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Implementation of a Socio-Scientific Issues-Based 'Question Shopping' Student Worksheet to Foster Junior High School Students' Engagement and Critical Thinking in Science Learning

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Abstract

The urgency of this research is to implement a socio-scientific issues-based "Question Shopping" student worksheet to enhance students' engagement and critical thinking in science learning. Science learning at the junior high school level still faces problems related to low student engagement and critical thinking skills due to teacher-centered instruction and the continued use of conventional student worksheets. This study aimed to describe the implementation of a Socio-Scientific Issues (SSI)-based 'Question Shopping' Student Worksheet (LKPD), students' engagement, and the tendency of students' critical thinking skills. The study employed a mixed-methods approach with an embedded design, in which qualitative data served as the primary data and quantitative data as supporting evidence. The participants were 25 Grade VIII students at SMP Raudlatul Musthofa. Data were collected through observation, semi-structured interviews, pretest-posttest assessments, and documentation. Qualitative data were analyzed using the Miles, Huberman, and Saldaña model, while quantitative data were analyzed descriptively. The results showed that the SSI-based LKPD was successfully implemented through the Discovery Learning stages, resulting in active, contextual, and student-centered learning. Student engagement increased from 68.7% to 75.0% and 81.2% across three meetings. Critical thinking performance also improved, with the mean score increasing from 58.32 on the pretest to 70.54 on the posttest. SSI-based learning helped students analyze problems, evaluate information, construct arguments, and formulate solutions to environmental issues.

Keywords: *Critical Thinking; Junior High School Science; Student Engagement; 'Question Shopping' Student Worksheet; Socio-Scientific Issues*.

Introduction

Twenty-first-century learning requires students to develop critical thinking, creativity, communication, and collaboration skills as preparation for various life challenges. In line with these demands, Kurikulum Merdeka emphasizes student-centered learning, in which students are expected to participate actively in constructing knowledge through meaningful learning experiences (Rahmawati et al., 2023). In science learning, this approach is particularly important because instruction is not only oriented toward conceptual mastery but also toward the development of scientific thinking and problem-solving skills (Fitria & Purnomo, 2025).

Nevertheless, the implementation of science learning in junior high schools still faces various challenges. Learning remains dominated by lectures and conventional assignments, so students' involvement in discussion, inquiry, and problem solving has not been optimal (Algozi et al., 2025; Putriana, 2020). This condition contributes to students' limited critical thinking

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skills, which are also reflected in the 2022 Programme for International Student Assessment (PISA) results indicating that Indonesian students' scientific literacy and higher-order thinking skills remain relatively low (Nurmaya & Sari, 2024). Critical thinking is an essential competency in science learning because it enables students to analyze information, evaluate evidence, and make rational decisions regarding scientific problems (Tampubolon & Megaline, 2025; Rahmawati et al., 2025).

One approach considered capable of developing these abilities is Socio-Scientific Issues (SSI). SSI integrates scientific concepts with real-world issues that involve social, environmental, economic, and ethical dimensions, thereby encouraging students to engage in analysis, argumentation, and evidence-based decision making (Nida et al., 2024; Vari & Bramastia, 2021). Previous studies have shown that SSI-based learning can enhance scientific literacy, argumentation, decision making, and critical thinking because learning becomes more contextual and relevant to students' everyday lives (Widodo et al., 2020).

The implementation of SSI can be supported through innovatively designed Student Worksheets (LKPD). An LKPD functions not only as a learning resource but also as a medium that facilitates active, collaborative, and problem-oriented learning activities (Putriana, 2020). To optimize its use, the LKPD needs to be combined with learning strategies that increase student engagement. One strategy that can be applied is 'Question Shopping,' an active-learning strategy that allows students to select, discuss, and collaboratively solve questions, thereby encouraging behavioral, cognitive, and social engagement during learning (Udin & Arfanaldy, 2025).

Based on preliminary observations at SMP Raudlatul Musthofa, teachers had already used LKPD in science learning; however, the worksheets were still conventional, with questions dominated by the cognitive levels of understanding (C2) and applying (C3). Learning was also oriented toward individual task completion and did not provide sufficient opportunities for students to analyze, evaluate, or construct arguments about contextual problems. These conditions indicate that learning had not yet fully facilitated the development of student engagement and critical thinking skills.

Previous studies have demonstrated that Socio-Scientific Issues-based LKPD can improve students' critical thinking skills and engagement in science learning (Putriana, 2020; Wahyuni et al., 2024). However, most studies have focused on developing or testing the effectiveness of SSI-based worksheets, while studies examining the implementation of SSI-based LKPD combined with a 'Question Shopping' strategy remain limited. Therefore, the novelty of this study lies in describing the implementation of a Socio-Scientific Issues-based 'Question Shopping' LKPD, student engagement during learning, and the tendency of students' critical thinking skills. This study aimed to describe the implementation of the SSI-based 'Question Shopping' LKPD in junior high school science learning and to portray its contribution to student engagement and critical thinking skills.

Method

This study employed a mixed-methods approach with an embedded design, which integrates qualitative data as the primary source and quantitative data as supporting evidence. This approach was selected to obtain a comprehensive description of the implementation of the Socio-Scientific Issues (SSI)-based 'Question Shopping' LKPD, student engagement during learning, and the tendency of students' critical thinking skills. The study was conducted during the second semester of the 2025/2026 academic year at SMP Raudlatul Musthofa,

Tulungagung Regency. The participants were 25 students from Grade VII-A, while the science teacher served as an informant in the interview activities and as an observer during the learning process.

The research procedure consisted of four stages: (1) preparation, including a preliminary study, preparation of learning materials, development of research instruments, and coordination with the school; (2) instrument testing through expert validation of the LKPD and test instruments, followed by question trials involving students outside the research participants; (3) implementation of the Socio-Scientific Issues-based 'Question Shopping' LKPD over four meetings, beginning with a pretest, followed by learning activities, observation, documentation, interviews, and ending with a posttest; and (4) data analysis and preparation of the research report.

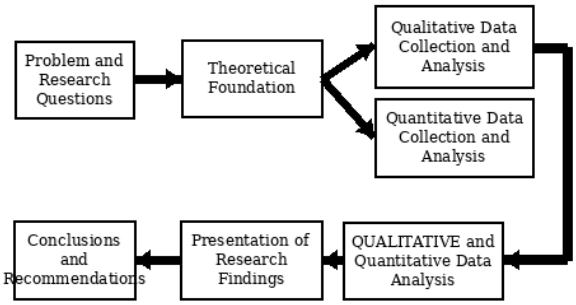


***Figure 1**. Stages of the Qualitative Research Method as the Primary Method and the Quantitative Research Method as the Secondary Method (The Embedded Design).*

The research instruments consisted of the Socio-Scientific Issues-based 'Question Shopping' LKPD as the treatment, a student-engagement observation sheet, a semi-structured interview guide, and a critical-thinking test consisting of 20 multiple-choice questions developed based on critical-thinking indicators and ecosystem content. A summary of the research instruments is presented in Table 1.

***Table 1.** Research Instruments*

Instrument	Purpose	Data Obtained
SSI-Based 'Question Shopping' LKPD	Learning material (treatment)	Learning implementation
Observation sheet	Observe student engagement	Observation data
Interview guide	Explore student responses	Qualitative data
Pretest-posttest	Measure critical thinking skills	Quantitative data

The observation sheet was developed based on indicators of student engagement encompassing behavioral engagement, emotional engagement, and cognitive engagement. These three dimensions were operationalized into observable behaviors during the learning process.

***Table 2.** Blueprint of the Student-Engagement Observation Sheet*

Dimension	Aspect	Indicator
Behavioral Engagement	Asking	Asks questions relevant to the learning material
Behavioral Engagement	Answering	Answers the teacher's questions and responds to peers' opinions
Emotional Engagement	Discussion	Actively participates and expresses opinions in group discussions
Cognitive Engagement	Problem Solving	Actively solves problems in the LKPD and proposes solutions to the issues discussed

The test instrument consisted of 20 Socio-Scientific Issues-based multiple-choice questions developed according to critical-thinking indicators on ecosystem topics. The questions were administered before (pretest) and after (posttest) the learning implementation.

Table 3. *Pretest-Posttest Blueprint*

Topic	Critical Thinking Indicator	Item Number	Cognitive Level
Ecosystem	Analyze relationships among ecosystem components	1,4,10,11	C4
Pollution	Evaluate causes and impacts	2,6,12	C4-C5
Climate Change	Evaluate solutions	5,8	C5
Conservation	Evaluate conservation efforts	13,14	C5
Environmental Management	Determine SSI-based solutions	7,9,15,19	C5-C6

All instruments first underwent content-validity assessment by two validators consisting of a science-education lecturer and a science teacher. Validation covered content appropriateness, instrument construction, language use, integration with the Socio-Scientific Issues approach, and representation of critical-thinking indicators. Feedback from the validators was used as the basis for revision before the instruments were applied in the study.

Specifically for the test instrument, after it was deemed feasible by the validators, it was empirically tested with 30 Grade VII students outside the research participants. A Point-Biserial correlation validity test showed that, of the 20 developed items, 15 were valid (r calculated > r table = 0.361), while 5 items were invalid and therefore excluded from the study. Reliability was then examined using Cronbach's Alpha with SPSS version 25. The analysis produced a Cronbach's Alpha value of 0.735, indicating good internal consistency and confirming that the instrument was suitable for use in the study.

Table 4. *Research Instrument Reliability*

Reliability Statistics	
Cronbach's Alpha	N of Items
.735	15

Qualitative data were analyzed using the interactive analysis model of Miles, Huberman, and Saldaña, which includes data reduction, data display, and conclusion drawing. Quantitative data were analyzed descriptively using percentages to describe student engagement and critical thinking skills. The calculated percentages were then interpreted according to the categories presented in Table 5.

Table 5. *Percentage Interpretation Categories*

Score Percentage	Category
75-100%	Very Good
50-75%	Good
25-50%	Fair
0-25%	Poor

Table 5 presents the percentage interpretation categories used to evaluate the results of the study. The scores are divided into four categories based on the percentage obtained. Scores ranging from 75–100% are categorized as very good, indicating a high level of achievement or response. Scores of 50–75% are classified as good, while scores between 25–50% are categorized as fair. Finally, scores ranging from 0–25% are classified as poor, indicating a low level of achievement or response. These categories provide a reference for interpreting the percentage results obtained from the assessment.

Results

Implementation of the SSI-Based 'Question Shopping' LKPD

At the beginning of the learning process, students were provided with stimuli in the form of environmental issues related to the content, including pesticide use, monoculture farming, deforestation, conversion of mangrove forests into shrimp ponds, and the presence of suckermouth catfish as an invasive species. These issues were used as learning contexts so that students could connect science concepts with problems occurring in their surrounding environment. Students were then divided into groups to conduct the 'Question Shopping' activity, in which they selected questions according to higher-order thinking levels (C4, C5, and C6), as shown in Figure 1, and subsequently discussed and presented their solutions.



Figure 2. *C4-C6 Questions in the LKPD*

The implementation of the learning activities showed progress across meetings. During the first meeting, some students were still adapting to the learning mechanism and the use of the LKPD, so their participation in discussions was not yet optimal. In the second meeting, students began to understand the learning sequence and became more active in discussion. The addition of a bottle-flip activity to determine turns for selecting questions also increased students' enthusiasm during learning. By the third meeting, students had become accustomed to the learning mechanism, and discussions, presentations, and expression of opinions became more active, fluent, and conducive, as shown in Figure 3.



Figure 3. *Implementation of the LKPD*

Overall, the Socio-Scientific Issues (SSI)-based 'Question Shopping' LKPD was successfully implemented in accordance with the stages of Discovery Learning. Learning became more active, interactive, and student-centered, as indicated by increased student participation in discussions, problem solving, and presentation of learning outcomes. Nevertheless, several challenges remained, including limited time for discussion and presentation and the need for additional guidance for several students during the initial implementation.

Student Engagement Results

Student engagement during the implementation of the Socio-Scientific Issues (SSI)-based 'Question Shopping' LKPD was observed through four aspects: asking questions, answering questions, group discussion, and problem solving. A summary of the observation results is presented in Table 6.

Table 6. Summary of Student-Engagement Observation Results

No.	Engagement Aspect	Meeting 1	Meeting 2	Meeting 3
1	Asking Questions	4	5	6
2	Answering Questions	5	5	6
3	Group Discussion	6	7	7
4	Problem Solving	7	7	7
Total Score		22	24	26
Percentage		68.7%	75%	81.2%

Based on the observations, student engagement increased at each meeting. The percentage of engagement rose from 68.7% in the first meeting to 75.0% in the second meeting and reached 81.2% in the third meeting. Overall, the average student-engagement percentage was 75%, categorized as high. Improvement occurred across all observed aspects, particularly group discussion and problem solving, which consistently received the highest scores. Students also became increasingly active in asking and answering questions and participating in group discussions as they became more familiar with learning through the SSI-based 'Question Shopping' LKPD.

Interview results indicated that most students responded positively to learning through the Socio-Scientific Issues (SSI)-based 'Question Shopping' LKPD. Students stated that learning was more interesting because it involved discussion, group work, and independent question selection. They also felt more active in exchanging opinions, presenting arguments, and collaborating to solve the problems contained in the LKPD. In addition to increasing engagement during learning, students reported that the issues presented in the LKPD helped them understand the relationship between science content and problems encountered in everyday life. Nevertheless, several students acknowledged difficulty in understanding questions that required higher-order thinking skills and therefore needed more time for discussion. Overall, the interviews showed that implementation of the Socio-Scientific Issues-based 'Question Shopping' LKPD created a more active, collaborative, and enjoyable learning environment and encouraged student engagement throughout the learning process.

Students' Critical Thinking Results

Based on the study involving 25 students, pretest and posttest data on students' critical thinking skills were obtained as presented in Table 7. The analysis showed an increase in students' average scores after learning through the SSI-based 'Question Shopping' LKPD.

Table 7. *Pretest and Posttest Results*

Mean Pretest Score	Mean Posttest Score
58.32	70.541

The students' average pretest score was 58.32, while the average posttest score was 70.54. These results indicate an average increase of 12.22 points, equivalent to 20.95%, after students participated in learning using the Socio-Scientific Issues (SSI)-based 'Question Shopping' LKPD.

Discussion

Implementation of the SSI-Based 'Question Shopping' LKPD

The Socio-Scientific Issues (SSI)-based 'Question Shopping' LKPD was implemented in Grade VII at SMP Raudlatul Musthofa with 25 students on the topic of Ecology and Environmental Conservation. Learning was conducted over three meetings using Discovery Learning combined with the SSI-based 'Question Shopping' LKPD. The integration of these approaches was designed to create student-centered learning by presenting contextual problems that were close to students' everyday lives, so that students not only understood science concepts theoretically but were also able to connect them with real phenomena in their surrounding environment.

At the beginning of learning, students were presented with stimuli in the form of environmental issues relevant to the topic, including pesticide use in agriculture, monoculture farming, deforestation, conversion of mangrove forests into shrimp ponds, and the presence of suckermouth catfish as an invasive species. These issues were intended to stimulate students' curiosity and encourage them to identify relationships between ecological concepts and social and environmental problems in society. Such characteristics represent a central feature of the Socio-Scientific Issues (SSI) approach, which connects science concepts with complex real-world issues and encourages students to analyze problems, evaluate alternative solutions, and make decisions based on scientific evidence (Sparks et al., 2022).

The main learning activity was conducted through the distinctive 'Question Shopping' activity. Each group was given the opportunity to select questions according to higher-order thinking levels: C4 (analyzing), C5 (evaluating), and C6 (creating). To ensure a fair distribution of the selected questions, the teacher directed groups to begin with C4 questions, followed by C5 and C6. After selecting a question, students collaboratively discussed the problem, constructed arguments based on science concepts, and presented their discussion results to the class to receive feedback from other groups. These activities provided opportunities for students to participate actively in learning because they acted not only as recipients of information but also as decision makers regarding the learning strategies they used. Consequently, learning became more interactive, collaborative, and centered on student activity.

Observations across the three meetings showed considerable changes in the learning process. During the first meeting, some students needed time to adapt to the 'Question Shopping' mechanism and issue-based learning, so participation in discussion was not yet optimal. In the second and third meetings, students began to understand the sequence of activities and became more active in discussion, expressing opinions, asking questions, and responding to other groups' presentations. This progress indicates that the SSI-based 'Question Shopping' LKPD created an increasingly conducive environment for active student participation. In addition, the bottle-flip activity introduced as a variation in selecting questions increased student enthusiasm and created a more enjoyable learning atmosphere without reducing the substance of the learning activities.

The findings indicate that integrating the 'Question Shopping' LKPD with SSI created more contextual science learning than conventional instruction. Environmental issues helped students understand that science concepts are not learned solely for content mastery but can also be used as a basis for understanding and solving problems in their surrounding environment. Allowing students to select questions independently also provided a different

learning experience because groups had opportunities to determine problem-solving strategies according to their abilities. This condition indicates that learning was no longer dominated by the teacher but instead provided greater space for students to construct knowledge through exploration, discussion, and scientific argumentation.

These findings reinforce previous research showing that SSI can improve the quality of science learning by presenting contextual issues relevant to students' lives. (Kumar et al., 2024) explains that SSI-based learning helps students understand relationships between scientific concepts and social and environmental problems, thereby strengthening analysis and decision-making skills. The previous studied also concluded that consistent implementation of SSI can improve science learning through scientific argumentation, problem analysis, and contextual problem solving (Dusturi et al., 2024). In addition, the use of LKPD provides a systematic structure for learning activities so that the learning process becomes more directed while simultaneously increasing student engagement.

Nevertheless, the implementation of the SSI-based 'Question Shopping' LKPD still faced several challenges. Limited time was one factor preventing discussion and presentation activities from being fully optimized, particularly when students encountered questions at higher cognitive levels. During the initial implementation, some students were also unfamiliar with learning that required analysis and argumentation and therefore needed more intensive teacher guidance. These challenges could be minimized through clearer explanations of the learning mechanism, more effective time management, and teacher assistance during discussions. Thus, the difficulties encountered were primarily technical and did not reduce the overall quality of the LKPD implementation.

Overall, implementation of the Socio-Scientific Issues-based 'Question Shopping' LKPD successfully created science learning that was more active, contextual, and student-centered. Its main advantage lies in integrating real-world issues with a question-selection strategy that gives students opportunities to select, analyze, discuss, and justify solutions based on scientific concepts. Therefore, the SSI-based 'Question Shopping' LKPD can serve as an innovative alternative learning resource supporting 21st-century science education by integrating contextual learning, collaborative activities, and higher-order thinking skill development within a single sequence of learning activities.

Student Engagement

Based on the observations presented in Table 2, student engagement increased at each meeting. The percentage rose from 68.7% in the first meeting to 75.0% in the second meeting and increased again to 81.2% in the third meeting. Overall, average student engagement reached 75%, categorized as high. This increase indicates that implementation of the Socio-Scientific Issues-based 'Question Shopping' LKPD encouraged students to participate more actively throughout the learning process.

Improvement in engagement was evident across almost all observed aspects, particularly asking and answering questions, participating in discussions, and solving problems. Group discussion and problem solving obtained the highest scores in every meeting. These findings indicate that learning was no longer dominated by teacher explanations but instead provided broader opportunities for students to interact, exchange ideas, and construct knowledge through group discussion. The independent selection of questions during 'Question Shopping' also encouraged each group to develop learning strategies and take responsibility for its decisions, thereby further increasing student engagement.

The observation results were reinforced by interviews showing that most students responded positively to the learning activities. Students stated that learning felt more interesting because they did not merely listen to teacher explanations but also discussed, selected questions according to group strategies, and expressed opinions while solving the problems provided. Several students also stated that learning became more enjoyable because it was organized collaboratively and provided opportunities for every group member to participate in completing the tasks. These findings indicate that the SSI-based LKPD created a more active learning environment while increasing students' motivation to participate in learning. In addition to behavioral engagement, interviews also indicated increased emotional engagement. Most students stated that learning was more exciting, less monotonous, and made them more enthusiastic about participating in each activity. The presentation of environmental issues that were close to everyday life made the material more meaningful and relevant to real conditions around them.

The 'Question Shopping' activity also offered a different learning experience because students were given freedom to determine which questions to solve according to their group's abilities. This created a more enjoyable learning atmosphere and increased students' sense of ownership of the learning process. From the perspective of cognitive engagement, interviews indicated that students felt more encouraged to think before deciding on an answer because each question presented a problem that first had to be analyzed. During discussions, students exchanged opinions, defended arguments, and considered alternative solutions before making decisions. These activities indicate that implementation of the SSI-based 'Question Shopping' LKPD increased not only physical participation but also mental engagement through analysis, evaluation, and problem solving related to contextual issues.

These findings are consistent with the student-engagement framework proposed by previous studied, which describes engagement as comprising behavioral, emotional, and cognitive dimensions. All three dimensions were evident during the learning implementation. Behavioral engagement was reflected in increased questioning, answering, discussion, and group-task completion. Emotional engagement was reflected in students' enthusiasm and positive responses to learning, which they considered more interesting than conventional instruction. Cognitive engagement was evident in students' ability to analyze problems, evaluate alternative answers, and construct arguments based on scientific concepts before making decisions. These findings also reinforce previous research reporting that Socio-Scientific Issues can increase student engagement through contextual issues that stimulate discussion, argumentation, and scientific decision making. explains that SSI-based learning gives students opportunities to actively analyze social problems related to science, thereby increasing engagement (Normawati et al., 2022). likewise reported that issue-based learning can increase active student participation because learning content is directly connected to real-world problems familiar to students (Rambe et al., 2024). Further states that SSI-based learning creates an environment that encourages students to exchange ideas, present arguments, and make decisions based on scientific evidence (Subiantoro et al., 2024).

Nevertheless, interviews also revealed several challenges, particularly students' difficulties in understanding questions that required higher-order thinking and maintaining concentration during discussion. These challenges caused some students to require more time to understand the problems before formulating answers. However, they did not disrupt the overall learning process because the teacher provided guidance during discussions and helped students understand difficult problems. Thus, these challenges mainly indicate that SSI-based learning requires greater cognitive engagement than conventional instruction.

Overall, observations and interviews showed that implementation of the Socio-Scientific Issues-based 'Question Shopping' LKPD increased student engagement during science learning. The improvement was reflected not only in increased participation in learning activities but also in greater enthusiasm, motivation, discussion skills, and cognitive involvement in analyzing and solving problems. These findings indicate that integrating SSI with the 'Question Shopping' strategy provides a more active, collaborative, and meaningful learning experience and therefore has the potential to serve as an innovative alternative for improving the quality of science learning.

Students' Critical Thinking Results

This section is also a major part of the research articles and is also usually the longest part of an article. Discussion of the research presented in this section are the result. The process of data analysis such as statistical calculations or other processes for the achievement of its research. Please present the discussion narratively. Based on Table 3, the mean critical-thinking score increased from 58.32 on the pretest to 70.54 on the posttest. Thus, an increase of 12.22 points, or approximately 20.95%, occurred after implementation of the Socio-Scientific Issues-based 'Question Shopping' LKPD. This improvement indicates that learning combining socio-scientific issues with the 'Question Shopping' activity provided experiences that supported the development of students' critical thinking skills. Although the improvement was not uniform across all students, the overall findings show that most students demonstrated development in their thinking skills after participating in the learning activities.

The improvement in critical thinking skills was closely related to the characteristics of the developed LKPD. Unlike conventional worksheets, which generally contain exercises focused on concept comprehension, the LKPD in this study was designed with Higher Order Thinking Skills (HOTS) questions at cognitive levels C4 (analyzing), C5 (evaluating), and C6 (creating). Each question required students not only to identify the correct answer but also to identify problems, analyze cause-and-effect relationships, evaluate alternative solutions, and formulate solutions based on scientific concepts. Accordingly, students consistently practiced higher-order thinking processes that are central to critical thinking throughout the learning process.

In addition to the characteristics of the HOTS questions, improvement in critical thinking was supported by the Socio-Scientific Issues approach. Issues such as pesticide use, deforestation, monoculture farming, conversion of mangrove forests, and suckermouth catfish as an invasive species placed students in open-ended situations in which no single absolute answer was available. These conditions encouraged students to gather information, connect science concepts with real conditions, consider multiple perspectives, and construct arguments supported by scientific evidence before making decisions. Such processes are central to critical thinking because students are required not merely to recall information but to reason logically when solving problems.

The 'Question Shopping' strategy also contributed to the development of students' critical thinking. Giving each group the opportunity to select questions according to its strategy and the perceived level of difficulty made students more responsible for their learning process. Before choosing a question, students discussed the difficulty of each alternative, considered the group's abilities, and then made a joint decision. After selecting a question, they analyzed the problem, discussed possible answers, defended arguments, and evaluated group members' opinions before agreeing on a final answer. Thus, critical thinking occurred not only

while answering the questions but also from the stage of determining problem-solving strategies.

The interview results reinforced these findings. Most students stated that the questions in the LKPD required them to think before deciding on an answer because each problem required group discussion and joint consideration. Students also reported becoming more accustomed to providing reasons for selected answers and considering peers' opinions before making decisions. These findings indicate that implementation of the SSI-based LKPD not only improved quantitative learning outcomes but also developed students' thinking processes through analysis, argumentation, evaluation, and collaborative decision making. From the perspective of critical-thinking theory, the learning activities facilitated several key indicators, including identifying problems, analyzing information, evaluating evidence, constructing logical arguments, and drawing conclusions based on available facts. During group discussion, students were required not only to provide answers but also to explain the scientific reasoning supporting those answers. These activities indicate that students became increasingly accustomed to using reasoning before reaching conclusions. In other words, learning produced not only higher test scores but also observable changes in the way students approached problems during the learning process.

These findings are consistent with previous studies reporting the effectiveness of Socio-Scientific Issues in improving critical thinking skills. Reported that SSI-based learning positively influenced critical thinking because students were encouraged to analyze real problems, evaluate information from different sources, and make decisions based on scientific evidence (Aisy et al., 2024). This finding is strengthened by whose systematic review showed that SSI implementation consistently improves critical thinking through scientific argumentation, issue analysis, and contextual problem solving (Dusturi et al., 2024) . Also found higher posttest than pretest scores in SSI-based learning because students were provided with broader opportunities to reason during the learning process (Rosyidah & Subekti, 2023). The improvement in critical thinking in this study was also influenced by the collaborative learning process during LKPD implementation. Group discussion gave students opportunities to test arguments, clarify information, and evaluate peers' opinions before reaching a collective decision. Such interactions enriched students' thinking because each group member encountered multiple perspectives on a problem.

Consequently, critical thinking developed not only through individual question answering but also through negotiation of meaning and scientific argumentation during discussion. Although critical thinking generally improved, some students obtained unchanged scores or experienced slight declines on the posttest. This indicates that the development of critical thinking does not occur uniformly across individuals. Differences may be influenced by factors such as students' prior abilities, learning motivation, readiness for problem-based learning, self-regulation, and the ability to connect new concepts with prior knowledge. Therefore, developing critical thinking requires continuous practice and cannot be achieved through a single instructional intervention. Overall, the findings indicate that implementation of the Socio-Scientific Issues-based 'Question Shopping' LKPD supported the development of students' critical thinking skills. This success was associated not only with the SSI approach, which introduced real-world problems, but also with the integration of HOTS questions and the 'Question Shopping' strategy, which gave students opportunities to determine learning strategies, discuss, construct arguments, and make scientific decisions. The combination of these three components produced a more active, contextual, and challenging learning experience that facilitated the development of critical thinking in science learning.

Conclusion

The Socio-Scientific Issues (SSI)-based 'Question Shopping' LKPD was successfully implemented in science learning through the stages of Discovery Learning, including stimulation, problem statement, data collection, data processing, verification, and generalization, thereby creating active, contextual, and student-centered learning. The integration of socio-scientific issues that are close to everyday life, such as pesticide use, deforestation, mangrove ecosystem degradation, and invasive species, provided meaningful learning experiences while encouraging students to connect science concepts with real problems in their surrounding environment. The implementation of the LKPD was also associated with increased student engagement, as shown by engagement percentages rising from 68.7% in the first meeting to 75.0% in the second meeting and 81.2% in the third meeting, ranging from high to very high categories. Students' critical thinking skills also improved, as indicated by an increase in the mean score from 58.32 on the pretest to 70.54 on the posttest. These findings show that activities using the SSI-based 'Question Shopping' LKPD provided students with opportunities to actively identify problems, analyze information, evaluate different perspectives, construct evidence-based arguments, and formulate logical and scientific solutions to environmental problems. Thus, this study confirms that the Socio-Scientific Issues-based 'Question Shopping' LKPD is an alternative learning resource that can improve the quality of science learning by simultaneously strengthening student engagement and critical thinking, with the potential to support science learning that is more meaningful and relevant to the demands of 21st-century education. This study is limited to junior high school students, science learning, and a specific socio-scientific issues-based worksheet. Future research should involve diverse educational levels, broader topics, larger samples, and longer implementation periods to examine its effectiveness in developing engagement and critical thinking skills.

Acknowledgment

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