



Improvement of Critical Attitude after Using Worksheet Web Based on Socio-Scientific Issues (SSI)

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Abstract

Critical attitude is an important 21st-century competency that supports analytical and decision-making skills. Observations show that students are still passive in learning, such as being reluctant to ask and answer questions, indicating that critical attitude is still low. This study aims to determine the effectiveness of improving critical attitude using worksheets web-based Socio-Scientific Issues (SSI) that have been developed previously on environmental pollution. The research method uses a quantitative approach using a one-group pretest and posttest experimental design. The study was conducted on eighth-grade junior high school students on environmental pollution material. The study was conducted at SMP 1 Suruh Trenggalek. The data analysis technique used was the N-gain test. The critical attitude instrument includes four indicators: truth-seeking, open-mindedness, confidence in reasoning, and cognitive maturity. The results showed an n-gain value of 0.32 (moderate category). The highest sub-indicator was cognitive maturity, while confidence in reasoning was the lowest. These findings prove that the use of worksheets web-based SSI-based is effective in improving students' critical attitude, although optimization is needed in the confidence in reasoning aspect.

Abstrak

Sikap kritis merupakan kompetensi penting abad ke-21 yang mendukung kemampuan analitis dan pengambilan keputusan. Hasil observasi menunjukkan peserta didik masih pasif dalam pembelajaran, seperti enggan bertanya dan menjawab, menunjukkan bahwa sikap kritis belum masih rendah. Penelitian ini bertujuan untuk mengetahui efektivitas peningkatan sikap kritis dari media Lembar Kerja Peserta Didik Berbasis Socio-Scientific Issues (SSI) berbantuan web yang telah dikembangkan sebelumnya pada materi pencemaran lingkungan. Metode penelitian menggunakan pendekatan kuantitatif dengan menggunakan one-group pretest and posttest experimental design.



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Penelitian dilakukan pada peserta didik SMP kelas VIII pada materi pencemaran lingkungan. Penelitian dilakukan di SMP 1 Suruh Trenggalek. Teknik analisis data yang digunakan adalah uji N-gain. Instrumen sikap kritis mencakup empat indikator: truth-seeking, open-mindedness, confidence in reasoning, dan cognitive maturity. Hasil penelitian menunjukkan nilai n-gain sikap kritis sebesar 0,32 (kategori sedang). Sub indikator tertinggi adalah cognitive maturity, sedangkan confidence in reasoning terendah. Temuan ini membuktikan bahwa penggunaan LKPD berbasis SSI berbantuan web efektif dalam meningkatkan sikap kritis peserta didik, meskipun perlu optimalisasi pada aspek confidence in reasoning.

Introduction

Critical attitude plays a crucial role in 21st-century education, as it fosters analytical thinking and decision-making skills. Both are crucial in students' daily lives. In addition to 21st-century education, education in Indonesia also emphasizes the development of attitudes, skills, and knowledge. Critical attitude is a key component in developing the critical attitude skills required for 21st-century education (Safitri & Syahfitri, 2023).

Critical attitude is characterized by students' ability to understand abstract concepts and their self-confidence in the learning process (Hong et al., 2021). Students with self-confidence are more likely to ask questions and take initiative in class. However, observations by researchers indicate that some students are reluctant to ask questions and answer questions during the learning process. This suggests that some students remain passive during the learning process. Interviews revealed that teachers tend to use the lecture method in class, resulting in passive learning. Students are considered passive in learning when they focus solely on listening to the teacher without engaging in any activities (Mamombe & Mathabathe, 2024). Students who are not yet actively asking questions and expressing opinions demonstrate low critical attitude (Rahmawati, 2012).

Observations revealed low critical attitude skills, which are evident when students express opinions without supporting scientific evidence. Rahmawati's research explains that providing appropriate and logical reasons accompanied by evidence is an indicator for assessing critical attitude (Rahmawati, 2012). Critical attitude is characterized by critical interactions among students. A lack of critical interaction hinders students from developing analytical thinking skills and problem-solving abilities (Umroh et al., 2025). Characteristics of someone with critical attitude include the ability to receive information, utilize current and past memories, apply logic and reason, review data in an orderly manner, and make clear and creative decisions. While someone who is not critical is generally characterized by closed-minded thinking, which includes adhering strictly to existing points of view while ignoring new evidence, excessive interest in a new idea with

the mistaken belief that all opinions are valid, and slow thinking, which is a failure to analyze ideas thoroughly (Novianti, 2020).

Critical attitude plays a crucial role in shaping students' futures (Bravo et al., 2020). This attitude is necessary to improve critical thinking (CT), a key element in decision-making in an information-rich society. Furthermore, critical attitude contributes to developing students' ability to analyze and evaluate controversial issues in the social, scientific, and technological fields (Gul & Akcay, 2020), as critical thinking encompasses a combination of cognitive skills and critical attitude.

Students need a critical attitude in their daily lives. A critical attitude is essential for dealing with various everyday problems, such as countering fake news or hate speech on social media (Redhana & Wahyuni, 2021). This ability requires awareness and enthusiasm in addressing problems, because if ignored, they can harm individuals and threaten the progress of a nation. The quality of human resources determines a nation's progress, and one of the main indicators of this quality is a critical attitude. A critical attitude cannot be developed if education does not teach critical thinking (Shaughnessy, 1985). Therefore, a critical attitude cannot be separated from critical thinking skills. Teachers need to teach critical attitude methods to strengthen a critical spirit that encourages students to develop the skills, habits, and character necessary for developing a critical spirit.

Students need to develop a critical attitude in addressing problems in their daily lives, for example, environmental pollution. Environmental pollution is seen as an issue relevant to everyday life. Environmental pollution requires student involvement in developing a critical attitude through problem analysis, discussion, debate, and problem-solving. Environmental pollution requires the application of the Socio-Scientific Issues (SSI) approach because this issue is directly related to problems that occur in everyday life (Eş & Öztürk, 2021).

Critical thinking regarding environmental pollution can be developed using the SSI approach. Environmental pollution material falls within the SSI context because it relates to emerging scientific issues in society, thus requiring student involvement in exploring the problem in greater depth through discussion, debate, and problem-solving, enabling them to analyze an issue critically (Anggraini et al., 2020). SSI can be integrated into learning to foster critical thinking and support the development of 21st-century educational skills (Liu & Tu, 2024). SSI is interdisciplinary or cross-cultural, requiring individuals to gather and analyze a problem from a variety of information. SSI are complex and controversial issues that involve both scientific and social dimensions. SSI can be used to foster critical attitude (Nahdiyati et al., 2025).

In addition to the SSI approach, critical attitude can also be developed with the help of learning media. One form of learning media is student worksheet. Worksheet with SSI

can be used to improve students' critical attitude (Nahdiyati et al., 2025). Although many studies have integrated the SSI approach into worksheet to improve critical attitudes, there is still a lack of research examining the role of worksheets web-based Socio-Scientific-Issues (SSI) in improving critical attitudes. Therefore, this study aims to determine the effectiveness of improving critical attitudes of junior high school students after using worksheets web-based Socio-Scientific-Issues (SSI) for environmental pollution material.

Method

This study employed a quantitative approach with a one-group pretest and posttest experimental design. The aim of this study was to determine improving critical attitude after of using worksheets web-based Socio-Scientific-Issues (SSI) on environmental pollution. The subjects were 32 eighth-grade junior high school students at SMP 1 Suruh, Trenggalek.

To determine to know improving critical attitude after using worksheet web-based Socio-Scientific-Issues (SSI) in among junior high school students, the researchers used observation techniques. The critical attitude observation instrument was developed based on four main indicators: truth-seeking, open-mindedness, confidence in reasoning, and cognitive maturity.

Observations were conducted before and after learning with the worksheet web-based SSI on environmental pollution. The data obtained were then analyzed using the N-gain test. The standard gain was calculated using the following formula:

$$g = \frac{\text{post} - \text{pre}}{100 - \text{pre}}$$

Keterangan:

g = average normalized gain score

pre = average percentage of students' posttest scores

post = average percentage of students' pretest scores

The average gain scores are categorized in Table 1.

Table 1. Gain Score Categories

Nilai	Kategori
$g \geq 0,7$	High
$0,7 > g \geq 0,3$	Medium
$g < 0,3$	Low

(Hake, 1998)

The data in the form of scores on critical attitudes were then analyzed using standard gains (Hake, 1998) which aimed to determine whether there was an increase in critical attitudes in students after using worksheet web-based SSI.

Result and Discussion

The results of the research on critical attitudes before and after the use of worksheets web-based SSI are integrated in the table below.

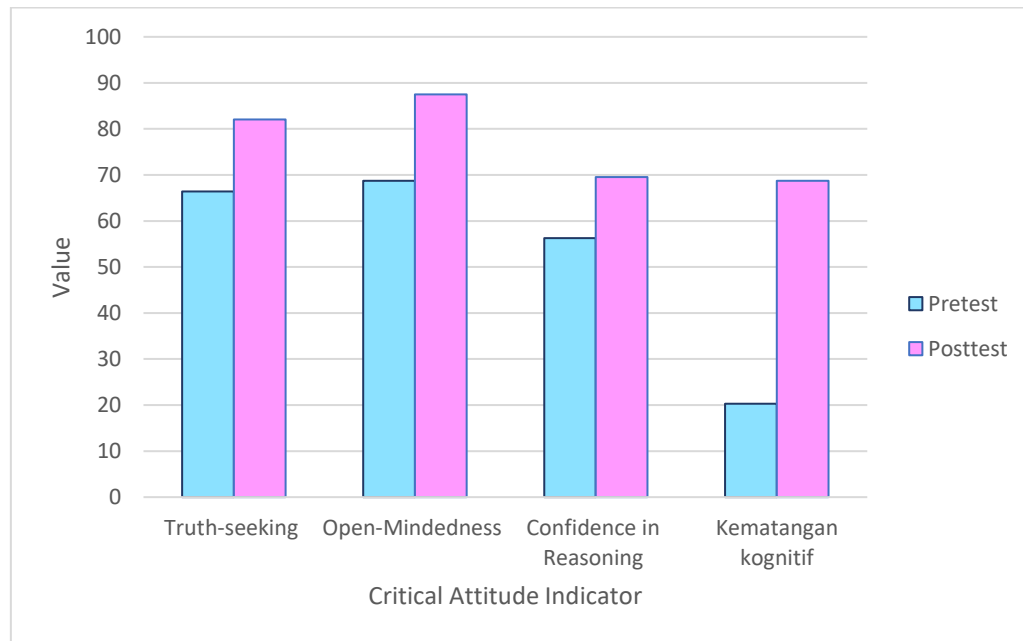


Figure 1. Graph of Pretest and Posttest Critical Attitude Values

From the bar graph above, it is known that posttest scores increased across all critical attitude indicators. A significant increase was found in the cognitive maturity indicator. High cognitive maturity indicates that students are open-minded and able to consider various perspectives, and they are open-minded about a problem (Rabago & Muegna, 2025). The second-ranked indicator of improvement in critical attitude is open-mindedness. High open-mindedness indicates that students are interested in different perspectives, they value feedback, and encourage collaborative learning (Rabago & Muegna, 2025). The third-ranked indicator of improvement in critical attitude is truth-seeking. The search for truth aligns with students' conditions where they are cognitively challenged in critical thinking skills, which impacts student performance and participation in learning, as well as student academic achievement (Rabago & Muegna, 2025). A high level of truth-seeking indicates a high level of critical attitude (Rabago & Muegna, 2025). Meanwhile, the confidence in reasoning indicator increased less significantly. Confidence is a tool to facilitate effective problem-solving and decision-making (PS et al., 2023).

From the pretest and posttest results, an n-gain test was conducted. The results of the n-gain test are shown in Table 2.

Table 2. Results of Students' Critical Attitudes

Indicator	Pretest	Posttest	N-Gain	Category
<i>Truth-seeking</i>	66,41	82,03	0,47	Medium
Open-Mindedness	68,75	87,5	0,6	Medium
Confidence in Reasoning	56,25	69,53	0,3	Medium
Cognitive maturity	20,31	68,75	0,61	Medium
Average	34,41	57,36	0,32	Medium

The results showed that the highest gain score was found in the cognitive maturity indicator. The lowest gain score was found in the confidence in reasoning indicator. The low confidence in reasoning result contradicts research (Kabeel & Eisa, 2016). Low confidence in reasoning results result from students accepting others' opinions without question, even if they differ from their own. In fact, confidence is a tool to facilitate problem-solving and effective decision-making (PS et al., 2023). Meanwhile, the highest gain score was found in the cognitive maturity sub-indicator. This low cognitive maturity aligns with the findings of (Meherali et al., 2015), which showed that students did not reevaluate new information received.

The overall gain score was 0.32, categorized as moderate. These analysis results indicate that the use of worksheets web-based SSI is effective in improving students' critical attitude. However, these results are still lower than the research by Huda et al., where the effectiveness of the E-worksheet product in improving critical thinking skills was categorized as moderately effective, the N-Gain percentage (%) was 63.47 (Huda et al., 2025). The effectiveness test calculation using the N-Gain score distribution yielded a value of 0.63, categorized as moderate. Critical thinking skills are inseparable from critical attitude. Shaughnessy in his summary explains that critical thinking is one of the domains of critical thinking and must be developed and explored (Shaughnessy, 1985).

The research results indicate that critical attitude can be enhanced by using worksheets web-based SSI. The use of worksheet based SSI supported by web technology plays a crucial role in educational institutions, as the web serves as the primary medium for facilitating information retrieval for students (Ismail & Kuppusamy, 2019). Furthermore, the web offers high flexibility of use, allowing it to be accessed anytime and anywhere (Arkorful & Abaidoo, 2014).

This is in line with research that electronically assisted student worksheets as an innovative learning method are believed to be effective in changing student attitudes (Alifriilia & Wisanti, 2024). Worksheet has been proven effective in improving students' critical attitudes (Khusnah, 2016), while SSI can also be used as a method to develop these

critical attitudes (Ekborg et al., 2012). SSI with PjBL can encourage students to acquire critical attitude and scientific thinking skills (Nahdiyati et al., 2025). The important role of critical attitudes is used to support students in seeking information, evaluating evidence, and solving existing problems (Liu et al., 2026). Critical attitudes can play a role in student attitudes and habits to motivate critical thinking. Critical attitudes are curiosity, broad knowledge, self-confidence in abilities, open-mindedness, and a willingness to reconsider a view. Critical attitude is a consistent internal motivation that supports individuals in engaging in problem solving and decision making that require critical thinking skills (PS et al., 2023).

Conclusion

The results of this study indicate that the use of worksheet web-based SSI-based effectively improves junior high school students' critical attitude on environmental pollution. This is evident from the n-gain value of 0.32 (moderate category). The critical attitude sub-indicator with the highest development was cognitive maturity, while the confidence in reasoning indicator remained the lowest. These results indicate that worksheets web-based SSI are effective in fostering analytical and evaluation skills, although the aspect of confidence in reasoning requires further attention.

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