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SSI-Based WebQuest: Instructional Media for Improving Critical Thinking Skills of Alpha Generation in Science

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Abstract: Critical thinking is essential for today's students (Alpha Generation) due to rapid technology and globalization. It means thinking logically and making wise decisions. This research aimed to create an SSI-based WebQuest to improve critical thinking in elementary science students. This tool was designed using the ADDIE model and tested on 20 Grade V students at an international Christian school in West Surabaya during the second semester of 2023/2024. The research design used a one-group pretest-post-test approach. Data were collected through multiple methods, including validation, observation, a critical thinking skills test, and a questionnaire. The data were analyzed using descriptive and quantitative methods. Students' critical thinking skills were examined by n-gain and nonparametric tests. The results showed that (1) the developed media was classified as very valid, (2) learning activities were carried out very well, (3) students' critical thinking skills increased with an average n-gain value of 0.70 (high category), and (4) students' response to the learning that was carried out was classified as good with a percentage of 81%. The developed science learning materials are valid, practical, and effective in improving critical thinking among young students (Generation Alpha). This study highlights the value of using real-world socio-scientific issues in science education to help students understand the links between science, technology, and society. The findings offer a basis for future research on creating effective learning tools to enhance critical thinking across subjects and can inform teacher training in designing and using WebQuest-based materials centered on these real-world issues.

Keywords: alpha generation, critical thinking skills, science learning, socio-scientific issues, WebQuest

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INTRODUCTION

The 21st century is characterized by rapid technological advancements and a more globalized economy, and critical thinking has emerged as a highly relevant and indispensable skill for students (Chen et al., 2024; Geng et al., 2024; Santos-Meneses & Drugova, 2023; Solikah et al., 2024). Students employ this skill to solve problems, gather evidence, and evaluate information (Song et al., 2024). Through critical thinking, students can distinguish accurate from inaccurate information (Horn & Veermans, 2019).

Critical thinking is widely recognized as essential for academic success and professional development (Le & Chong, 2024; Lucas, 2019; Van et al., 2022). It is often described as a higher-order cognitive process focusing on an individual's ability to comprehend a problem and devise reasonable solutions (Ennis, 2018; Li et al., 2024). This process is characterized by systematic analysis of information, consideration of multiple perspectives, and application of logical reasoning to make sound

judgments and decisions (Tang et al., 2024; Yusuf et al., 2024). Therefore, to develop a high-quality human capital capable of competing in technological innovation, it is imperative to cultivate the critical thinking skills of the younger generation, enabling them to efficiently seek and evaluate information (Lestari & Sunarso, 2024).

Empirical evidence reveals a significant gap between the importance of critical thinking skills and the academic performance of Indonesian students in science. This is evident in the results of the Program for International Student Assessment (PISA) conducted by the Organization for Economic Cooperation and Development (OECD). PISA is a global evaluation that measures students' skills in reading, mathematics, and science. In the science category, PISA specifically assesses students' scientific literacy, which is demonstrated by their ability to engage directly with scientific issues and ideas. Additionally, students' competence in critiquing phenomena and evaluating, analyzing, and understanding data scientifically is another key indicator evaluated by PISA. Findings from PISA 2022 indicate that the science skills of Indonesian elementary school students are below the OECD average. Indonesian elementary school students achieved a score of only 383, a decrease of 13 points from the PISA 2018 results, while the OECD average was 485 (OECD, 2023). Furthermore, a survey conducted in 2015 by the TIMSS and PIRLS International Study Center revealed that the quality of basic education in Indonesia remains relatively low, particularly in science. Indonesia ranked only 44th out of 47 countries with an average science score of 397 (Rachamatika et al., 2021).

To enhance students' critical thinking skills, teachers should use an effective to organize classroom learning processes appropriately. According to Cahyaningsih & Nahdi (2020), developing suitable instructional media aligned with appropriate learning models is crucial for effective classroom organization. Instructional media play a significant role in the learning process as they can simplify complex or abstract concepts that may be difficult for students to grasp (Djamarah & Zain, 2006).

Elementary school students, predominantly belonging to Generation Alpha (Gen A) born between approximately 2010 and the mid-2020s, are growing up in a rapidly changing world. Gen A is the most technologically savvy generation, with extensive experience in using technology and the Internet. This digital familiarity significantly influences their learning styles and educational preferences. Consequently, learning experiences for Gen A students should incorporate information and communication technologies, as contemporary children often gravitate towards activities involving these technologies (Schwartz et al., 2023; Suryanti et al., 2021). Therefore, this research focuses on WebQuest-based instructional media.

WebQuest is a web-based inquiry-oriented learning medium (Munadzar & Darojat, 2024). This medium effectively engages students in thought patterns essential for the 21st century (Murphy et al., 2020). WebQuests represent an innovative, gadget-based approach centered on student-driven, active learning, whether individual or collaborative, to search, analyze, and synthesize data to construct new and meaningful knowledge (Aslanyan-rad & Ghaderi, 2024).

Implementing WebQuest-based instructional media should be supported by a teaching approach that aligns with the subject matter, learning objectives, and student characteristics. One such approach that can foster and refine students' critical thinking skills is the Socio-Scientific Issues (SSI) Approach (Dusturi et al., 2024; Febriana et al., 2023; Rosyidah & Subekti, 2023; Santika et al., 2018). The SSI approach is a teaching approach that focuses on helping students understand real-world environmental issues. The components embedded in SSI-based learning can support the development of student's critical thinking skills as they grapple with issues relevant to their daily lives.

Integrating WebQuest-based instructional media with the SSI approach is believed to be a promising strategy for enhancing students' critical thinking skills. Modern technology can be a powerful tool for providing access to relevant social issues. Despite the increasing recognition of the importance of SSI-based WebQuests in science education, research on their effectiveness in enhancing the critical thinking skills of elementary school students is still limited. To accommodate SSI-based learning in improving critical thinking skills, the researcher developed a WebQuest-based instructional media as a teaching tool in the classroom. This learning media is expected to develop the critical thinking skills of elementary school students who are the alpha generation. Therefore, developing SSI-based WebQuest media is expected to be a significant step in equipping elementary school students with the critical thinking skills needed to face future challenges.

METHOD

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This development research adopts the ADDIE (analysis, design, develop, implement, evaluate) model. This development model emphasizes investigating how each development stage is interconnected and interacts with one another (Branch, 2009). The product developed in this research is an SSI-based WebQuest media to enhance critical thinking skills. The study was conducted on grade V students of an international Christian elementary school in West Surabaya in their second semester of the 2023/2024 academic year in the science subject.

The feasibility of the developed SSI-based WebQuest media was measured based on validity, practicality, and effectiveness (Plomp, 2013). Validity was measured based on the assessment results of experts, consisting of two material experts and one media expert. Practicality was tested based on observations conducted by two observers regarding the implementation and constraints of the developed instructional media. Effectiveness was evaluated based on the improvement of critical thinking skills and the responses provided by students. The improvement of students' critical thinking skills was based on N-gain analysis. In addition, a t-test was conducted for statistical analysis.

The ratings provided by each expert on the validity of the SSI-based WebQuest media, through the validation sheet, were analyzed using the following equation.

$$P(\%) = \frac{\Sigma F}{N \times R} \times 100\%$$

Description:
P(%) = validity score
ΣF = score obtained
N = total number of scores
R = number of validators

The validity scores obtained from the calculations were then interpreted and categorized based on the validity criteria presented in Table 1.

Table 1. Interpretation of the Validity Assessment

Percentage	Validity Criteria
81% - 100%	Highly Valid
61% - 80%	Valid
41% - 60%	Moderately Valid
21% - 40%	Low Validity
0% - 20%	Invalid

(Karim & Adistana, 2020)

The practicality of the SSI-based WebQuest media, as measured by the ratings provided by each observer on the observation sheet, was analyzed using the following equation.

$$P(\%) = \frac{\Sigma F}{N \times R} \times 100\%$$

Description:
P(%) = practicality score
ΣF = score obtained
N = total number of scores
R = number of observers

The practicality scores obtained from the calculations were then interpreted and categorized based on the practicality criteria presented in Table 2 (Karim & Adistana, 2020).

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Table 2. Interpretation of the Practicality Assessment

Percentage	Practicality Criteria
81% - 100%	Highly Practical
61% - 80%	Practical
41% - 60%	Moderately Practical

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21% - 40%	Less Practicality
0% - 20%	Impractical

The effectiveness of the SSI-based WebQuest media was measured by the improvement in students' critical thinking skills resulting from the media implementation. This was determined based on the results of N-gain analysis using the following equation.

$$g = \frac{\%Posttest - \%Pretest}{100\% - \%Pretest}$$

The results of the N-gain analysis were then categorized based on the criteria for improvement in critical thinking skills as presented in Table 3(Sudiarman et al., 2017).

Table 3. N-Gain Criteria

N-Gain Score	Criteria
0.70 ≤ N-Gain	High
0.30 ≤ N-Gain < 0.70	Medium
N-Gain < 0.30	Low

To strengthen the results of the N-gain analysis, this study also conducted a comparison test between the pretest and post-test scores using statistical tests. This process began by conducting a normality test using the Shapiro-Wilk test. This test is a tool to ensure that the data follows a normal distribution pattern (Sugiyono, 2014). If the data met the normality assumption, the data were then analyzed using a paired t-test. However, if the data did not meet the normality assumption, it was followed up with a nonparametric statistical analysis using the Wilcoxon test. These statistical tests were conducted using IBM SPSS Statistics 24 software.

The effectiveness of the SSI-based WebQuest media was also measured based on the responses provided by students through a response questionnaire. These responses were analyzed using the following equation.

$$P(\%) = \frac{Number\ of\ "yes"\ answer}{Number\ of\ aspect\ observed} \times 100\%$$

The calculated results were then mapped onto the interpretive criteria shown in Table 4 (Karim & Adistana, 2020).

Table 4. Interpretation of the Effectiveness Assessment

Percentage	Effectiveness Criteria
81% - 100%	Very Good
73% - 80%	Good
72%	Satisfactory
40% - 71%	Fair
0% - 39%	Poor

RESULT AND DISCUSSION

SSI-based WebQuest media presents an innovative approach to addressing the critical thinking challenges faced by elementary school students, particularly Generation A, in science learning. The need to enhance this skill is evident, as indicated by interviews conducted by the researcher with several science teachers who reported a deficiency in students' critical thinking abilities. This finding is attributed to the tendency of tech-savvy students to seek immediate answers from the Internet, often neglecting the perseverance and inclination to analyze questions and responses in greater depth. This observation aligns with previous research that has established a strong correlation between critical thinking and information literacy (Al-Zoubi, 2021; Goodsett, 2020; Phippen et al., 2021). Such skills are essential for students to navigate the challenges posed by disinformation (Marcos-Vílchez et al., 2024).

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The researcher developed the SSI-based WebQuest media for the topics of waste and pollution. The learning objectives for these topics were aligned with the Cambridge curriculum, which is used in the research school. The selected SSIs were contextualized to the students' characteristics and environment. Two SSI topics were chosen: plastic and paper waste, and food waste (see Figure 1).

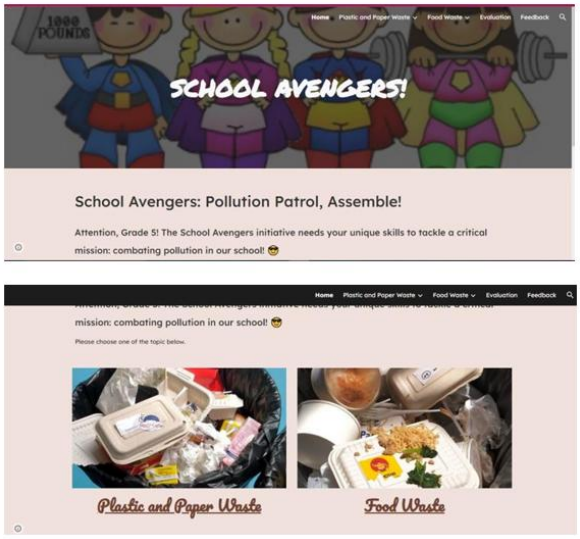

Figure 1. SSI Topics in the Initial Display of SSI-Based WebQuest Media

On the main page of the "Plastic and Paper Waste" module, students are presented with images of school canteen trash bins filled with plastic and paper waste. The images are displayed in a carousel format, allowing students to view multiple pictures by swiping the screen. Figure 2 illustrates the appearance of the "Plastic and Paper Waste" page.

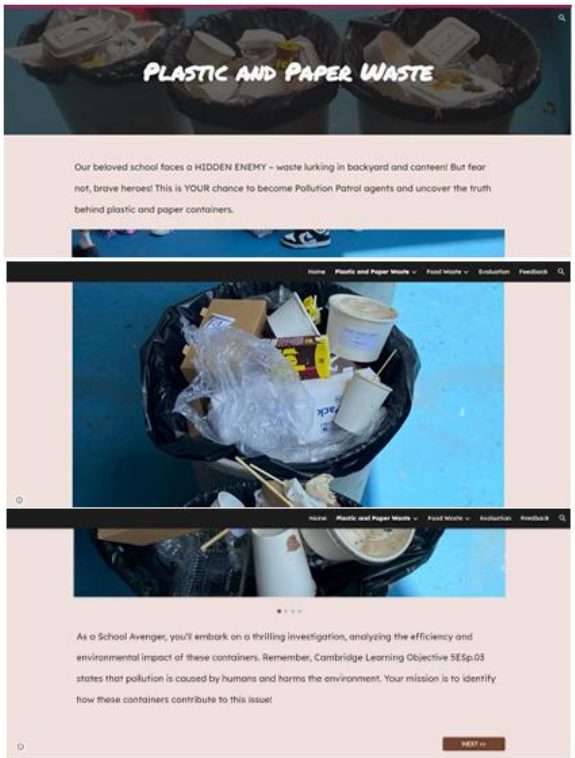

Figure 2. Plastic and Paper Waste Main Page

Subsequently, from the main page of each topic, students are directed to the task page. The task page for the "Plastic and Paper Waste" topic outlines the final task for the module, which is a group debate. Figure 3 presents the appearance of this task page.

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Figure 3. Plastic and Paper Waste Task Page

The subsequent page in the SSI-based WebQuest media is the process page. This page presents a detailed breakdown of the steps involved, along with guiding questions to assist students in completing the final task (group debate). The process page also includes links to relevant websites that students can utilize as supporting materials for their group arguments. Figure 4 illustrates the appearance of the process page for the "Plastic and Paper Waste" topic.

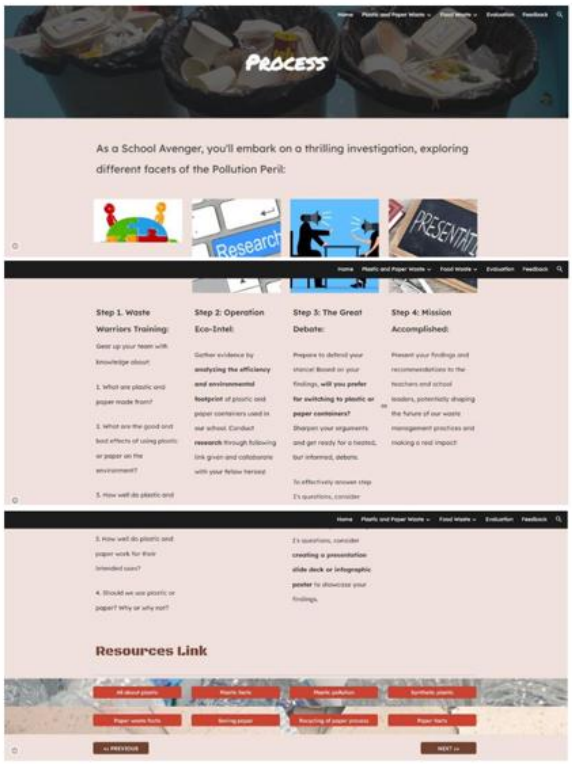

Figure 4. Plastic and Paper Waste Process Page

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The subsequent page within the developed learning media is the conclusion page. This page provides a concise recapitulation of the learned material. Additionally, a button is included to direct students to complete a reflection sheet (via Google Forms). Figure 5 presents the appearance of the conclusion page for the "Plastic and Paper Waste" topic.

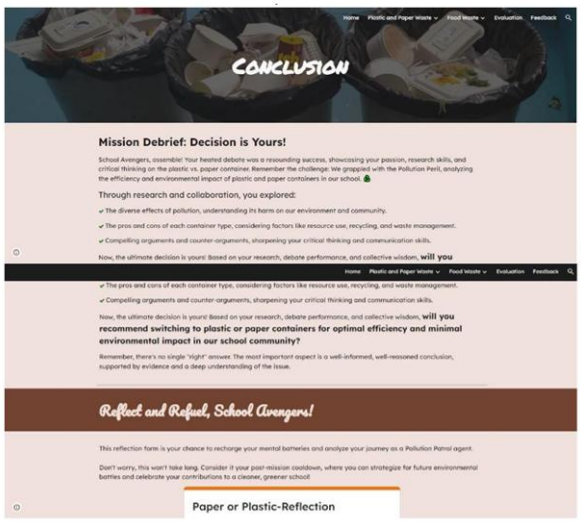

Figure 5. Plastic and Paper Waste Conclusion Page

Upon completion of the learning processes within each topic embedded in the SSI-based WebQuest media, students are directed to the evaluation page. On this page, a button guides students to complete a critical thinking skills assessment (via Google Forms). The appearance of the evaluation page is presented in Figure 6.

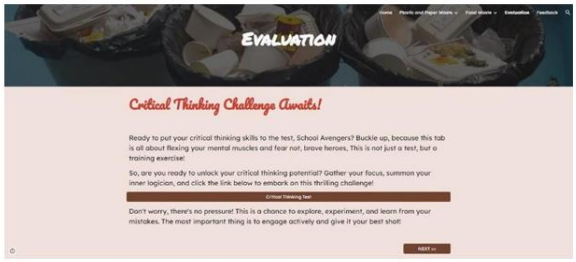

Figure 6. Evaluation Page in SSI-Based WebQuest Media

The final page of the SSI-based WebQuest media is the feedback page. A button on this page directs students to complete a student response questionnaire (via Google Forms). The appearance of this final page is presented in Figure 7.

Figure 7. Feedback Page in SSI-Based WebQuest Media

Subsequently, the developed SSI-based WebQuest media was evaluated for its validity. The validity was measured based on six main aspects: design, content, language, WebQuest components, SSI characteristics, and coverage of critical thinking skills indicators. The validity data of the learning media are presented in Table 5.

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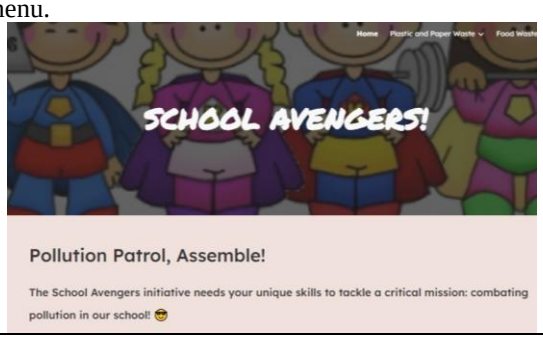
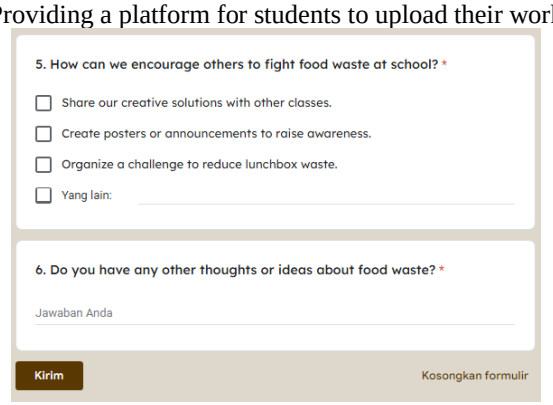
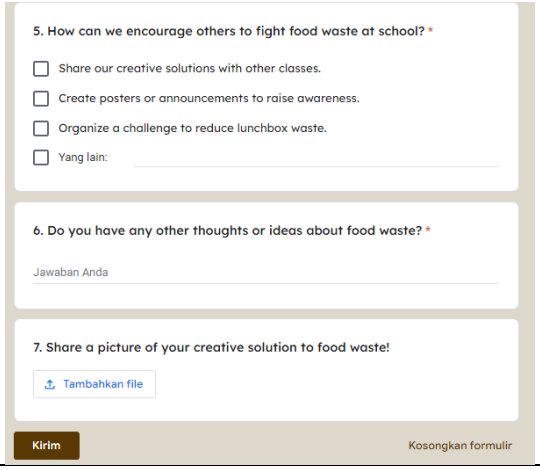
Table 5. SSI-Based WebQuest Media Validity

Aspect	Score	Criteria
Design	83.33%	Highly Valid
Content	100.00%	Highly Valid
Language	100.00%	Highly Valid
WebQuest Component	100.00%	Highly Valid
SSI Characteristics	100.00%	Highly Valid
Critical Thinking Indicators	100.00%	Highly Valid
Total Score	**97.22%**	**Highly Valid**

Overall, the validity of the developed learning media falls into the highly valid category. Each aspect of the learning media received a significant score from each validator. This indicates that the learning media has met the criteria as a good learning media and it can be implemented to improve students' critical thinking skills. However, design was the aspect that received the lowest score. The design of a learning medium is one of the important aspects that can attract students' interest and attention to the learning medium (Rosiyanti et al., 2020). Therefore, improvements were made to the design of the developed learning media based on the suggestions given by the validators.

In addition to making improvements to the design aspect, the researcher also made improvements in several areas. These improvements were also based on the suggestions given by each validator. The suggestions provided by the validators and the improvements made can be seen in Table 6.

Table 6. Validators' Suggestions and Improvements Made to the SSI-Based WebQuest Media

Suggestions	Improvements
Specify the target class (e.g., Grade 5) on the main menu. 	Designate the target class in the opening remark. ("Attention Grade 5!") 
Providing a platform for students to upload their work 	Including instructions in the Google Form reflection section to upload photos or videos of the completed work 

The validated instructional media was piloted in a fifth-grade class at an international Christian elementary school in West Surabaya from April to May 2024. The pilot study involved six learning sessions. During this pilot phase, the practicality of the developed instructional media was measured.

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This evaluation was based on observations of the implementation and identified challenges during the trial of the instructional media.

Two observers were present during the six learning sessions to monitor the implementation of the developed instructional media. Using a previously validated observation checklist, these observers assessed the practicality of the instructional media. The results of the practicality assessment by both observers are presented in Table 7.

Table 7. SSI-based WebQuest Media Practicality

Learning Sessions	Practicality Score	Criteria
1	94%	Highly Practical
2	96%	Highly Practical
3	92%	Highly Practical
4	95%	Highly Practical
5	96%	Highly Practical
6	94%	Highly Practical

The data presented in Table 7 indicate that the implementation of SSI-based WebQuest learning was practical, and teachers could carry out all learning activities very well. According to Reigeluth (1999), instructional media is considered applicable if it is easy for teachers and students to use, is time and cost-effective, and is easily accessible. The use of the developed instructional media proved to be practical and able to support the achievement of optimal learning processes.

After undergoing a series of validity and practicality tests, the effectiveness of the developed SSI-based WebQuest in improving the critical thinking skills of elementary school students in science was tested. The effectiveness of the instructional media was measured using pretest and post-test scores of critical thinking skills given to 20 students. The scores obtained from these tests were used as a basis for determining the improvement in students' critical thinking skills as a result of the implementation of the SSI-based WebQuest. This improvement was based on the results of the N-Gain analysis. The pre-test, post-test, and N-Gain scores of the students are presented in Table 8.

Table 8. Pretest, Post-test, and N-Gain Score

No.	Pretest	Mastery	Post-test	Mastery	N-Gain	N-Gain Criteria
1.	52	Not pass	96	Pass	0.92	High
2.	52	Not pass	92	Pass	0.83	High
3.	72	Pass	92	Pass	0.71	High
4.	52	Not pass	89	Pass	0.77	High
5.	68	Not pass	89	Pass	0.66	Medium
6.	68	Not pass	89	Pass	0.66	Medium
7.	56	Not pass	85	Pass	0.66	Medium
8.	68	Not pass	89	Pass	0.66	Medium
9.	56	Not pass	85	Pass	0.66	Medium
10.	52	Not pass	77	Pass	0.52	Medium
11.	56	Not pass	89	Pass	0.75	High
12.	84	Pass	96	Pass	0.75	High
13.	68	Not pass	89	Pass	0.66	Medium
14.	56	Not pass	89	Pass	0.75	High
15.	64	Not pass	89	Pass	0.69	Medium
16.	48	Not pass	85	Pass	0.71	High
17.	56	Not pass	89	Pass	0.75	High
18.	64	Not pass	89	Pass	0.69	Medium
19.	48	Not pass	77	Pass	0.56	Medium
20.	60	Not pass	89	Pass	0.72	High
Mean	**60**	**Not pass**	**88.2**	**Pass**	**0.70**	**High**

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The data presented in Table 8 indicate that the implementation of the SSI-based WebQuest in learning activities enabled students to achieve critical thinking skills that were, on average, above the school's minimum mastery criteria of ≥ 72. Furthermore, the N-gain analysis showed that 10 out of 20 students experienced a moderate increase in critical thinking skills (0.30 ≤ N-Gain ≤ 0.70), while the remaining 10 students demonstrated a high increase (0.70 < N-Gain). These findings align with previous research that has shown that the use of technology in the learning process can enhance students' critical thinking skills (Ilfiana et al., 2021; Wardani et al., 2024; Yusri et al., 2023). More specifically, web-based learning has proven to be a catalyst for students to improve their critical thinking skills (Bilik et al., 2020; Salleh et al., 2012). Additionally, the use of an SSI context in the developed instructional media has also been shown to contribute significantly to the improvement of students' critical thinking skills. Through SSI-based learning, students can practice higher-order thinking processes and develop skills in information gathering and understanding of the issues being studied, which will impact their critical thinking (Rasyih et al., 2024).

In addition to the N-gain analysis, a statistical test was also conducted in this study. This began with the Shapiro-Wilk normality test. The results of the normality test are presented in Table 9.

Table 9. The Results of the Normality Test

Test of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statisic	df	Sig.
Pretest	0.214	20	0.017	0.912	20	0.069
Post-test	0.235	20	0.005	0.895	20	0.034

a. Liliefors Significance Correction

The data in Table 9 shows that the significance value for the pretest is 0.069, meaning that the null hypothesis (H_0) is accepted and the data is normally distributed. However, the significance value for the post-test is 0.034, indicating that H_0 is rejected and the data is not normally distributed. Based on the results of the normality test, the researcher continued with nonparametric analysis to test whether there was a significant difference between the means of the two paired samples. The results of the nonparametric analysis using the Wilcoxon Signed-Rank test are presented in Table 10.

Table 10. Wilcoxon Signed-Rank Results

Ranks				
		N	Mean Rank	Sum of Ranks
Post-test - Pretest	Negative Ranks	0[a]	0.00	0.00
	Positive Ranks	20[b]	10.50	210.00
	Ties	0[c]		
	Total	20		

a. Post-test < Pretest
b. Post-test > Pretest
c. Post-test = Pretest

The interpretation of the Wilcoxon Signed-Rank Test results indicates that there were no negative ranks between the pretest and post-test scores, as evidenced by the values of N, Mean Rank, and Sum of Ranks being 0. This means that no students experienced a decrease in scores from the pretest to the post-test. Furthermore, the positive rank between the pretest and post-test scores showed a value of 20. indicating that 20 students experienced an increase in scores from the pretest to the post-test. The average score increase was 10.50, and the total increase was 210. Additionally, there were no ties (identical scores) between the pretest and post-test results, meaning that no students had the same score on both tests.

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Further analysis was conducted by conducting a hypothesis test on the SPSS output. The null hypothesis (H_0) is rejected if the p-value is less than the significance level of 0.05. The output generated by the SPSS Wilcoxon Signed-Rank Test is presented in Table 11.

The results of the hypothesis test, as presented in Table 11, show that the significance value (Sig.) is < 0.001. Therefore, the null hypothesis (H_0) is rejected. This indicates that there is a significant difference in learning outcomes between the pretest and post-test after the implementation of the developed instructional media.

Table 11. Wilcoxon Signed-Rank Results

Test Statistics[a]	
	Post-test -Pretest
Z	-3.929[b]
Asymp. Sig. (2-tailed)	< 0.001

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks

The significant difference between the pretest and post-test scores indicates that the implementation of SSI-based WebQuest has a positive impact on student's critical thinking skills. The utilization of web-based instructional media can support the smooth process of science learning in elementary schools, especially in developing 4C skills, one of which is critical thinking (Jannah & Atmojo, 2022). This instructional media is interesting to use because it is easily accessible, attracts students' learning interest, facilitates understanding of the material, and uses language that is easy to understand based on students' thinking levels (Putri et al., 2021; Sevtia et al., 2022). Ultimately, this has a positive impact on the achievement of learning objectives, which in this study is the improvement of students' critical thinking skills.

The significant difference in the pretest and post-test scores is due to the effect of SSI as a learning topic facilitated in the WebQuest media. This is because SSI is not only related to science but is also aimed at stimulating intellectual, ethical, and moral development as well as awareness of the relationship between science and social life (Utomo et al., 2020). SSI guides students to think in the process of problem-solving and decision-making, which can train students to learn comprehensively (Sholehah et al., 2023). SSI has a positive impact on student's development, and through active participation in small groups and engaging in independent inquiry activities, students can develop critical thinking skills, evaluation of scientific information, and involvement in the decision-making process related to these issues (Yuniswara et al., 2024).

The improvement of students' critical thinking skills as an impact of the implementation of SSI-based WebQuest media is in line with the improvement of each indicator of these skills. In this study, there are five indicators of critical thinking skills that are measured, namely inference, assumption, deduction, interpretation, and argument evaluation. The scores for each indicator, both in the pre-test and post-test and their improvements (N-Gain scores), are presented in Table 12.

Table 12. Results of N-Gain Analysis on Each Critical Thinking Skills Indicator

Indicators	**Pre-test**	**Criteria**	**Post-test**	**Criteria**	**Skor N-Gain**	**Criteria**
Inference	69%	Not good	90%	Very good	0.68	Medium
Assumptions	52%	Not good	99%	Very good	0.98	High
Deduction	58%	Not good	99%	Very good	0.98	High
Interpretation	58%	Not good	78%	Good	0.48	Medium
Argument Evaluation	63%	Not good	71%	Not good	0.22	Low

The implementation of SSI-based WebQuest media has been proven to improve inference indicators with a moderate improvement category. Inference in the context of critical thinking is the process of drawing conclusions or interpretations based on available information or data (Rahmawati et al., 2021). This indicator is built based on accuracy in identifying and explaining the background of the problems presented (Nurhasanah et al., 2024). The implementation of SSI-based WebQuest not only effectively improves students' inference skills but also significantly contributes to their understanding

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of the context of the problems faced. This shows the great potential of this learning media in improving the quality of education.

Assumptions and deductions are indicators of critical thinking skills that have increased in the moderate category after the implementation of SSI-based WebQuest media. Assumptions in the context of critical thinking refer to beliefs or views held by someone without direct evidence, which are the basis for reasoning or decisions. This is one of the important indicators of critical thinking (Facione, 2011; Halpern, 1998). On the other hand, deduction in the context of critical thinking is the process of concluding based on existing premises, where the conclusions logically follow from the premises (Copi & Cohen, 2009). The high achievement of students in both indicators indicates that SSI-based WebQuest media has succeeded in providing significant encouragement in honing students' critical thinking skills. This emphasizes the importance of innovative learning media in facilitating the development of students' analytical and reflective abilities.

After students participated in learning with SSI-based WebQuest media, their interpretation skills increased to a moderate category. Interpretation is a reasoning process that involves analyzing and understanding information or data to provide meaning. In critical thinking, interpretation allows individuals to identify and evaluate arguments and understand the context behind the information (Paul & Elder, 2019). This shows that, when students are faced with a problem at the beginning, they must think critically, starting by interpreting the right information to solve the problem (Herlita et al., 2023). This improvement in interpretation skills shows that SSI-based WebQuest media is effective in encouraging students to be more active in analyzing information. This approach not only enriches students' understanding but also prepares them to face critical thinking challenges in the real world.

Argument evaluation is the only indicator of critical thinking that has a low increase in this study. Argument evaluation is a critical process to assess and analyze the arguments presented, considering the strengths and weaknesses of the premises and conclusions and the reliability of the evidence that supports them (Paul & Elder, 2019). This indicator has been considered a key component in critical thinking (Chen et al., 2024; Lytzerinou & Iordanou, 2020; Yilmaz-Na & Sönmez, 2023), is not easy to learn, and is valued in many fields (Orbach et al., 2019). The students' low achievement in evaluating arguments is in line with the results of previous studies which state that students have not been trained in critical thinking as evidenced by the difficulty in providing reasonable answers, not having alternative opinions other than books, not providing arguments accompanied by facts, and not having appropriate ability to evaluate a statement (Rahmawati et al., 2021). This finding indicates that SSI-based WebQuest media still needs to be improved in terms of developing students' argument evaluation skills. Therefore, adjustments in teaching methods and more focused exercises may be needed to help students overcome these challenges and improve their overall critical thinking skills.

In addition to the critical thinking skills test, in the form of both pretest and post-test, student response questionnaires were also used to evaluate the effectiveness of the developed instructional media. Student responses were measured using a questionnaire distributed through Google Forms. The questionnaire was designed to measure students' perceptions of the learning experience with SSI-based WebQuest media. They were asked to answer 18 yes-no questions. Table 13 presents the findings of the analysis of student responses to learning with the developed instructional media.

Table 13. Analysis of Student Response Questionnaire Data

Aspect	Average Percentage of "yes" Answers	Criteria
Content	78%	Good
Design	77%	Good
Language	87%	Very Good
Effectivity	81%	Very Good

The results of the analysis, as presented in Table 12, indicate that the highest percentage is in the language aspect, where the language used in the WebQuest media is very easy to understand. This significantly affects the effectiveness of the media. Aligned with Vygotsky's constructivist theory of the Zone of Proximal Development (ZPD), the ZPD refers to the gap between an individual's actual developmental level, where they can complete tasks independently, and their potential developmental level, where they can complete tasks with the assistance of a more knowledgeable other (Santrock, 2011).

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In the context of SSI-based WebQuests, easily comprehensible language can function as a scaffold, providing a structure or support that assists students within their Zone of Proximal Development (ZPD). When students encounter complex information presented in convoluted language, they may exceed their ZPD and struggle to complete tasks independently. However, by employing clear and simple language, SSI-based WebQuests can facilitate the comprehension of information and the completion of tasks, even when students lack the requisite knowledge and skills. This allows students to learn and progress beyond their current capabilities. Consequently, a significant proportion of students responded very positively to the effectiveness of the instructional media. Students who engaged with easily understandable language perceived their learning to be efficacious.

CONCLUSION

Based on the data analysis, discussion of results, and research findings, it can be concluded that the developed SSI-based WebQuest media to enhance critical thinking skills is deemed suitable. The developed SSI-based WebQuest instructional media is valid based on the assessment of three validators (media experts and subject matter experts), practical based on the results of classroom observation, and effective with an N-Gain score of 0.70, which is categorized as high. The students respond positively to the developed media after they use it in learning. The SSI-based WebQuest media can be a breakthrough in improving the critical thinking skills of elementary school students, especially Alpha Generation, in science learning.

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