Unnes.J.Biol.Educ. 14 (2) (2025)

Journal of Biology Education

http://journal.unnes.ac.id/sju/index.php/ujbe

The Effect of Double Loop Problem Solving Integrated Jelajah Alam Sekitar to Improve Students' Scientific Literacy and Critical Thinking

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Article Info

Article History:

Received: June 2025

Accepted: July 2025

Published: August 2025

Keywords:

Critical Thinking, Double Loop Problem Solving, Jelajah Alam Sekitar, Scientific Literacy

Abstract

Indonesian students' scientific literacy in PISA 2022 experienced decline of 396 (PISA 2018) to 383 points. SMAN 1 Sragi's learning is limited to PPT-assisted lectures and Covid-19 causes students' cognitive decline so that students' scientific literacy and critical thinking need to be optimized through JAS integrated DLPS in environmental change material. The aim research are to analyze the form of integration of DLPS with JAS, analyze the effect of implementing JAS integrated DLPS and analyze the effectiveness of JAS integrated DLPS. Pre-Experimental in the form of one group pretest-posttest design. The results show that JAS integrated DLPS has positive effect on increasing students' scientific literacy and critical thinking and the N-Gain value is ≥ 0.60 in all aspects of scientific literacy and critical thinking. Three criteria for testing the effectiveness of JAS integrated DLPS, namely 79% of students scored ≥75 on scientific literacy and 94% on critical thinking. Second, the N-Gain value for scientific literacy is 0.71 (high) and critical thinking is 0.77 (high). Third, the Wilcoxon test is significant. The conclusion are the form of integration of DLPS with JAS consists of the syntax of problem identification, initial detection, tentative solutions, causal analysis, root problem detection and designing main solution to problem; implementation of JAS integrated DLPS has positive effect on increasing students' scientific literacy and critical thinking; and JAS integrated DLPS is significantly effective in increasing students' scientific literacy and critical thinking on environmental change material.

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p-ISSN 2252-6579

e-ISSN 2540-833X

INTRODUCTION

Scientific literacy is one of the keys to success in facing the challenges of the 21st century (Suciati et al. 2014). However, Indonesia's scientific literacy capabilities need to be paid attention and improved, especially after the Covid-19 pandemic. Indonesia's scientific literacy has increased from rank 70 (PISA 2018) to rank 65 (PISA 2022) but this ranking is inversely proportional to the score obtained. PISA 2018 shows scientific literacy score of 396 points while PISA 2022 is 383 (OECD, 2023). The falling PISA 2022 scores show decline in performance in scientific literacy so that efforts to improve are needed. Scientific literacy abilities are based on 4 aspects: context, knowledge, competence and scientific attitudes (OECD (2017); Nasution et al. (2019); Risma & Handayani (2019)). Students' scientific literacy abilities should be balanced with critical thinking competencies (Harlinda & Amir, 2019). However, it turns out that the critical thinking skills of Indonesian students currently also need to be improved. According to Temuningsih et al. (2017), Indonesian students' critical thinking abilities are limited to the ability to recognize and identify a number of basic phenomena. Then, Susilowati et al. (2017) shows that students' critical thinking abilities need to be optimized when viewed from the aspects of interpretation, analysis, evaluation, conclusions and explanations.

According to the results of observations and interviews of biology teachers at SMA Negeri 1 Sragi, SMA Negeri 1 Sragi's learning is still limited to teacher centered learning assisted by PPT. In fact, if the material is close to the end of the semester, the teacher only gives assignments or simple project assignments as a substitute for summative assessments such as environmental change material. This has an impact on students' cognitive abilities which ultimately need to be optimized, including scientific literacy and critical thinking. Apart from that, the existence of lost learning among students due to the Covid-19 pandemic is also the cause of students' lack of honed scientific literacy and critical thinking skills. Therefore, learning is needed that related to everyday problems to improve scientific literacy and critical thinking, one of which is environmental change material.

Environmental change is major environmental issue in Pekalongan due to water pollution due to the dumping of batik waste directly into the river so that environmental balance is disturbed (Permatasari et al. (2021); Fadhilah & Solichin (2022); Kharisma, Yulianto & Nuraini (2023)). Pollution by waste from daily human activities, such as cooking, bathing and trading, needs to be considered. Therefore, learning is needed that can improve students' scientific literacy and critical thinking skills in schools in order to address these problems. One of them is through Double Loop Problem Solving (DLPS) learning model.

DLPS can improve students' critical thinking skills (Arsya et al. (2023); Rahman (2023); Usnalillah et al. (2023)). Then, DLPS also able to improve students' literacy skills in class (Dito & Khaerunnisa (2021); Yulianti & Winarti (2021)) so can improve students' scientific literacy skills. Apart from DLPS, Jelajag Alam Sekitar (JAS) is effective learning approach for increasing students' scientific literacy and critical thinking. Student activities and learning outcomes can increase in learning that uses the JAS approach (Amiruddin, 2021). Therefore, further research is needed regarding scientific literacy and critical thinking skills with the title "The Effect of Double Loop Problem Solving Integrated Exploring the Natural Environment to Improve Students' Scientific Literacy and Critical Thinking".

RESEARCH METHOD

This research was conducted at SMA Negeri 1 Sragi at the end of the even semester of the 2022/2023 academic year. The population in this study consisted of all class X students of SMA Negeri 1 Sragi, totaling nine classes. The sampling technique uses purposive random sampling technique. The research sample used 3 classes, namely X4. This research implements the merdeka curriculum.

RESULTS AND DISCUSSION

The aim research is to analyze form of integration of the DLPS learning model with the JAS learning approach, to analyze effect of implementing JAS integrated DLPS on increasing students' scientific literacy and critical thinking on environmental change material, to analyze effectiveness of JAS integrated DLPS to

increase students' scientific literacy and critical thinking on the environmental changes material. The form of integration can be seen from the combined syntax which is based on the DLPS model and the JAS approach. The effect of implementing JAS integrated DLPS on increasing students' scientific literacy and critical thinking determined by 2 criteria, namely increase in pre-test and post-test scores and the N-Gain value per aspect of scientific literacy and critical thinking ≥ 0.60. The effectiveness of JAS integrated DLPS to improve students' scientific literacy and critical thinking measured by 3 criteria: (1) 75% or more of students get a score ≥ 75; (2) N-Gain value in the medium to high category; (3) The significance value in the Wilcoxon Test shows <0.05.

Form of Integration between Double Loop Problem Solving Learning Model and Jelajah Alam Sekitar Learning Approach

Biology closely related to nature like environment and living creatures with various kinds of problems that can be used as learning material to improve students' scientific literacy and critical thinking skills on environmental change material in implementing JAS integrated DLPS by considering water pollution problems in Pekalongan. This is in line with research by Arestu et al. (2018) that biology covers problems in the natural environment with the aim of making students able to investigate scientifically to practice problem solving.

Table 1 Integration of Double Loop Problem Solving Model Integrated Jelajah Alam Sekitar Approach

No.	Components of JAS Approach	Syntax of Double Loop Problem Solving Model	Syntax of JAS Integrated DLPS
1.	Exploration	Identification of problems	Identification of problems
2.	Constructivist	Immediate Cause Detection	Early Detection
3.	Science Process	Evaluation of Success of Temporary Solutions (LOOP 1)	Tentative Solution
4.	Learning Society	Determining Whether Root Analysis is Necessary	Causal Analysis
5.	Bioedutainment	Root Cause Detection (LOOP 2)	Detect the Root of the Problem and
6.	Authentic Assessment	Root Problem Solution Design	Design the Main Solution to the Problem

Based on Table 1, it is known that the form of integration of DLPS with JAS includes 5 main syntaxes, namely problem identification, initial detection, tentative solutions, causal analysis, as well as root detection and designing the main solution to the problem. The first is identification of problems. This stage consists of cognitive diagnostic assessment activities and problem detection. The cognitive diagnostic assessment in Merdeka curriculum functions to map students' initial abilities, competencies, mastery and needs to decide on differentiated learning. In line with Budiono & Hatip (2023), identifying the initial level of mastery or achievement of student competencies at the start of learning is diagnostic assessment function. Then, students are introduced to daily life problems based on the video (https://www.youtube.com/watch?v=ruH03WooR_8) as stimulus and initial apperception. At this stage students explore the video to detect all the facts of environmental problems in the video and analyze the causes. In accordance with the statement (Usnalillah et al., 2023) that this stage aims to practice students' interpretation of the problems presented.

The second syntax, namely initial detection, contains news literacy activities about environmental problems in Indonesia. In groups, students read news to analyze. Students analyze the characteristics, impacts, predicted causes, solutions to pollution, and examples and handling of waste. Reading practices students to identify and analyze information correctly. Then, students formulate conclusions from the results of literacy activities. The third syntax is tentative solution that evaluates the success of the temporary solution formulated by students through group presentation. The activity continued with discussion to consider how effective and successful the temporary solution was.

The fourth is causal analysis. At this stage the teacher considers whether the student's ability is able to continue with practical activities to detect the root of the problem based on the literacy that the student has done. Understanding and reasoning in solving science problems during news literacy can develop students' problem-solving abilities. In line with research by Puspitasari et al. (2022) that DLPS can improve the understanding and reasoning achieved by students. Students proceed to the final syntax namely detect the

root of the problem and designing the main solution to the problem. This stage is the climax in the JAS integrated DLPS syntax by carrying out practicum in groups. The problems used by this syntax are more complex than initial detection syntax (news literacy). Practical activities focus on water pollution which is the main problem in Pekalongan with research objects being fish and liquid waste around schools. The aim is for students to know the influence of various types of waste in the surrounding environment on the life of organisms and solutions for handling through practicums in order to imprinted in memories. Practical activities become the syntax that dominates students in improving students' problem solving abilities (Widiastika et al., 2019).

At the end of the practical activity, students deduce that human activity was the dominant cause of environmental change and pollution so that the most appropriate main solution also lay in humans. Nature must be used optimally and sustainably. In line with research by Cahyani & Setyawati (2017), when students solve problems, students apply and use scientific knowledge so that they have a relatively high attitude and sensitivity towards themselves, other people and their environment in making every decision scientifically. Finally, post-test was carried out on environmental change material to determine the competency achievements that students had obtained based on aspects of scientific literacy and critical thinking in JAS integrated DLPS learning.

This research uses Merdeka curriculum with differentiated learning. Differentiated learning consists of process differentiation, content differentiation and product differentiation (Martanti et al., 2022). In this research, researchers carried out content modifications: using news as a literary source and practicum activities. This research also using process modifications, implemented through group activities in accordance with the content and learning objectives of the Merdeka curriculum. Merdeka curriculum learning also pays attention to strengthening student character through the Profil Pelajar Pancasila. Six dimensions of the Profil Pelajar Pancasila: Beriman, bertakwa kepada Tuhan YME, dan berakhlak mulia; Kebhinekaan global; Bergotong royong; Mandiri; Bernalar kritis; Kreatif (Rachmawati et al., 2022). Profil Pelajar Pancasila in this research are bergotong royong, mandiri, dan bernalar kritis. Three constituent elements in the Gotong Royong dimension: collaboration, sharing and caring. Implementation of collaboration elements is demonstrated by cooperation and communication in groups. The application of the sharing element is expressed when students share their time, services and thoughts in group assignments. Students demonstrate the caring element of concern in full from the beginning to the end of learning until they are finally able to formulate solutions to overcome environmental problems, especially water pollution, as a form of caring for the environment as Indonesian students.

The Mandiri dimension consists of elements of self-understanding and the situations faced as well as elements of self-regulation. Elements of self-understanding and the situation faced are implemented through contributing according to roles and division of tasks in the group and knowing potential and shortcomings. The element of self-regulation is applied when developing an attitude of controlling oneself to focus on learning and the tasks at hand. The Bernalar Kritis dimension consists of elements of obtaining and processing information and ideas, elements of analyzing and evaluating reasoning and procedures, elements of reflection and thought processes. The element of obtaining and processing information and ideas is carried out when identifying, clarifying and processing information obtained through literacy or practical activities. elements of analyzing and evaluating reasoning and procedures is clearly visible when students analyze and evaluate work steps in news literacy and practicum. Elements of thought reflection and thought processes are reflected when students provide feedback to educators through self-reflection assignments at the end of the meeting.

The Effect of Implementing Integrated Double Loop Problem Solving in Exploring the Environment to Improve Students' Scientific Literacy and Thinking Skills on Environmental Change Material

1. Scientific Literacy Skill

Data on the impact of implementing JAS integrated DLPS to improve students' scientific literacy and critical thinking skills was obtained from the results of students' pre-test and post-test on environmental change material. This effect is measured based on the increase in student test results after being given

treatment and the N-Gain test results ≥ 0.60. The results of the pre-test and post-test scientific literacy abilities of the students studied are presented in Figure 1.

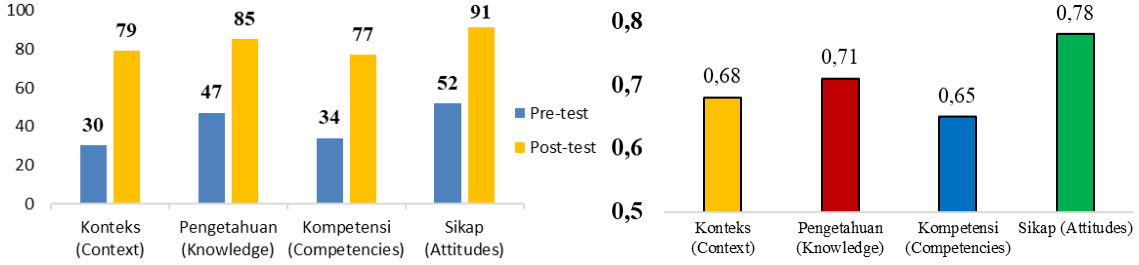


Figure 1 Average Results of Student Pre-test and Post-test (Left) and N-Gain Test (Right) Increasing Scientific Literacy Skill per Aspect

Figure 1 shows that average results of students' pre-test and post-test in all aspects have increased. The highest increase in scientific literacy skill was in context aspect with an increase of 49 points, followed by competencies aspect of 43 points, attitudes aspect of 39 points, and the lowest was knowledge aspect of 38 points. In addition, Figure 1 shows that N-Gain test results in all aspects of scientific literacy skill are ≥ 0.60. The highest N-Gain results were achieved in attitudes aspect which is included in the high category. Then, continued with knowledge aspect in the high category, context aspect in the medium category. The lowest N-gain results are in competencies aspect which is in the medium category. Based on the two criteria above, it can be seen that the implementation of JAS integrated DLPS has positive influence on increasing scientific literacy skills in environmental change material.

a. Context Aspect

Scientific literacy skill is measured by literacy activities using news as a source of literature that analyzed scientifically. This activity can familiarize students with implementing and training them to think computationally in order to improve critical thinking. In line with Lestari & Annizar (2020), critical thinking is improved by getting used to computational thinking, namely the thinking process in solving complex problems in various simple ways. Problems are re-examined in more depth through more complex problems in practical activities. The practicum is carried out scientifically, reflecting aspects of the scientific literacy context, thereby enabling students' scientific literacy skills to become better. Context aspect reflects that students are able to be involved in handling situations related to environmental issues by utilizing science and technology.

b. Knowledge Aspect

Three categories in the knowledge aspect: content, procedural and epistemic knowledge. Content knowledge requires students to form foundation of scientific knowledge. In learning, students are required to form basic knowledge of environmental change through facts found in the news or from practicum data. Content knowledge requires students to form a basis of scientific knowledge using facts explored by students in constructing their knowledge (Mellyzar et al., 2022). Procedural knowledge contains students' skills to carry out scientific findings related to collecting, analyzing and interpreting data from learning content information (news literacy and practicum). Scientific literacy activities in the news produce data in the form of facts and readers' assumptions. The practicum shows the use of procedural knowledge where students find out waste variables that influence fish variables (research objects) and design the final solution based on the interpretation of practicum data. This is supported by the procedural knowledge statement explaining knowledge about variables and data interpretation (Fadilah et al., 2020). Epistemic knowledge related to the knowledge construction process which is directly related to the content of knowledge which is the substrate (environmental changes).

c. Competencies Aspect

Competencies aspect is characterized by the skill to interpret data. This skill is trained through news reading literacy and through practicum. Reading the news makes students analyze facts to become information data. Practicum produces observational data to be interpreted into information. Data

interpretation skills are also visible when students work on pre-test and post-test questions in the form of diagrams, tables, pictures, pamphlets and short texts. In line with the statement that one of students' scientific literacy competencies in schools is their proficiency in interpreting data and making graphs (OECD, 2017b). Apart from that, the competencies aspect is also supported by skill to explain phenomena scientifically, interpret data and facts scientifically, and formulate scientific inquiries during student practicum.

d. Attitudes Aspect

Attitudes aspects can be accustomed to through everyday life. In fact, students can reflect the application of attitudinal aspects of scientific literacy skills from the beginning to the end of learning. At the beginning of the lesson, researchers began to instill a scientific attitude when providing stimulus (YouTube video). The video shows the dangers of pollution or waste so that environmental awareness is expected to emerge. As a result, students have an interest and feel like finding out the root of the problem. This is in line with (Hanifah & Retnoningsih, 2019) that scientific attitudes are one of the responses shown by students to issues of environmental change that are observed. This is reinforced by statements of student interest in science issues which can motivate students to solve problems scientifically so that they become more concerned and responsible for the surrounding environment (Wulandari & Sholihin, 2015). This can change people's awareness of science and technology. Scientific literacy focuses students on analyzing, predicting, and applying scientific concepts in everyday life (Mardhiyyah et al., 2016).

2. Critical Thinking Skill

The effect of implementing JAS integrated DLPS to improve critical thinking skills on environmental change material is determined by 2 criteria. These criteria are increase between students' pre-test and post-test and N-Gain value of ≥0.60 in every aspect of critical thinking. Figure 2 shows an increase in average results of students' pre-test and post-test in each aspect of students' critical thinking skills. The highest increase was in the advance clarification aspect with difference in pre-test and post-test scores of 39 points, followed by the inference aspect with difference of 38 points. The lowest increase was in the elemtary clarification aspect of 34 points. The parameter, namely N-Gain result ≥0.60, can also be seen in Figure 2. The N-Gain result for critical thinking skill with the highest score lies in the elementary clarification aspect in the high category and then in the advance clarification aspect in the high category too. The lowest N-Gain was obtained from the inference aspect in the high category too. Based on the two criteria above, it can be seen that the implementation of JAS integrated DLPS has positive influence on increasing critical thinking

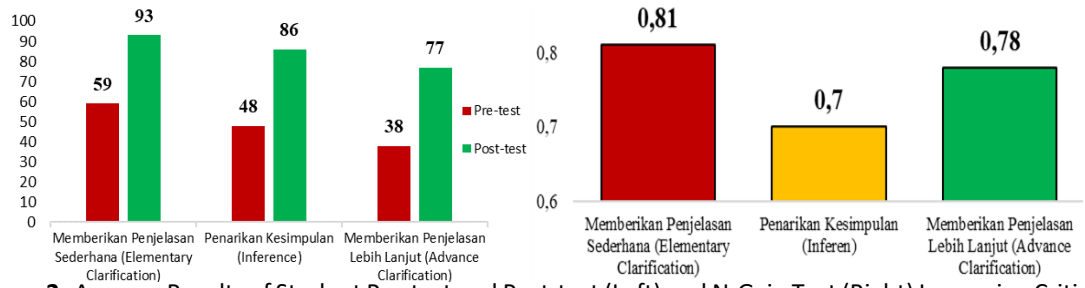


Figure 2 Average Results of Student Pre-test and Post-test (Left) and N-Gain Test (Right) Increasing Critical Thinking Aspect per Aspect

skills on environmental change material.

a. Elementary Clarification Aspect

The N-Gain value for the elementary clarification aspect is the highest compared to other aspects of critical thinking. This can be caused by the students' skill to answer questions based on aspect indicators to provide simple explanations after being given treatment. This aspect has the easiest indicator compared to other. The elementary calrification aspect uses shorter types of questions, assisted by infographics, and easy for students to understand. Therefore, the results of N-Gain and student tests in this aspect are the highest. This aspect is reflected when students collect facts and evidence from learning to form scientific information. This is because at this stage students are trained to ask and answer questions during presentations at the

tentative solution stage as well as the root detection stage and designing the main solution to the problem. Students' critical thinking skills that can improve at this stage. Therefore, this research is in line with Adiwijaya et al. (2016) that students are able to focus questions, ask and answer questions about an explanation. This skill is marker of the development of students' skill to provide further explanations.

b. Inference Aspect

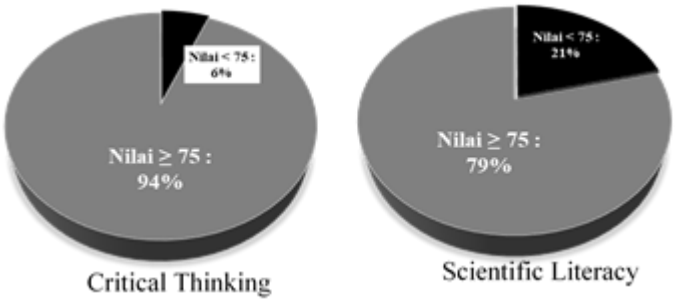
Inference activities consist of deducing information and considering deductions obtained by students when reading the news and doing practical. Students draw conclusions from information through literacy activities. During the practicum, students also discovered the fact that organisms can die if exposed to high levels of waste. Activities to reason about information and put forward hypotheses can be seen when doing literacy and practicums that lead students to draw conclusions. This is in accordance with the statement that the inference aspect emphasizes students to get used to thinking critically in making the most appropriate conclusions to solve problems (Pritananda et al., 2016). This aspect trains skill to consider the results of deductions which is part of critical thinking. Critical thinking increases after being given treatment. However, the N-Gain results show aspects in the medium category. This is in line with research by Supriyati et al. (2018) which states that the average value for the inference aspect in the medium category when compared with other aspect. This is due to several factors. Not all students are able to conclude information correctly based on tables, pictures, text, facts in the questions. When doing group work, there is possibility that some students are lazy about reading. This has impact on students' inability to use information that is appropriate and in line with the problem to find the root of the problem and find the right solution so that the solution designed by the student is not appropriate. In essence, inference aspect trains students to think critically in determining the most appropriate conclusion based on the root of the problem that students find when solving a problem.

c. Advance Clarification Aspect

In the JAS integrated DLPS model there are initial detection and causal analysis syntaxs where students consider more deeply the effectiveness of the results of solutions designed. Solutions designed by students are based on information gathered both through literacy and practicum. Then, this information is considered to form a new assumption as to the cause of the problem. Once students know the cause of the problem, students can focus on formulating effective solution to the problem. This activity trains students to think scientifically and critically in solving scientific problems. In accordance of Priadi et al. (2021) that in the advance clarification aspect, students are given questions or information so they are able to define terms and identify assumptions regarding various environmental problems. Solving scientific problems can be practiced by defining and considering terms. During the activity, researchers found that most of the students were still unfamiliar with terms related to environmental change material, such as pollutants, blooming, microplastics, greenhouse effect, B3 waste etc. Thus, defining and considering terms or definitions for students still needs to be improved. This is in accordance with research by Ridho et al. (2020) which explains that students' skill to define terms and consider definitions must be improved to be able to provide more detailed explanations.

The Effect of Implementing Double Loop Problem Solving Integrated Exploring the Natural Environment to increase Students' Scientific Literacy and Thinking on Environmental Change Material

Indicators of the effectiveness of JAS integrated DLPS to improve students' scientific literacy and critical thinking skills in environmental change material can be identified through a) Kriteria Ketercapaian Tujuan Pembelajaran (KKTP) 75% of students achieved score of ≥75 from the results of the post-test for



scientific literacy skills and critical thinking. b) The N-Gain value of students' scientific literacy and critical thinking abilities is in the medium to high category. c) The significance of student scores using the Wilcoxon test shows a value <0.05.

Figure 3 Skills of Students fulfill KKTP in Scientific Literacy (Right) and Critical Thinking Skill (Left)

When learning environmental change material with JAS integrated DLPS, the KKTP was set with a score of 75. Figure 3 shows that more than 75% of students scored ≥75 on students' scientific literacy and critical thinking skills. These two results show that the majority of students have been able and succeeded in achieving the specified competencies.

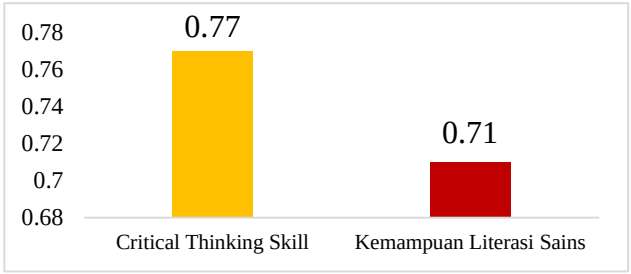


Figure 4 N-Gain Test Results for Students' Scientific Literacy Skill and Critical Thinking Skill

The second criterion for the effectiveness of JAS integrated DLPS is determined by the N-Gain test which is in the medium to high category for students' scientific literacy and critical thinking skill. The results of the N-Gain test for students' scientific literacy and critical thinking abilities can be seen in Figure 6. Figure 6 shows that the N-Gain results for scientific literacy and critical thinking abilities are in the high category. In line with research by Santoso et al. (2017) & Widiawati et al. (2019) that the DLPS model and JAS approach can improve students' scientific literacy skills. Then, the DLPS model and JAS approach also have an effect on increasing students' critical thinking skills (Usnalillah et al., 2023).

The final criterion, namely significance through a non-parametric test in the form of the Wilcoxon test assisted by SPSS software because the data is not normally distributed. The Wilcoxon test in this research was carried out to determine the effect of using JAS integrated DLPS on students' scientific literacy and critical thinking skills. This influence focuses on increasing students' skills. Table 1 and Table 2 show that H_o is rejected and H1 is accepted. This means that there are differences in students' scientific literacy and critical thinking skills before and after the implementation of JAS integrated DLPS. Then in Table 2 shows the average positive rank value which is more than the negative rank. This means that there was an increase in scientific literacy skills in all students after being given treatment and no students experienced decline. Then, this also happens to critical thinking skills. Table 3 shows that the average value of positive rank is more than negative rank = 0.00. This also means that there is an increase in students' critical thinking abilities after being treated with JAS integrated DLPS.

Table 2 Wilcoxon Test Results for Scientific Literacy Skill

Ranks

		N	Mean Rank	Sum of Ranks
Post-test Scientific Literacy - Pre-test Scientific Literacy	Asymp. Sig. (2-tailed)	.000		
	Negative Ranks	0[a]	.00	.00
	Positive Ranks	107[b]	54.00	5778.00
	Ties	0[c]		
	Total	107		

a. *Post-test* Scientific Literacy < *Pre-test* Scientific Literacy
b. *Post-test* Scientific Literacy > *Pre-test* Scientific Literacy
c. *Post-test* Scientific Literacy = *Pre-test* Scientific Literacy

Table 3 Wilcoxon Test Results for Critical Thinking Skill

Ranks

		N	Mean Rank	Sum of Ranks
Post-test Critical Thinking - *Pre-test* Critical Thinking	Asymp. Sig. (2-tailed)	.000		
	Negative Ranks	0[a]	.00	.00
	Positive Ranks	107[b]	54.00	5778.00
	Ties	0[c]		
	Total	107		

a. *Post-test* Critical Thinking < *Pre-test* Critical Thinking
b. *Post-test* Critical Thinking > *Pre-test* Critical Thinking
c. *Post-test* Critical Thinking = *Pre-test* Critical Thinking

Thus, based on 3 criteria above, the results showed that providing JAS integrated DLPS had significant effect on increasing the scientific literacy and critical thinking skill of students at SMA N 1 Sragi. In its implementation, this learning emphasizes group activities so that students can interact with each other, work together, collaborate in building and developing scientific literacy and critical thinking skills. Students work together so that students' thinking skill from lower order thinking skills (LOTS) to higher order thinking skills (HOTS) are stimulated to develop. This is in accordance with research by Khalistyawati & Muhyadi (2018) which explains that group activities influence students' critical thinking skill. Students' critical thinking skills are reflected through problem solving using HOTS in the form of the skills to differentiate ideas, argue, construct explanations, hypothesize and understand complex things, thus showing ability to reason (Hikmah et al., 2019).

JAS integrated DLPS is a form of innovation carried out by researchers with the aim of increasing students' prospects in improving their scientific literacy and critical thinking skills. This syntax has an influence on students' scientific literacy and critical thinking skilss because the DLPS model and JAS approach focus on scientific problem solving. In solving problems, students use and apply scientific knowledge to make the most appropriate decisions so that it has an impact on increasing scientific literacy and critical thinking (Cahyana et al., 2017).

CONCLUSION

Based on the results in the analysis and discussion section, it can be concluded that (1) the JAS integrated DLPS form consists of 5 syntaxes, namely problem identification, initial detection, tentative solutions, causal analysis, root problem detection and designing the main solution to the problem; (2) The implementation of JAS integrated DLPS has positive effect on increasing students' scientific literacy skills and critical thinking skills on environmental change material. Based on 2 criteria, namely increase in scientific literacy and critical thinking in students' pre-test and post-test. The second criterion is the N-Gain value, all aspects of students' scientific literacy have value ≥ 0.60: attitude aspect 0.78, knowledge 0.71, context 0.68, and competence 0.65. The critical thinking N-Gain value is also ≥ 0.60 in all aspects: the elementary clarification aspect is 0.81, advance clarification aspect is 0.78 and inference is 0.70. (3) JAS integrated DLPS is significantly effective in improving students' scientific literacy and critical thinking skills on environmental change material. The three criteria for testing the effectiveness of JAS integrated DLPS, namely KKTP which shows 79% of students getting score of ≥75 in scientific literacy and 94% of students getting score of ≥75 in critical thinking. The second criterion, the N-Gain value for scientific literacy is 0.71 (high) and critical thinking is 0.77 (high). Third, the Wilcoxon Test, scientific literacy and critical thinking skills show significant values.

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