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Profiling students' critical thinking and communication skills through research-oriented collaborative inquiry learning

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Abstract

Research-based learning through teacher-guided collaborative activities offers students meaningful and direct learning experiences. This study aimed to examine how students' critical thinking and communication skills develop through the application of the Research Oriented Collaborative Inquiry Learning model. A descriptive method with a quantitative approach was employed, with purposive sampling used to select a sample of 29 grade nine students. Data were collected using structured observation instruments designed to assess critical thinking, oral communication, and written communication skills. The learning stages of the model were implemented with a high level of adherence, indicating effective instructional execution. Observational data showed that students demonstrated moderate proficiency in all three skill areas. The findings suggest that the model is effective in promoting the development of essential competencies, particularly in science education at the junior secondary level. By engaging students in collaborative inquiry and guided research activities, the model fosters both analytical reasoning and communication in classroom contexts. These results highlight the value of structured, inquiry-based learning in supporting cognitive and interpersonal skill development.

***Keywords*:** Communication skills; critical thinking; inquiry-based learning; research-oriented learning; secondary education

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1. INTRODUCTION

Contemporary educational paradigms in the twenty-first century emphasize the creation of student-centered collaborative environments aimed at enhancing knowledge acquisition, skill development, and attitudinal growth (Boholano, 2017). Mastery of conceptual understanding, laboratory competence, problem-solving capabilities, critical thinking, and a diverse array of additional competencies is regarded as essential (Lawrence et al., 2019; Ben Ouahi et al., 2022; Tadesse & Gillies, 2022). Despite these expectations, current instructional practices remain predominantly teacher-centered, which contributes to passive learner engagement and limited application of acquired knowledge (Emaliana, 2017; Situmorang et al., 2022).

Instructional activities largely continue to function as mechanisms for knowledge transmission, offering limited opportunities for formative feedback and practical experience necessary for developing critical thinking and applied competencies (Goodman et al., 2018; Komatsu et al., 2021; Ay & Dağhan, 2023). A strong focus on cognitive mastery persists (Aleshchanova et al., 2017; Schibli et al., 2017), while psychomotor and affective domains receive insufficient attention (Alannasir, 2020; Supena et al., 2021; Ramírez-Montoya et al., 2022). This condition may result from a lack of awareness among educators regarding the competencies required for effective twenty-first century learning (Boholano, 2017; Kaput, 2018).

Optimal learning outcomes necessitate the implementation of appropriate pedagogical models. Research-oriented collaborative inquiry learning is positioned as a promising approach to address existing challenges and to reframe perceptions regarding the importance of practical engagement. The integration of theoretical and practical needs through the REORCILEA model has demonstrated potential in enhancing critical thinking and communication skills in a progressive manner (López-Belmonte et al., 2021).

Research-based learning approaches are instrumental in developing essential competencies relevant to contemporary education (Khoiri et al., 2021). These models demand active learner engagement in scientific inquiry, including problem identification, hypothesis testing, exploratory investigation, problem resolution, and communication of findings (Nursofah et al., 2018; Susiani et al., 2018). Designed to incorporate discovery-based and problem-based elements, research-based curricula provide experiential learning that supports knowledge construction and transfer to complex contexts (Usmeldi et al., 2017; Wessels et al., 2021; Cheng et al., 2023). Practical activities evolve beyond guided procedures to autonomous research-driven inquiry (Camacho et al., 2017; Suntusia et al., 2019).

Collaborative learning environments are essential for facilitating discourse and cooperative problem solving relevant to real-world contexts (Pires et al., 2020). Collaborative engagement promotes group cohesion, goal alignment, mutual understanding, and negotiated reasoning through coordinated interaction, thereby enhancing learning outcomes (Fakomogbon & Bolaji, 2017; Zhang et al., 2022). Emphasis on communication within collaborative inquiry-based instruction fosters active participation and collective reflection on disciplinary knowledge and theoretical constructs (Fu & Hwang, 2018; Sung & Hwang, 2013; Bhuttah et al., 2024).

1.1. Literature review

The REORCILEA model constitutes a constructivist pedagogical framework that effectively bridges theoretical instruction with experiential learning (Fiolida et al., 2021). It synthesizes the principles of inquiry, collaboration, and research-based learning to promote active engagement and experimentation (Rohaeti & Prodjosantoso, 2020). This model supports learner autonomy and offers meaningful educational experiences by fostering the ability to distinguish, organize, and integrate information (Saputro et al., 2019).

The REORCILEA instructional sequence encompasses five stages: Initiating, Hypothesizing, Experimenting, Writing, and Evaluating and Reflecting. During the Initiating phase, learners confront unstructured problems and engage in exploratory reasoning. The Hypothesizing stage involves the articulation of questions and potential

explanations grounded in empirical evidence. The Experimenting phase replicates scientific procedures in a laboratory setting to test hypotheses collaboratively. The Writing phase involves the compilation, organization, and presentation of data through various forms of representation, culminating in the production of concise scientific narratives. Finally, the Evaluating and Reflecting stage incorporates evaluative practices and metacognitive reflection on performance and understanding (Rohaeti & Prodjosantoso, 2020).

1.2. Related studies

Prior studies have demonstrated the effectiveness of collaborative inquiry within research-oriented frameworks in enhancing critical thinking (Espinosa et al., 2013; Uzunöz & Demirhan, 2017). Critical thinking encompasses advanced cognitive operations essential to problem-solving, including issue identification, argument evaluation, relational analysis, and evidence-based reasoning (Firipis et al., 2018).

Competency in critical thinking and scientific inquiry is positively correlated with communication proficiency, both of which are integral to scientific literacy (Ridlo, 2020). Communication is foundational to the scientific enterprise and constitutes a core component of scientific epistemology (Nielsen, 2013). Enhanced communication capabilities contribute to improved cognitive processing and conceptual understanding. Argument construction benefits from engagement in experimental design, data analysis, and evidence-based justification in collaborative settings (Cigdemoglu et al., 2017).

Science as a discipline is characterized by systematic observation, methodical inquiry, and the logical interpretation of natural phenomena, facilitating problem resolution and the generation of new knowledge (Mutvei et al., 2018). It is distinguished by its exploratory and explanatory orientation toward the natural world (Aristeidou & Herodotou, 2020). Scientific practice is driven by intrinsic curiosity, encompassing not only phenomena of interest but also the role of the investigator and the processes of knowledge transformation during inquiry (Nouri et al., 2021).

Scientific methodology includes sequential stages such as observation, problem formulation, hypothesis development, experimental testing, data interpretation, and theory generation (Camerer et al., 2018). Science embodies a synthesis of conceptual products, procedural methods, and attitudinal dispositions. Learning science effectively requires the integration of these elements through skill development aimed at achieving educational objectives (Gulen, 2019). Emphasis is placed on critical reasoning and the capacity to communicate outcomes derived from investigative activities (Nguru, 2021; Tsybulsky, 2019).

1.2. Purpose of study

The study investigated the enhancement of students' critical thinking and communication competencies resulting from the application of the Research Oriented Collaborative Inquiry Learning model.

2. METHODS AND MATERIALS

2.1. Participants

This research was conducted in April 2022 at SMP Negeri 14 Yogyakarta. This study used a descriptive method with a qualitative approach. The population in this study were all students of class IX, which consisted of 4 classes, namely class IX A, IX B, IX C, and IX D. The sample in this study used a purposive sampling technique to obtain class IX C with 29 students.

2.2. Data collection instrument

The research instrument used was an observation sheet on critical thinking skills consisting of 19 items as shown in Table 1, oral communication skills consisting of 11 items as shown in Table 2, and written communication skills consisting of 9 items as shown in Table 3 modified based on some previous research. Items of critical thinking

skills were presented in a diatomic type; if yes, it is worth 1, and if not, it is worth 0. Oral and written communication skills were presented on a 5-point Likert scale (1-very low, 2-low, 3-average, 4-high, 5-very high).

Table 1

Instrument of critical thinking skills

Items	Descriptions
1	Make simple hypotheses or guesses in their language from a question on the LKPD
2	Estimating the alleged substance contained in each object
3	Conclusions based on facts
4	Conclusions from practical results
5	Prepare tools and materials
6	Have a discussion before practicum
7	Find information from various sources
8	Making experimental procedures or practical work steps
9	Analyzing argument questions, namely students provide simple explanations by looking at facts that exist in everyday life
10	Asking and answering questions, that is, students can ask and answer questions about an explanation of the questions in the practicum
11	Mention examples of objects in everyday life that have the same content as objects that have been practiced
12	Smell all the ingredients used in the practicum before burning
13	Smell all the ingredients used in the practicum after being burned
14	Caution in practice
15	Fill in the table of observations of practical results on the LKPD
16	Presenting practical results
17	Explain how the smell of an object before and after being burned
18	Grouping the same smell of burned objects
19	Explain why an object that is burned produces a certain smell

Table 2

Instrument of oral communication skills

Items	Description
1	Effective introduction
2	Main objectives and ideas
3	The student presents and properly argues the results
4	Conclusions are appropriate and concise
5	Discuss and justifies the information presented
6	Structured, clear, effective and consistent
7	Appropriate technical language
8	Available resources for a more efficient communication
9	Adjust to time available
10	Clear voice, the right tone, proper corporal posture and eye contact with the audience
11	Analyze, evaluate and answer the audience questions

Table 3

Instrument of written communication skills

Items	Description
1	Effective introduction
2	Main objectives and ideas
3	The student presents results and is well-founded
4	Conclusions are appropriated and concise
5	Report clear, structured, and coherent
6	Formal style and format
7	Grammar (orthography)
8	Appropriate technical language
9	Discuss and justifies the information presented

2.2.1. Validity and reliability

Before the observation sheet instrument was used in research activities, the validity test was carried out using SPSS Statistics 25. All instrument items used were valid. R table for data with the N = 59 is 0.252. Based analysis by using SPSS showed that the alpha Cronbach value of the critical thinking skill observation sheet instrument is 0.633, so 0.633. > 0.252, then the data is reliable. R table for data with the N = 13 is 0.553. Based analysis using SPSS showed that the alpha Cronbach value of the oral communication skill observation sheet instrument is 0.579, so 0.579 > 0.553, then the data is reliable. R table for data with the N = 49 is 0.281. Based on analysis using SPSS showed that the alpha Cronbach value of the written communication skill observation sheet instrument is 0.588, so 0.588 > 0.281, then the data is reliable.

2.3. Data collection and analysis

The data collection technique was carried out directly at the school using the observation sheet instrument. Two science education master students were used as observers. The observation criteria given are grouped as shown in Table 4 to determine the level of students' critical thinking skills. The calculation of the percentage score with the equation formula is as follows.

$$R = \frac{f}{n} \times 100\%$$

Description:
R = Percentage score
F = Total score obtained
N = Maximum score obtained

Table 4
Criteria percentage of critical thinking skills

Percentage (%)	Criteria
0.00-29.99	Very Low
30.00-55.99	Low
56.00-79.99	Average
80.00-89.99	High
90.00-100	Very High

The observation criteria given are grouped as shown in Table 5 to determine the level of students' oral and written communication skills. The calculate score with the equation formula as follows.

$$S = \frac{f}{n}$$

Description:
S = Score
F = Total score obtained
N = Total item

Table 5
Criteria of oral and written communication skills

Range	Criteria
x ≤ 2.00	Very Low

2.00 < x ≤ 3.00	Low
3.00 < x ≤ 4.00	Average
4.00 < x ≤ 4.50	High
4.50 < x ≤ 5.00	Very High

Analysis of the implementation learning stages in the lesson plan can be done to determine how the learning process occurs. The IJA (Inter Judge Argument) formula calculates the implementation learning stages. IJA calculation criteria are shown in Table 6.

$$IJA = \frac{Ay}{Ay + AN} \times 100\%$$

Description:
Ay = Activities carried out
AN = Activities not carried out

Table 6
Criteria percentage of learning implementation

Percentage (%)	Criteria
0.00-20.00	Very Low
20.10-40.00	Low
40.10-60.00	Average
60.01-80.00	High
80.10-100	Very High

3. RESULTS

3.1. Research oriented collaborative inquiry learning (REORCILEA)

The learning stages (RPP) implementation with an IJA calculation of 87.50% with a very high category**.** Table 7 describes the results of applying the REORCILEA model to learning.

Table 7
Learning stages of REORCILEA model

Activity	Stages	Implementation	Description
Preliminary	The teacher opens the class with greetings.	Done	
	The teacher directs the students to pray before starting the lesson.	Not	Because this subject is carried out in the first hour of learning, before this first hour the school holds routine activities and prays together in class.
	The teacher checks attendance.	Done	
	The teacher gives apperception	Done	
	The teacher gives motivation.	Done	
	The teacher informs about learning objectives, materials, core competencies, basic competencies, indicators, and KKM.	In part	Teachers do not inform about core competencies, indicators, and KKM.
	The teacher divides study groups.	Done	By seat
Core	*Initiating* - The teacher provides a stimulus in the form of a	Done	Students give attention to and understand the PPT and learning videos.

	phenomenon to students to be observed and listened to - Students observe - Students read, study, and seek information		When the teacher gives time to read and look for other information in textbooks or the internet, not all students do it, only some of them.
	Hypothesizing - Students make questions	Done	Some students ask.
	- Students make hypotheses from the practicum that will be implemented		Some students do not make hypotheses before doing the practicum.
	Experimenting Students formulate goals, determine variables, design steps, and conduct, and observe experiments.	Done	Some students just do the practicum without understanding what is contained in the LKPD. Just ask the teacher what to do. There are students in practical activities who are passive and even play with practical tools and materials.
	Writing - Students write the experimental data into the table	Done	For each material that has been tested, students immediately write down the experimental data in the table.
	- Students write reports of temporary experimental results and conclusions.		Some students do not write a temporary report on the results of the experiment.
	Evaluating and Reflecting - Students present the results of their experiments with their groups	In part	Two groups presented their experimental results. There are no questions given by other groups to the group presenter.
	- Students answer questions from the teacher and other students		
	- Students compile the final report of the experiment.		Students do not make a final experimental report because the LKPD given all the report formats are already in it and are structured and clear.
	Make a summary/conclusion of the lesson on the important points of learning.	Done	Two to three students answer in turn about what can be concluded in this meeting.
Closing	Give assignments to students.	Done	The teacher gives assignments contained in the science textbooks.
	Remind students to study the material that will be discussed at the next meeting.	Done	
	Greetings and Prayers.	Done	

3.2. Critical thinking skills

All students of class IX C take a critical thinking skills assessment. The average percentage of students' critical thinking skills in learning with the REORCILEA model is 71.13%. The minimum percentage of critical thinking skills possessed by students is 47.36%, and the maximum is 89.47%. Table 8 shows the results of the descriptive test.

Table 8

Descriptive statistics of students' critical thinking skills using the reorcilea model

Descriptive Statistics					
	N	Minimum (%)	Maximum (%)	Mean (%)	Std. Deviation
Critical	29	47.36	89.47	71.1390	10.86127
REORCILEA	29	1	1	1.00	.000
Valid N (listwise)	29				

The observer filled in the critical thinking skills instrument during group practicum activities, presentation activities, and after the results of the student worksheet were collected. The calculation of the percentage of assessment and the criteria for assessing critical thinking skills are written in Table 9.

Table 9

Results of students' critical thinking skills

Items	Percentage (%)	Criteria
Make simple hypotheses or guesses in their language from a question on the LKPD	58.62	Average
Estimating the alleged substance contained in each object	93.10	Very High
Conclusions based on facts	55.17	Low
Conclusions from practical results	68.96	Average
Prepare tools and materials	86.20	High
Have a discussion before practicum	75.86	Average
Find information from various sources	34.48	Low
Making experimental procedures or practical work steps	93.10	Very High
Analyzing argument questions, namely students provide simple explanations by looking at facts that exist in everyday life	34.48	Low
Asking and answering questions, that is, students can ask and answer questions about an explanation of the questions in the practicum	41.37	Low
Mention examples of objects in everyday life that have the same content as objects that have been practiced	37.93	Low
Smell all the ingredients used in the practicum before burning	100	Very High
Smell all the ingredients used in the practicum after being burned	100	Very High
Caution in practice	79.31	High
Fill in the table of observations of practical results on the LKPD	100	Very High
Presenting practical results	44.82	Low
Explain how the smell of an object before and after being burned	93.10	Very High
Grouping the same smell of burned objects	62.06	Average

Explain why an object that is burned produces a certain smell	93.10	Very High
Total	71.13	Average

3.3. Oral communication skills

The observer filled in the instrument for assessing oral communication skills during the presentation. In contrast, the observer filled out the instrument for the written communication skill after the students collected the student worksheet.

3.3.1. Oral communication skills

The table 10 shows the results of the descriptive test of students' oral communication skills using the REORCILEA model.

Table 10

Descriptive statistics of students' oral communication skills using the REORCILEA model

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
REOCILEA	9	1	1	1.00	.000
Oral	9	2.90	3.72	3.2889	.29595
Valid N (listwise)	9				

Nine students took the oral communication skills assessment because only two groups did presentation activities. The average of students' oral communication skills in learning with the REORCILEA model is 3.28. The minimum value of oral communication skills possessed by students is 2.90, and the maximum is 3.72. The calculation of the averages of assessment and the criteria for assessing oral communication skills are written in Table 11.

Table 11

Results of students' oral communication skill

Items	Averages	Criteria
Effective introduction	2.89	Low
Main objectives and ideas	4.00	High
The student presents and properly argues the results	3.22	Average
Conclusions are appropriate and concise	3.56	Average
Discuss and justifies the information presented	3.67	Average
Structured, clear, effective and consistent	3	Average
Appropriate technical language	3.56	Average
Available resources for a more efficient communication	3	Average
Adjust to time available	2.56	Low
Clear voice, the right tone, proper corporal posture and eye contact with the audience	4.00	High
Analyze, evaluate and answer the audience's questions	2.78	Low
Total	3.28	Average

3.3.2. Written communication skills

The table 12 shows the results of the descriptive test of students' written communication skills using the REORCILEA model.

Table 12

Descriptive statistics of students' written communication skills using the REORCILEA model

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
REORCILEA	24	1	1	1.00	.000
Written	24	2.78	3.78	3.3009	.25056
Valid N (listwise)	24				

Twenty-four students took the written communication skills assessment because there were students who still needed to collect student worksheets. Students' average written communication skills in learning with the REORCILEA model is 3.30. The minimum value of written communication skills that students have is 2.78, and the maximum value is 3.78. The calculation of the averages of assessment and the criteria for assessing written communication skills are written in Table 13.

Table 13

Results of students' written communication skill

Items	Averages	Criteria
Effective introduction	4	High
Main objectives and ideas	3.20	Average
The student presents results and is well-founded	3.16	Average
Conclusions are appropriated and concise	3.04	Average
Report clear, structured, and coherent	4	High
Formal style and format	3.29	Average
Grammar (orthography)	2.87	Average
Appropriate technical language	2.87	Average
Discuss and justifies the information presented	3.25	Average
Total	3.30	Average

4. DISCUSSION

The preliminary activities did not proceed in the prescribed sequence, and several components were omitted. The class began with a greeting, followed by an apperception activity linking the current material to previous lessons and the topic of the present session. Students were seated in groups based on their assigned positions, requiring them to adjust their desks accordingly. During this process, the teacher recorded student attendance. Motivational input was then provided, along with information regarding learning objectives, instructional content, and essential competencies. The sequence in the lesson plan was not followed strictly, as the teacher adapted the procedure to align with classroom dynamics at the start of the session.

In contrast, the core activities were implemented in accordance with the planned sequence, and all stages were completed. During the experimentation phase, students occasionally failed to adhere to procedural order, such as omitting prerequisite steps before progressing. Disruptions were noted, including instances where male students disturbed female peers, temporarily disrupting classroom order. Enthusiasm was evident during hands-on activities, although engagement diminished when responding to analytical questions in the student worksheet. Presentation opportunities were limited by time constraints, allowing only two groups to share their results despite interest from additional groups.

Closing activities were conducted in order and were fully implemented. However, student focus declined during this phase due to concurrent efforts to clean practical equipment and prepare for the subsequent lesson. Despite some procedural deviations and omissions, the modeling session using the Research Oriented Collaborative Inquiry Learning (REORCILEA) model in class IX-A was generally executed successfully.

According to the data presented, the overall percentage of students' critical thinking skills in the implementation class was 71.13 percent, which falls within the average category. Three items were classified in

the very high category, with 100 percent of students demonstrating competency in statements 12, 13, and 15. These included sensory observation of practicum materials before and after combustion and accurate completion of observation tables in the worksheet, indicating a strong understanding of experimental procedures.

Additional items classified in the very high category included statements 2, 8, 17, and 19, each scoring 93.10 percent. These findings reflect students' abilities to hypothesize anticipated outcomes, construct experimental procedures, albeit with repeated guidance, and justify responses in the worksheet. One high-category item was identified in statement 5, regarding the preparation of tools and materials. Most students brought necessary items from home, although some were incomplete, and efforts were made to compensate using available resources. Statement 14, which assessed carefulness during the practicum, was also in the high category. While some students were distracted, others demonstrated consistent attention to safety protocols.

Statements 1, 4, 6, and 18 were categorized as average. Students were generally capable of making preliminary predictions and drawing fact-based conclusions from the results. Group discussions were held prior to practical activities, focusing on anticipated outcomes, and observations were appropriately classified in the worksheet.

Statements 7 and 9 were placed in the low category, with scores of 34.48 percent, indicating deficiencies in sourcing external information and argument analysis. Despite teacher authorization to use mobile phones, students often used them for unrelated applications. Responses to peer inquiries were limited, with most engagement initiated by the teacher.

Additional low-category items included statements 3, 10, 11, and 16. Students' conclusions were often limited to immediate results, lacking broader contextual interpretation. Worksheet responses were typically restricted to direct questions, with limited spontaneous participation. Connections between practicum results and real-world contexts were minimal. Furthermore, due to time limitations, only two groups were able to present findings, although more groups had prepared presentations.

Regarding oral communication skills, the average score among the implementation class, represented by two groups of nine students, was 3.28, classified as intermediate. The highest-scoring items, statements 2 and 10, each received a score of 4, reflecting high performance. These statements assessed the clarity of objectives and main ideas, vocal delivery, tone, gesture, and eye contact. Students presented their findings clearly, maintained appropriate posture, and engaged visually with the audience, ensuring effective communication.

Items in the average category included statements 3, 4, 5, 6, 7, and 8. Students generally presented all results sequentially and offered accurate conclusions. Worksheets were completed through group discussions, though not all students actively participated. Technical language usage was inconsistent, with frequent errors attributed to unfamiliarity. Although access to reference materials was provided, some students opted to engage with unrelated digital content.

Statement 9 had the lowest score of 2.56, categorized as low. Time constraints impacted presentation quality, leading to rushed and less effective delivery. Statements 1 and 11 also fell in the low category. Students introduced themselves collectively rather than individually, reducing clarity. When questioned by peers, responses were often inadequate and required teacher intervention.

In terms of written communication, the average score across 24 submitted worksheets was 3.30, also within the intermediate category. Statements 1 and 5 received the highest scores of 4, indicating effective introductions and structured, coherent presentation. Students correctly completed identity sections and structured responses logically.

Items with intermediate scores included statements 2, 3, 4, 6, and 9. While some students articulated practicum objectives and key ideas clearly, others did so incompletely. Reasoning in responses was inconsistently

applied. Conclusions were often partial, lacking integration of both factual data and experimental results. The organization of worksheet responses was generally logical, though some remained poorly structured.

Statements 7 and 8 received the lowest average scores of 2.87, indicating low performance in grammar and technical language. Numerous errors were identified, including misuse of vocabulary, inconsistent spelling, abbreviation without standard formatting, and incorrect application of scientific terminology.

5. CONCLUSION

The implementation of the Research Oriented Collaborative Inquiry Learning (REORCILEA) model was conducted effectively and demonstrated appropriateness, despite the presence of several instructional challenges. The execution of learning stages under the REORCILEA model was categorized as very high, with an implementation score of 81.25 percent. Students' critical thinking skills, oral communication, and written communication were classified within the average category, with respective scores of 71.13 percent, 3.28, and 3.30. The REORCILEA model has demonstrated potential in enhancing students' critical thinking by promoting student-centered learning practices.

In the application of the REORCILEA model, instructional adaptation to students' academic backgrounds is essential to ensure the smooth implementation of each learning stage. Furthermore, the model contributes to the development of communication skills by engaging students in experiential activities such as practicum-based learning, which fosters interpersonal interaction and participation. Future research is recommended to examine the effectiveness of the REORCILEA model in enhancing critical thinking and to explore the correlation between critical thinking and communication skills. The current study involved a limited number of observers, specifically two graduate students in science education. Subsequent studies should consider involving several observers proportional to the student groups within the class to allow for more accurate and comprehensive observation of each instructional stage.

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