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Infusing Argumentation Activity on The Anticipation Guides Strategy to Improve The Reading Literacy: A Study on The Topic of Heat and Temperature

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Abstract

Reading literacy is a basic ability to master conceptual understanding and high-order thinking skills. The latest PISA results show that Indonesians are at a low level of reading literacy achievement. This research was conducted to test the effectiveness of implementing the anticipation guides strategy, which is integrated with argumentation activities in improving students' reading literacy (literal, inferential, and critical indicators). A non-equivalent pre-test post-test control group was carried out. In the experimental class, the anticipation guide is implemented by inserting argumentation activities. The traditional reading strategy used in the control class was where students were asked to read the textbook directly. The findings show that reading literacy was increased significantly in the experimental class. Students who learned through Anticipation Guides integrated with argumentation activities demonstrated a greater improvement in reading literacy compared to those who experienced traditional reading activities. The integration of argumentation activities in Anticipation Guides proved to be effective in stimulating the activation of prior knowledge, strengthening inferential abilities, and fostering critical evaluation of reading texts. This research is useful in providing both practical and theoretical contributions in the development of science learning that trains students' reading literacy by inserting an argumentation activity on reading.

Keywords: reading literacy, anticipation guides, argumentation activity, reading on science learning.

INTRODUCTION

Reading literacy is a basic skill that is important to teach students. Reading literacy supports students' mastery of concepts and higher-order thinking skills (Tengberg, 2016). Several studies show that good reading literacy can improve several science learning skills (Downs, 2025; Reynolds, 2007), such as understanding concepts and problem-solving (Harrington, 2025), argumentation skills (Siswanto, 2022), and critical thinking skills (Larhmaid, 2025).

Despite its role in supporting the development of students' thinking skills, reading literacy among Indonesian students remains problematic, as their literacy levels are still considered very low (Daulay, 2025). This condition is also clearly shown by the PISA results, which reveal that 25% of students in Indonesia have limited abilities at level two (far from the OECD average of 74%), where students are only capable of literal literacy or literacy comprehension of a reading passage (OECD, 2023). This condition shows that Indonesian students have deficiencies in understanding, interpreting, and evaluating

reading texts (Elmiana, 2019; Wijaya, 2022). In the future, if attention to reading literacy in Indonesia is neglected, Indonesian students may lose their competitiveness in the global arena. In addition to these issues, most reading literacy enhancement processes focus solely on science subjects. In fact, there are opportunities to enhance reading literacy through subjects other than language, such as science.

In addition to reading literacy, the implementation of science learning emphasizes scientific practice. One example of scientific practice is the application of argumentation activities in science learning (Fernández-Huetos, 2025). In the science learning process, scientific argumentation activities are not only discussion activities, but also involve thinking about how to construct knowledge critically by presenting empirical evidence based on scientific data and facts.

Argumentation activity is a form of scientific practice that describes the formation of valid scientific knowledge based on scientific data. In this activity, students are actively involved in making claims, then providing rational explanations between the claims and data and evidence (Toulmin, 2003). In the context of reading, when students are involved in direct argumentation activities, they will be trained to read critically by interpreting and evaluating texts. This will, of course, have a direct impact on the development of HOTs (Higher order thinking skills) and also students' reading literacy (Alfa, 2022; Wulaningsih, 2024; Gumilar, 2025). Several research findings show that the integration of argumentation activities in the science learning process has an impact on increasing concept mastery, science literacy abilities, and also critical thinking skills (Sampson, 2013; Walker, 2013).

Therefore, research will be conducted on “Infusing Argumentation Activity on the Anticipation Guides Strategy to Improve the Reading Literacy: A Study on the Topic of Heat and Temperature”. Anticipation Guides are a reading strategy designed to promote students’ reading literacy by emphasizing the activation of prior knowledge that students have previously acquired or experienced, which is then evaluated and reinforced through critical reading activities conducted in three stages: before, during, and after reading (Pegg, 2012). Usually, anticipation guides are used in language subjects. In this study, this strategy will be used in science learning and integrated with argumentation activities as part of science practice.

Therefore, this study was carried out to analyze the effectiveness of the anticipation guides strategy, which is integrated with argumentation activities to enhance junior high school students’ reading literacy. Specifically, this study examines students’ gains in reading literacy at the literal, inferential, and critical levels.

METHODS

Research Design

The research used a non-equivalent pre-test post-test control group (Table 1) (Creswell, 201). There are two classes, namely the experimental and the control class. Before the learning intervention, students in both classes completed a reading literacy pre-test to identify their initial literacy profiles. The experimental class was taught using the Anticipation Guides strategy integrated with argumentation activities, whereas the control class participated in traditional reading activities involving direct reading of the science textbook. The grid of questions/statements used as a guide in reading activities in the experimental and control classes can be seen in Tables 2 and 3. Following the instructional intervention, both groups completed a reading literacy posttest to assess changes in students’ reading literacy.

Table 1. Research Design

	Pretest	Treatment	Posttest
Experimental	P_1	√	P_3
Control	P_2	-	P_4

Table 2. The Sample of Statement Grid for Student Worksheet in Experimental Class

No.	Reading Literacy Aspect	The Statement Grid
Meeting 1, Topic: Temperature and Measurement		
1	Literal reading	Identifying the definition of temperature
2	Literal reading	Explain the characteristics of the temperature scale
… etc.		
3	Inferential reading	Analyzing the differences in perception of hot and cold with temperature
4	Inferential reading	Relating temperature to energy
… etc.		
5	Critical reading	Providing arguments to convince of the scientific truth of the concept of using a temperature scale
6	Critical reading	Providing arguments to convince of the scientific truth about the validity of the measurement
… etc.		
Meeting 2, Topic: Heat and Its Transfer		
1	Literal reading	Explaining the meaning of heat
2	Literal reading	Explain the characteristics of heat transfer by conduction
… etc.		
3	Inferential reading	Summarize the types of heat transfer
4	Inferential reading	Relating the concept of heat to everyday life
… etc.		
5	Critical reading	Provide arguments to analyze the differences in heat conductivity of materials.
6	Critical reading	Provide arguments to analyze factors that influence heat absorption
… etc.		
Meeting 3, Topic: Changes in the State of Substances		
1	Literal reading	Explain the effect of heat on temperature
2	Literal reading	Identifying types of changes in the state
… etc.		
3	Inferential reading	Conclude the relationship between specific heat and temperature changes
4	Inferential reading	Comparing the specific heat properties of substances
… etc.		
5	Critical reading	Provide arguments to analyze the impact of differences in the specific heat of substances.
6	Critical reading	Providing arguments to analyze the relationship between heat, temperature, and changes in state
… etc.		

Table 3. The Sample of Question Grid for Student Worksheet in the Control Class

No.	The Question Grid
Meeting 1, Topic: Temperature and Measurement	
1	Explain that temperature is different from heat.
2	Analyzing the use of standardized temperature measuring instruments
3	Explains the process of heat change without being followed by a temperature increase process
… etc.	
Meeting 2, Topic: Heat and Its Transfer	
1	Explain the mechanism of heat transfer.
2	Analyzing the effect of material type on heat transfer
3	Analyzing the relationship between heat transfer and temperature changes
… etc.	
Meeting 3, Topic: Changes in the State of Substances	
1	Analyzing the role of heat during the freezing and melting processes
2	Analyze the evaporation process of substances that occur below the boiling point.
3	Analyzing the boiling points and melting points of several different objects
… etc.	

Table 4. The Test Item Blueprint

Item Number	Reading Literacy Aspect	Indicator
Text 1: Why Does a Metal Spoon Feel Hotter than a Plastic Spoon?		
1	Literal Reading	Identifying the event experienced by the character when stirring a hot drink
2	Literal Reading	Identifying the properties of metal based on information in the text
3	Inferential Reading	Inferring the reason why a metal spoon feels hotter than a plastic spoon
4	Critical Reading	Evaluating the appropriateness of materials used for stirring hot drinks
Text 2: Thick Jackets and Their Role in Maintaining Body Temperature		
5	Literal Reading	Identifying the main function of a jacket based on the text
6	Literal Reading	Identifying the role of trapped air inside a jacket
7	Inferential Reading	Inferring how a jacket reduces heat transfer from the body
8	Critical Reading	Evaluating the correctness of the statement that a jacket produces heat
Text 3: Changes in Temperature and State of Water When Heated		
9	Literal Reading	Identifying what happens to water when it is heated
10	Literal Reading	Identifying the condition when the temperature of the water stops increasing
11	Inferential Reading	Inferring the function of heat during the boiling process
12	Inferential Reading	Inferring the difference between heat used to increase temperature and heat used to change the state of matter
Text 4: Traditional Houses and Thermal Comfort		
13	Literal Reading	Identifying building materials used in traditional houses mentioned in the text
14	Inferential Reading	Inferring why traditional houses feel cooler during the day
15	Inferential Reading	Inferring the heat conduction properties of zinc roofing materials
16	Critical Reading	Evaluating appropriate building materials for houses in hot climates
Text 5: Measuring Body Temperature to Maintain Health		
17	Literal Reading	Identifying the function of a thermometer based on the text
18	Literal Reading	Identifying the purpose of measuring body temperature
19	Inferential Reading	Inferring the impact of improper use of a thermometer
20	Critical Reading	Evaluating the accuracy of body temperature measurement results

Participants

This study was conducted at one of the schools in Grobogan, Central Java, Indonesia, with a population of 256 students, mainly seventh graders. From the total number of students, two classes (each consisting of 28 students) were purposively sampled to serve as the treatment (experimental) and the control) groups. The sampling was based on considerations related to the determination of the main sample, looking at the cognitive ability profiles that were almost similar (referring to the mid-semester scores), had the same number of students, and were undergoing learning with the same theme.

Data Collection and Analysis

In this study, reading literacy was measured using a reading literacy test developed by the researchers with three main indicators, namely literal, inferential, and critical (OECD, 2023). Literal reading refers to the ability to identify information explicitly stated in a text, while inferential reading involves interpreting implicit meanings and drawing logical conclusions based on textual information. Critical reading is the ability to evaluate the text content, where students check the credibility and truth of the text along with valid and scientific reasons and evidence.

The test instrument used in this research was 20 multiple-choice questions, consisting of nine literal questions, six inferential questions, and five critical questions. The test instrument blueprint can be seen in Table 4. All questions have been tested for validity by 5 experts using Aiken's V (Hidayah, 2023). All experts agreed that the test items were valid based on three aspects, namely the alignment of the test items with the indicators or objectives being measured, the accuracy of the content and concepts presented in the test items and answer keys, and the clarity of the words or phrases used in each test item. The tests were also assessed for reliability or consistency using *Cronbach's Alpha* (reliability value of 0.928) and declared consistent or reliable. After the pretest and posttest data were obtained, the results were analyzed using inferential statistics to generalize the findings from

the sample.

Data analysis was carried out in stages, namely (1) calculating pretest and posttest scores (Score range 1-100), (2) testing data normality (Shapiro-Wilk, can be seen in Table 5), (3) mean difference test, (4) N-Gain test, the classification criteria can be seen Table 6 (Siswanto, 2014), (5) effect size test (Rhea, 2004). The effect size test was used to analyse the impact of the treatment (Anticipation Guides strategy integrated with argumentation activities) compared to the class that did not receive the treatment. The test was conducted using the. The results of this analysis were subsequently interpreted based on the Effect Size classification presented in Table 7.

Table 5. Results of the Normality Prerequisite Test

		Sig.	Description
Control	Pretest	0.177	Normal
	Posttest	0.386	Normal
Experiment	Pretest	0.121	Normal
	Posttest	0.002	Not normal

Table 6. Classification Criteria for Improvement

"g" value	Interpretation
"g" > 0.7	High
0.3 ≤ "g" ≤ 0.7	Medium
"g" < 0.3	Low

Table 7. Classification Criteria for Effect Size

Effect Size (“d”)	Interpretation
“d” < 0.41	Small
0.41 ≤ “d” ≤ 0.7	Medium
“d” > 0.7	Large

RESULT AND DISCUSSION

In Table 8, the learning process in the experimental and control classes is presented. Generally, the main difference is in the fifth stage, the reading strategies that are used. In the experimental class, the learning process applies the anticipation guides strategy, which is integrated with argumentation activities. Specifically, the anticipation guides strategy stage is (1) students respond to initial statements given by the teacher to generate initial knowledge and also predict the content of the text (pre-reading), (2) students verify the responses given in the previous stage. Verification is carried out in accordance with the information found when reading the text (during reading). (3) students compare the predictions that have been made at the stage before reading, then reflect on their understanding by writing complete scientific arguments containing claims, data, warrants, and supporting evidence that they obtained through the text in the reading. In the control class, students were given questions and then asked to find the answers in the textbook. Reading activities were conducted without the use of systematically organized pre-, during-, and post-reading strategies as in the experimental class. Students were given a list of questions and then investigated the text to answer them, unlike in the experimental class. For further clarification, the worksheet scheme for implementing the reading strategy integrated with argumentation activities is shown in Figure 1.

In both the control and experimental classes, the learning stages were structured into eight phases. The differences between the two classes were found in stages 5 and 6. Stage 1, "asking questions to awaken students' initial knowledge," aimed to awaken students' prior knowledge. This stage also served to identify students' preconceptions, allowing teachers to gain an initial understanding of their conceptual readiness. Stage 2, "asking motivational questions," aimed to foster students' curiosity. In this stage, students were asked questions that connected the material to everyday experiences they might have encountered, enabling them to understand its usefulness. Stage 3, "explaining important/main concepts," the teacher explained key concepts that serve as the foundation for a deeper understanding of the concepts to be studied through reading activities. Stage 4, "providing science textbooks to students," provided the same reading materials to all students to ensure they had the same source of information to explore concepts.

In stages 5 and 6 for the experimental class, students engaged in reading activities using the anticipation guides strategy, integrated with guided argumentation activities using worksheets (an example of the worksheet can be seen in Figure 1). In this stage, students actively explored the reading material according to the stages of the anticipation guides strategy, accompanied by scientific inquiry activities through text exploration to derive

evidence-based scientific arguments from the text. This encouraged the activation of prior knowledge, cognitive conflict, and the construction of knowledge through scientific claims, reasons, and evidence. Meanwhile, in the control class, at this stage, the teacher simply posed a few questions for students to answer by searching for answers within the text (we refer to this as a conventional reading activity).

In stage 7, group discussions were held to clarify the knowledge gained through reading activities. In the experimental class, discussions focused on constructing concepts and constructing scientific arguments. At this stage, students in the experimental class were also allowed to revise and reconstruct the scientific argumentation structures they had developed. In the control class, discussions focused on students' knowledge acquisition through matching answers. In stage 8, both in the experimental and control classes, reaffirmation was carried out regarding the main points of the material that had been studied in accordance with the correct concepts, and a learning reflection process was carried out.

The result of the study related to the mean score comparison between experiment and control class can be seen in Figure 2 (the average pretest and posttest scores for each indicator of reading literacy) and Figure 3 (the average pretest and posttest scores for all of reading literacy). The average pretest scores between the experiment and control classes were not very different. Based on Table 9, there was no significant difference between the control and experimental classes in terms of average pretest and posttest scores. This shows that before the treatment was carried out, there was no difference in reading literacy abilities between students in the experiment and control classes. However, the posttest mean difference test showed that between the experimental and control classes was no significantly difference.

These results indicate that the treatment provided has an impact on the students' reading literacy. Judging from the average post-test scores of both classes, it means that the provision of anticipation guides strategies integrated with argumentation activities is more effective in developing students' reading literacy than only using conventional reading strategies (students are given a text, then asked to read while answering questions). These results are also confirmed by the N-Gain test (see Figure 4). In the experimental class, reading achievement was higher than in the control class. The N-Gain scores for each reading literacy indicator can be seen in Figure 5.

Table 8. The Stage of Learning

Experimental Class	Control Class
Phase-1: Ask questions to awaken students' initial knowledge	Phase-1: Ask questions to awaken students' initial knowledge
Phase-2: Asking motivational questions	Phase-2: Asking motivational questions
Phase-3: Explain important/main concepts	Phase-3: Explain important/main concepts
Phase-4: Providing science textbooks to students	Phase-4: Providing science textbooks to students
Phase-5: Distributing worksheets for the Anticipation Guides strategy integrated with argumentation activities	Phase-5: Providing several questions for students to answer
Phase-6: Guiding students to read and complete the worksheet using the Anticipation Guides strategy integrated with argumentation activities	Phase-6: Guiding students to read and answer the questions
Phase-7: Guiding a class discussion on students' worksheet responses	Phase-7: Guiding a class discussion on students' worksheet responses
Phase-8: Concluding the lesson	Phase-8: Concluding the lesson

Statement	I think it's ...*		The text says that it's ...*		Reflection
	True	False	True	False	
Statement 1 (key concept)					Provide textual evidence from the text to support your answer (page and paragraph number): .....
Statement 2 (key concept)					Provide textual evidence from the text to support your answer (page and paragraph number): .....
.... etc					
Problem statement 1 (proposing argument)					Provide an argument to support your answer after reading by including a claim, data, warrant, and evidence. claim: data: warrant: evidence from the text:
Problem statement 2 (proposing argument)					Provide an argument to support your answer after reading by including a claim, data, warrant, and evidence. claim: data: warrant: evidence from the text:
.... etc					

* Put a check (✓)

Figure 1. Worksheet for the Anticipation Guides Strategy Integrated with Argumentation Activities

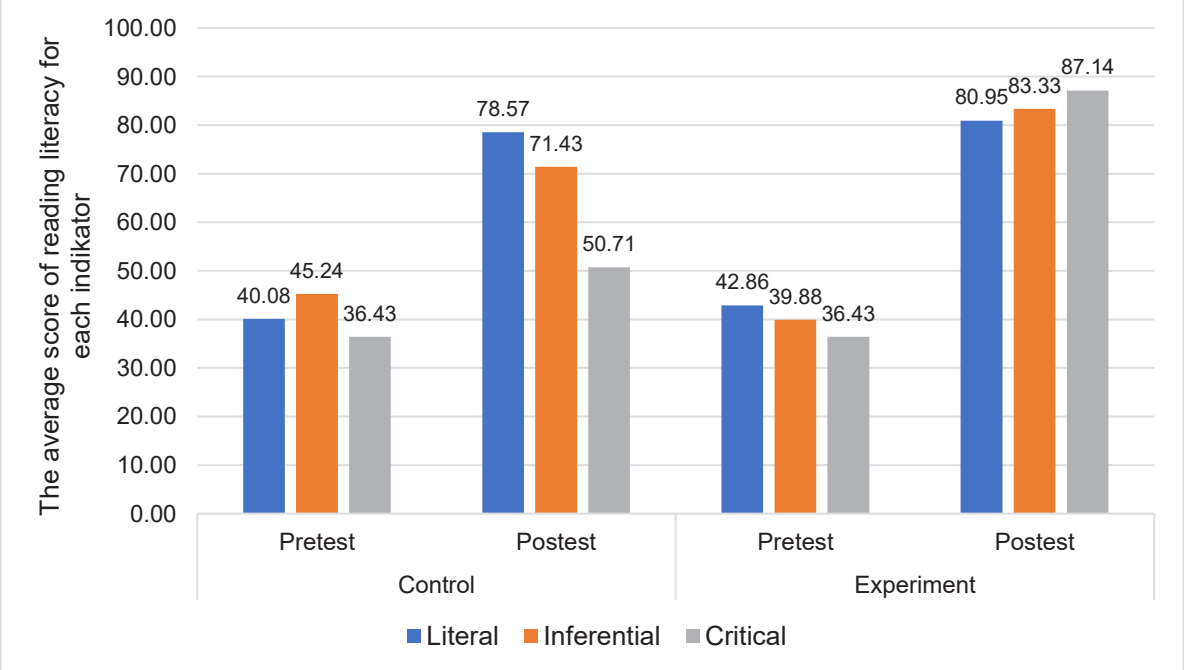

Figure 2. Average Pretest and Posttest Scores for Each Indicator of Reading Literacy

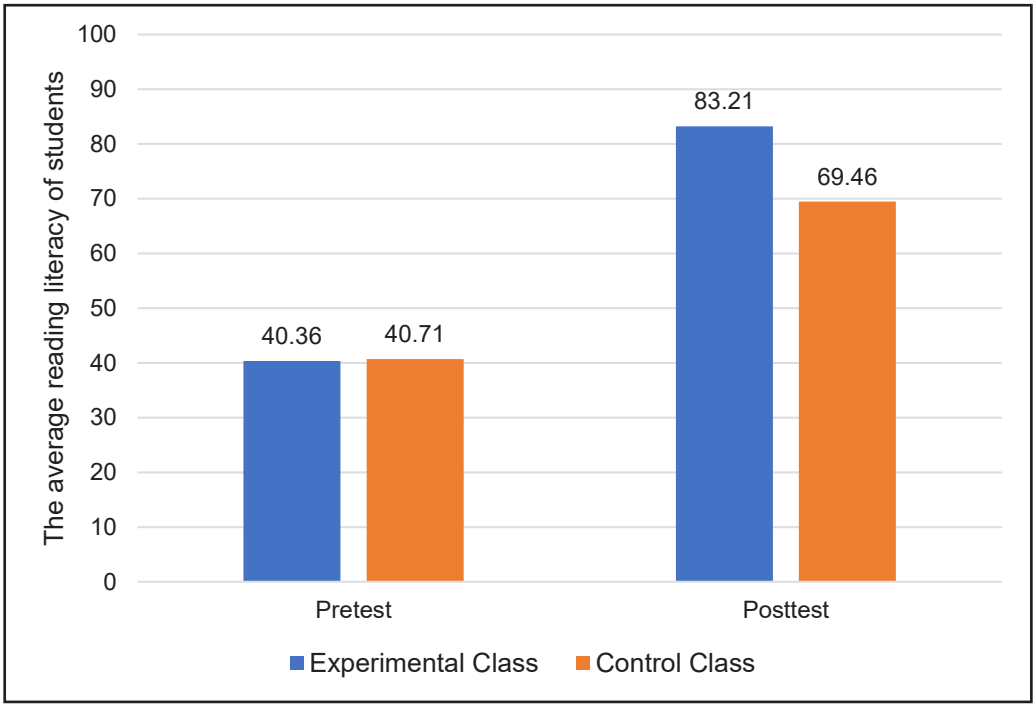

Figure 3. Average Pretest and Posttest Scores for Reading Literacy

Table 9. Mean Difference Test

	Sig.Value (2-Tailed)	Description
Pretest and pretest (control and experimental)	0.948	No significant difference in means
Pretest and posttest experimental	0.000	Significant difference in means

After the N-Gain analysis, an effect size analysis was conducted. The results showed an effect size score of 1.87 (large effect). Its mean that implementing the anticipation guide strategy integrated with argumentation activities has a significant impact on fostering reading literacy compared to using only conventional reading strategies. These findings also scientifically prove that argumentative activities incorporated into reading strategies have a significant impact on improving students' reading literacy. They are far more effective than simply using traditional reading activities. This score provides clear evidence that teachers need to select appropriate reading strategies to optimize the learning process.

The anticipation guide strategy consists of three main stages, namely pre-reading, during, and post-reading, that have a positive effect on students' reading literacy. According to Evan (2022), the anticipation guide strategy is effective in activating students' prior knowledge and training them to reflect on their understanding after reading. In the reading process, activating prior knowledge is crucial because students need this knowledge to understand each text they read (Hattan, 2024). Therefore, the use of the anticipation guides strategy enables students to more quickly grasp the literal meaning of a text, providing a foundation for deeper understanding. This, in turn, optimally develops students' reading literacy, including literal, inferential, and critical reading. In fact, according to Nasution (2019), the anticipation guides strategy facilitates students' ability to connect the meaning of the text they read with previously acquired knowledge and experience.

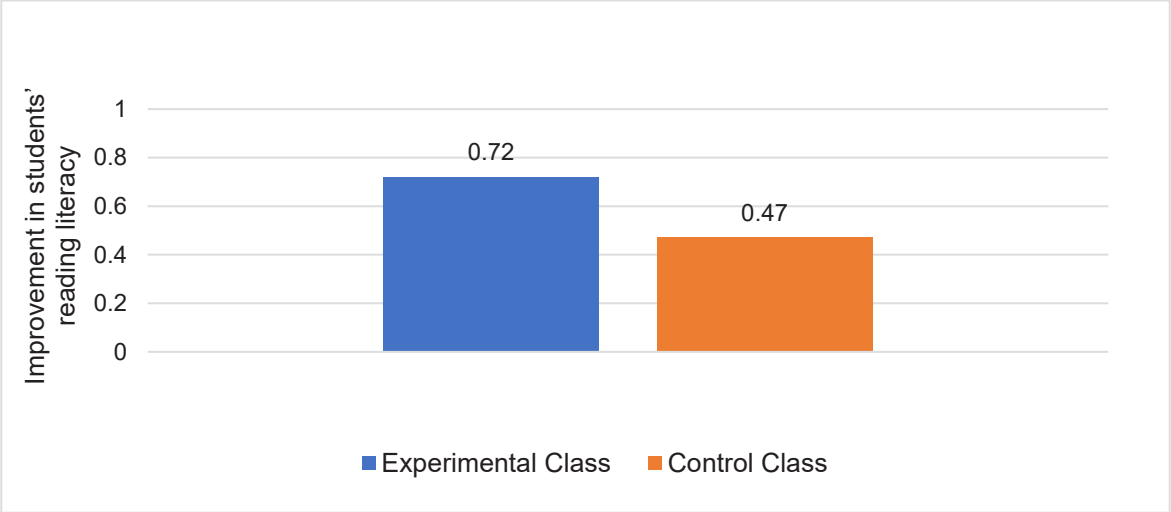

Figure 4. *N-Gain* Result

Furthermore, in the anticipation guides strategy, in the pre-reading stage, students respond to statements given by the teacher by responding with "agree or disagree" responses. The pre-reading stage of this strategy trains students to engage in initial argumentation activities, basing evidence on their prior knowledge (Fenty, 2019). This stage triggers cognitive conflict in students' minds, forcing them to choose an answer but presenting reasons and evidence that they must demonstrate textually in the reading. Therefore, this activity fosters the development of literal, inferential, and critical reading because students are forced to make predictions and verify them while reading (Siswanto, 2014).

As shown in Figure 4, the anticipation-guided strategy is highly effective in improving critical reading skills compared to conventional reading. This is because, while reading, students are trained to evaluate and critique texts accompanied by scientific argumentation. Students are asked to provide textually valid evidence within the text and provide explanations regarding the relationship between the evidence and the data presented to strengthen their claims. Several research findings indicate that engaging students in reading activities accompanied by argumentation is highly effective in developing critical reading skills (Jimola, 2021). Scientific argumentation is the foundation for critical thinking (Rapanta, 2019).

According to Evans (2022), during and after reading, students engage in metacognitive activities. At this stage, students are trained to re-evaluate their answers to questions, thereby fostering inferential and critical reading skills. This stage is crucial for students, as reading involves not only promoting the literal reading, but also assessing whether the reading process was appropriate. According to Tang (2025), reading will be effective if students understand what they have not understood and what they have understood. Thus, anticipation guide activities supplemented with argumentation (e.g., class discussion: "*Why did I choose to disagree? What evidence in the text influenced my change of answer*?") can strengthen critical and inferential aspects.

From a practical perspective in the classroom, guided argumentation activities using anticipation guides can be carried out in several stages: teachers prepare anticipation statements that challenge students' assumptions (including assumptions that may be incorrect) (Gumilar, 2025); students respond with "*agree/disagree*" and state their initial reasons; students read the text; students return to the statements, revise their answers if necessary, and look for evidence from the text that supports their change or maintains their views (Evans, 2022). In this stage, literal reading skills are trained when students look for facts in the text, inferential skills are trained when students make connections between statements and implied evidence, and critical skills are trained when students evaluate and discuss their initial assumptions about the text they read.

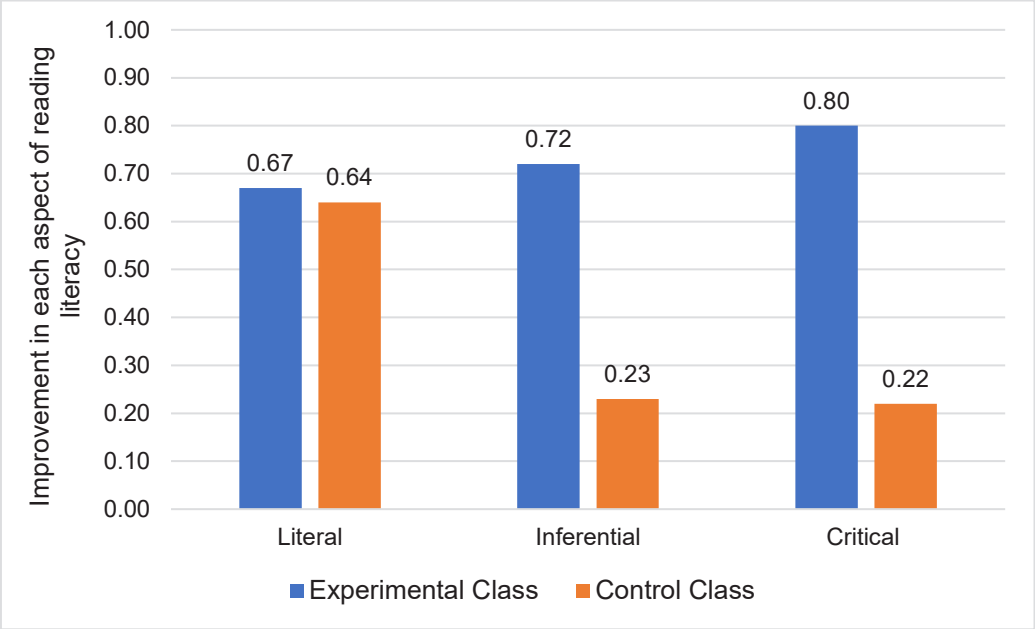

Figure 5. *N-Gain* Each Indicator

The effectiveness of the integrated anticipation guides strategy with argumentation activities is also due to its effectiveness in engaging students to become more actively involved in reading. In the experimental class, students demonstrated active engagement when providing answers to all the questions given and writing arguments to support their chosen answers. This made students more motivated to read (Siswanto, 2022). Furthermore, this strategy actively engaged students in conducting textual hypothesis testing by providing comprehensive and scientific arguments to strengthen their answer choices. In fact, students could become very active readers because they had to read repeatedly to gather accurate evidence to support their arguments. This made reading literacy training even more effective (Yang, 2021).

Furthermore, the reading activities undertaken by students using this strategy provide students with the freedom to express their ideas, ask clarifying questions, and construct scientific arguments. This makes critical reading training more effective. Research findings indicate that engaging students in structured argumentation activities can improve their conceptual understanding (Siswanto, 2022). This reading process automatically helps students become reflective and critical readers and engages them in stronger metacognitive processes (Yang, 2021).

Therefore, this study provides accurate evidence that the integration of argumentation activities in the anticipation guides strategy can improve students' reading literacy, both at the literal, inferential, and critical levels. This strategy helps students understand texts comprehensively, starting from generating prior knowledge, making predictions and verification, as well as reflection and argumentation (Evans, 2022; Fenty, 2019). This is because several research findings indicate that in reading activities, students need to be actively involved in practicing scientific argumentation by seeking justification and textually valid evidence to strengthen the claims put forward (List, 2022). Based on this, the strategy is very important in the science learning process to train students' reading literacy comprehensively.

CONCLUSION

Based on the research, the implementation of the anticipation guides strategy integrated with scientific argumentation activities can effectively improve students' reading literacy. The increase in students' reading literacy is categorized as high based on the N-gain test. In addition, based on the effect size test, the implementation of the anticipation guides strategy integrated with argumentation activities provides a large effect

when compared to the use of traditional reading strategies. These findings provide a recommendation that the involvement of argumentation as an example of scientific practice can be carried out in reading activities in science learning. Science educators can adopt this strategy to support the development of students' reading literacy.

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