator with an average of 70.01%. This indicates that the use of Science Ebook Innovation Based on Project-Based Learning (PjBL) can enhance the critical thinking skills of students. It is expected that this research can provide references for future researchers, and innovations related to interactive teaching materials can be developed not only for one subject but for all subjects in middle school science.

Keywords: Critical thinking; Ebook; PjBL

Introduction

The Merdeka Curriculum is the current curriculum that has been implemented. Within the Merdeka Curriculum, there are several profiles of Pancasila learners that need to be developed in students, one of which is critical thinking skills. Critical thinking is one of the abilities that students need in order to solve problems. Problem-solving is closely related to the thinking abilities of students. Critical thinking skills are important and should be possessed by students in order to face various personal and social issues, as well as to make decisions in solving problems (Patonah, 2014; Hart 2021). Critical thinking skills, particularly at the junior high school level, are still categorized as low. According to research conducted by Nuryanti and Diantoro (2018), the critical thinking skills of junior high school students are still classified as low. Furthermore, based on the results of the Programme for International Student Assessment (PISA) 2018 (OECD, 2018), Indonesia ranks among the bottom 7 out of 72 other countries in terms of high-level thinking skills. Based on these study results, it can be concluded that the high-level thinking skills of students in Indonesia are still relatively low. This is

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further supported by interview results from science teachers at SMPN in Yogyakarta, who stated that despite implementing the Merdeka Curriculum, students' critical thinking skills still appear to be lacking.

The improvement of students' critical thinking skills is greatly influenced by the classroom learning environment. There are several factors that significantly contribute to achieving learning objectives, including the use of instructional materials (Suardi, 2018; Wahid, 2018; husein, 2015; Effendi, 2015). Instructional materials are one of the most crucial components in teaching and learning because they serve as a guide for students, directing their activities related to the content to be learned (Nugroho, 2018; Prastowo, 2013). Various innovative instructional materials have been developed in electronic formats, enabling more interactive and engaging learning experiences. One such form of electronic instructional material widely developed today is the electronic book (ebook) (Rahmat, 2023). The use of ebooks in teaching and learning offers advantages by providing extensive feedback to students and not only containing written materials but also incorporating multimedia elements such as images, audio, animations, and videos (Sitorus, 2019; Putra, Murtiani, Gusnaedi, 2017). Therefore, the use of ebooks is expected to make students actively engaged in the learning process.

In science education, particularly in the topic of environmental pollution, students are expected to actively provide solutions to the existing problems. Therefore, project-based e-books are needed as instructional materials to train students to be active during the learning process through real-world actions. Project-based learning is one of the requirements of the Merdeka Curriculum. Schools are now given the flexibility to provide relevant projects that are closely related to students' environment. With project-based learning, students have the opportunity to learn and apply critical thinking skills to solve assigned tasks and problems (Anekawati, 2021; Mulia, 2019).

Based on the information provided, the objective of this research is to describe the implementation of interactive project-based learning (PjBL) science ebooks to enhance students' critical thinking skills.

Method

The population of this study consists of all seventh-grade students at SMPN in Yogyakarta. The sample for this research is the students from class VII D at one of the junior high schools in Yogyakarta. The sampling technique used is simple random sampling, which involves randomly selecting the sample. The research instrument used is a multiple-choice test of critical thinking skills. This study falls under the category of quantitative descriptive research, using a pre-experimental design known as a one-group pretest-posttest design. This design involves conducting research on only one group or class without a control group or comparison group.

Result and Discussion

Interactive Science Ebook Based on PjBL

Figure 1. Interactive Science Ebook Based on PjBL

Improving critical thinking using interactive science Ebook based on PjBL

After the suitability of the ebook to be used has been tested, the implementation or application of the ebook in enhancing students' critical thinking will be carried out, using several indicators. The descriptive analysis results of the students are presented in Table 2.

Table 2. Descriptive Analysis of Students' Critical Thinking

Mean	78.65
Standard deviation	20.67
Minimum score	65.00
Maximum score	96.00
N-Gain	0.80

Based on the table above, it is known that the average score of students' critical thinking is 73.61 with a standard deviation of 20.67. The minimum score is 33.33, and the maximum score is 91.67. The N-Gain obtained is 0.8, categorized as high. The assessment results of students' critical thinking based on several indicators (Ennis, 1993) are as follows:

Table 3. Critical Thinking Indicators

Indikator penilaian	Rerata skor (%)	Kategori
Explaining	90.50	Very High
Evaluation	70.50	High
Concluding	80.75	High
Analysis	70.01	High
Designing strategies	75.50	High
Mean	77.40	High

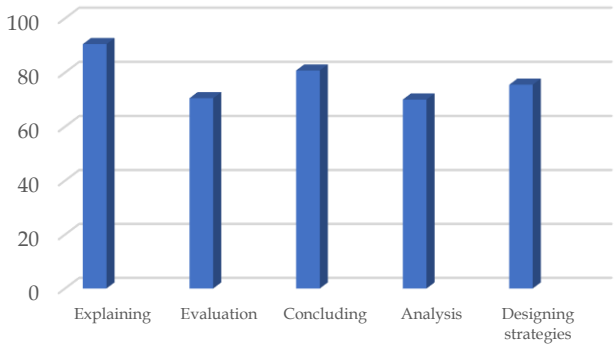

Figure 3.Critical Thinking Indicators

Based on the table and diagrams above, it is known that the values for each indicator fall under the categories of very high and high. With an average achievement of 77.4, which falls into the high category. Therefore, the use of PjBL-integrated ecoliteracy-based Science eBooks can enhance students' critical thinking abilities in the high category. Some innovative aspects of the ebook from the researcher, as well as the classroom learning process, include:

a) Addressing real-world issues by incorporating news articles that cover soil pollution problems in the students' local area.

Figure 2. The News Section in the Ebook.

b) Presenting videos about soil pollution in the vicinity of the students.

Figure 3. The Video Section in the Ebook.

c) Providing projects in the form of links as concrete actions by students to train their critical thinking skills in preventing and addressing soil pollution

Figure 4. The Project Section in the Ebook.

Figure 5. The creation of projects by students.

Figure 6. The use of ebooks in the classroom.

d) Offering a motivational column to encourage students to consistently protect the environment, especially the soil environment

Figure 7. The Motivation Section in the Ebook

From all the obtained results, it can be concluded that Interactive Science Ebook Innovation Based on Project-Based Learning (PjBL) is effective in improving students' critical thinking abilities. This is in line with the research conducted by Prabasari (2021), Liana (2022) and Marlina (2022), which states that the use of electronic teaching materials can engage students to be actively involved in learning, thus enhancing their critical thinking abilities after solving interesting problems presented in the electronic teaching materials. Additionally, Rahman (2021) states that the use of electronic teaching materials in learning results in an average indicator of critical thinking abilities falling in the high category. Moreover, the use of the PjBL model in learning can also train and enhance the critical thinking abilities of junior high school students (Mauziyah, 2023). Research conducted by Issa (2021); Hujjatusnaini (2022) and Rauziani (2016) has shown that the project-based learning model can enhance high-level thinking abilities, including critical thinking.

The ability to think critically is the ability to analyze facts, convey ideas, defend opinions, make comparisons, draw conclusions, evaluate given arguments, and the ability to solve problems (Astawa, 2022; Ramdani, 2020). The indicator with the highest level of critical thinking is the "explaining" indicator. The students obtained an average score of 90.5% in this indicator. On the other hand, the indicator with the lowest average score in critical thinking is the "analysis" indicator. According to interviews conducted with the students, they found the analysis indicator to be the most challenging because it requires them to carefully uncover hidden meanings and analyze the given readings or questions.

Conclusion

Based on the results and discussion above, it can be concluded that the use of interactive PjBL-based Science eBooks can enhance students' critical thinking abilities. This can be seen from the pretest and posttest results of the students, which showed an N-Gain score of 0.8 in the high category. Among the indicators of students' critical thinking abilities, the highest average score was achieved in the "explaining" indicator with an average of 90.5%, while the lowest average score was in the "analysis" indicator with an average of 70.01%. As a recommendation from this research, it is suggested to maximize the use of innovative teaching materials during lessons to train students' critical thinking abilities, especially in the indicators that are considered less proficient.

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Author Contributions

The main author, Musdalifah, contributed to designing the ebook and conducting research and writing articles. The second author, Asri Widowati, contributed help and guidance during the research. The third author, Suyanta, contributed to guiding the research and writing the article. The fourth and fifth authors, Sabar Nurohman and Sri Rejeki, took part in guiding the writing of the article until completion. All authors have approved the version of the manuscript to be published.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper

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