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Analysis of Oral Argumentation: Bridging Curriculum and Reality in Science Classrooms

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Abstract
Oral argumentation skills are crucial for 21st-century scientific literacy, yet they are inadequately developed in numerous educational environments. This study examines the oral argumentation skills of students in biology classes at Level A accredited junior and senior high schools in Lampung Province, Indonesia. Using a descriptive qualitative survey design with 132 participants, data were gathered through audio-visual recordings of classroom discourse and examined using a systematic coding framework. The results show that students' skills are very weak, with average scores below 12% for both levels of education. Most of the arguments were only at Level 1 or Level 2 of the Toulmin Argument Pattern, using simple claims without strong evidence or counterarguments. Even though the schools had a high level of accreditation, they had a teacher-centered focus and didn't have any interactive media, which made it hard for students to think critically. These results show that there is a big difference between what the national curriculum says should happen in the classroom and what actually happens. To help students develop higher-order thinking skills, we need to move toward a student-centered, inquiry-based way of teaching.

Keywords: Oral Argumentation Skills, Biology Learning, Accredited Schools, Discourse Analysis

1. Introduction

In the 21st century, education must provide students with the skills, knowledge, and competencies essential for adapting to swiftly evolving environments and achieving success in personal and professional spheres (Dishon & Gilead, 2021). The paradigm of contemporary learning underscores the cultivation of holistic competencies that encompass cognitive understanding, character development, creativity, and innovation, thereby creating a comprehensive educational experience that meets global standards (Aithal & Srinivasan, 2025). This educational vision promotes skills like critical thinking, problem-solving, working together, and talking to others. Critical thinking is considered a fundamental component of effective learning and can be developed through strong argumentation skills (Sellars et al., 2018).

Argumentation is the mental and verbal process by which people think about information about a certain topic and share their well-thought-out conclusions with others (Bathgate et al., 2015; Mercier, 2016). It helps people find and put together facts, procedures, and ideas, which leads to reasoning that makes sense and is based on evidence. Strong argumentation skills are very helpful when people have to solve problems in context, where they have to use logical evidence to back up their points of view (Belland et al., 2008). In schools, one of the main goals is to teach students how to argue well. Teachers are supposed to create learning experiences that help students improve these skills (Kim et al., 2019). However, research has shown that high school students in Lampung Province, Indonesia, are very bad at making arguments. A study conducted in 12 schools with different levels of accreditation found that students did poorly on tasks that required them to make arguments that went beyond just making claims. Instead, they often didn't back up their claims with the right reasoning, warrants, or evidence (Maulina et al., 2023). Oral communication skills, which are the basis for making arguments, are also important for working together well and being engaged in the classroom (Hill, 2021). Teachers who are good at speaking can clearly explain things and keep the class running smoothly. They can also build relationships that encourage students to participate more (Xie & Derakhshan, 2021). These skills go beyond teaching and help teachers, students, parents, and other people involved in education talk to each other (Luginbühl & Müller-Feldmeth, 2022). Oral argumentation, unlike its written form, facilitates dynamic and interactive exchanges that allow participants to directly respond to each other's arguments (D. Kuhn et al., 2013). Research indicates that components like rebuttals are more common in oral contexts, underscoring the immediacy and responsiveness of spoken debate (Huangfu et al., 2023). To effectively justify their positions, participants must not only apply their knowledge but also employ rhetorical strategies, adopt suitable stances, and discern weaknesses in opposing arguments (Newell et al., 2011).

Research conducted by Evagorou et al., (2023) corroborates this observation, indicating that while students frequently formulate claims in argumentative tasks, they infrequently provide supporting data, warrants, or rebuttals. For instance, 86% of students could make a claim, but only 28% gave data, and only 5% used qualifiers. Almost no students gave warrants or rebuttals. These results indicate that students' argumentative skills are superficial and lack depth, highlighting the consequences of learning loss. The restricted capacity to formulate comprehensive arguments indicates significant educational deficiencies arising from inequities in technological access, instructional quality, and extended school closures (Harmey & Moss, 2023).

Interviews with science teachers in junior and senior high schools in Lampung support these findings. Teachers said that students are usually reluctant to talk about things and don't often share their thoughts or make arguments. Students don't often use scientific facts in their arguments, and their discussions are often shallow and disconnected, probably because the prompts aren't clear or there isn't enough support (Reiser, 2013). Students can't make good arguments or improve their critical thinking skills when they aren't involved (Sulung & Erman, 2022). Argumentation is an important part of biology education because it helps students connect what they learn in class to things that happen in the real world. Biology is based on things that can be seen and experienced in nature, which makes it a great subject for teaching people how to argue (Hasnunidah et al., 2023). However, a lot of students have trouble connecting biological concepts to their everyday lives, which shows that the curriculum doesn't match up with what students actually do (Webster et al., 2022). So, good teaching must stress argumentative ways of learning science so that students can explain what they know using evidence-based reasoning (Kuhn & Reiser, 2005).

Biology lessons always have something to do with real life because students have probably come across biological ideas in their daily lives (Tsui & Treagust, 2013). Ideally, this experiential background should give them the tools they need to make arguments based on what they see and how they think (Jiménez-Aleixandre & Erduran, 2007). Students should become more confident and better at making arguments as they participate in biology classes more and more. There is evidence that students become more involved over time, but their arguments are still not very deep or critical (Auerbach & Andrews, 2018). Observations indicate that the majority of high school students present personal opinions devoid of supporting evidence, factual data, or counterarguments. It seems that most students are only able to make basic arguments, making claims with simple reasoning but not the level of sophistication that is expected in higher-level thinking (Miralda-Banda et al., 2021).

These observations underscore a notable discrepancy between the government's vision for 21st-century education, which prioritizes critical, creative, and communicative skills, and the existing practices within classrooms. Learning loss, whether due to ineffective online instruction or limited in-person learning environments, has hindered the advancement of argumentation skills (Bozkurt et al., 2020). To solve this problem, we need to look into how well educational strategies work in junior and senior high schools in a systematic way. Oral argumentation, an inadequately examined yet illuminating indicator of 21st-century learning success, necessitates further scrutiny. This study aims to analyze the oral argumentation skills of students enrolled in biology classes at junior and senior high schools with accreditation level A in Lampung Province.

The main goal of this study is to look into how well students can argue orally in biology classes, with a focus on accredited junior and senior high schools in Lampung. This study's originality resides in its focus on oral argumentation as a metric of 21st-century competencies, rather than written argumentation. Numerous studies have investigated written argumentation; however, there is a scarcity of systematic research on students' verbal reasoning in science education (Bogar, 2019; Jiménez-Aleixandre & Erduran, 2007; Kelly et al., 2007; Morris et al., 2024). This gap is especially important because spoken language is interactive and happens right away, which is very similar to how people talk in real life. This study enhances understanding of students' capacity to formulate, articulate, and justify their ideas within scientific frameworks by emphasizing oral argumentation. This research encompasses an evaluation of students' argumentation frameworks, including claims, data, warrants, and rebuttals, alongside the pedagogical ramifications for cultivating these competencies in the biology classroom. The results are anticipated to guide educators and policymakers aiming to reconcile curricular objectives with actual learning outcomes in Indonesian secondary education.

2. Literature Review

2.1 Argumentation in Science Learning

Argumentation in science education is based on a constructivist perspective, positing that knowledge is actively generated through social interaction and negotiation (DeVries, 2000). From this viewpoint, science transcends a mere collection of facts; it constitutes a social endeavor focused on the formation, evaluation, and justification of knowledge claims (Longino, 2020). Argumentation, consequently, reflects the genuine methodologies of scientists, who participate in discourse to propose, evaluate, and enhance ideas grounded in facts (Tippett, 2009). Many studies show that bringing argumentation into scientific courses has many benefits. Arguing forces students to explain their thinking, deal with misunderstandings, and improve their grasp of scientific ideas (Venville & Dawson, 2010; Sampson & Clark, 2008). Defending a claim and reacting to counterarguments makes them think more deeply and helps them learn more. Argumentation helps people develop higher-order thinking skills, such as being able to look at evidence, judge assertions, spot logical fallacies, and make arguments that make sense (Erduran et al., 2004) learn how to tell the difference between strong and weak evidence and how to back up their opinions with scientific facts.

Students learn that science is not just a set of facts, but a process of asking questions and debating them (Osborne & Patterson, 2011). They learn to value the fact that scientific knowledge is always changing and that evidence is important for making scientific explanations. This greatly improves their scientific literacy, which helps them make smart choices about science-related issues. Communication and working together are always a part of argumentation. Students learn how to clearly express their thoughts, listen to others, have respectful arguments, and work together to build a shared understanding (Chin & Osborne, 2010). These skills are very important for doing well in school and in your future job. Argument-rich environments can boost student interest and motivation by making science learning more interesting, useful, and personally relevant (Ludwig et al., 2021). Students are more likely to care about what they're learning when they have a say in how they learn it.

2.2 The Role of Instructional Strategies in Training Argumentation Skills

Constructivist and socio-cultural theories of learning (Vygotsky & Cole, 1978) have a big impact on how to teach people how to argue. Social constructivism underscores the significance of social interaction and discourse in

cognitive development. From this point of view, argumentation is not just something that happens in a person's mind; it's also something that happens in society, where learners build knowledge through interaction, negotiation, and the internalization of discursive practices. Argument Pattern (TAP) is a popular way to break down arguments into claims, data, warrants, backings, rebuttals, and qualifiers (Toulmin, 2003). This framework is not only a way to analyze things, but it also helps with designing lessons by showing what makes up a strong and complete argument. In terms of teaching, this means going beyond just saying what you think to giving proof, explaining how the proof supports your claim, and thinking about other points of view.

Even though there is evidence that these strategies work, it is hard to put them into practice because of things like teachers not being ready, not having enough time, the demands of the curriculum, students not wanting to do them, and problems with assessments. Many teachers don't know enough about how to help students argue or may not like how student-led discussions can be unpredictable and changeable (Osborne et al., 2013). A big change in how teachers teach is often needed. Adding strong argumentation activities can take a lot of time, which is hard for teachers who already have full schedules and are under pressure to cover all the material (Baram-Tsabari & Osborne, 2015). Students who are used to more traditional, teacher-centered instruction may not want to take part in open-ended argumentation at first because they are not used to sharing their opinions or challenging ideas (Crowell & Kuhn, 2014). Evaluating the quality of argumentation is difficult. It goes beyond just checking for right answers; it also requires a careful look at reasoning, use of evidence, and communication skills (Sampson & Clark, 2008).

2.3 Accreditation Level Determining Learning Quality

There is a lot of interest and debate in higher education about how institutional accreditation affects the quality of learning. The process of getting accreditation can help an organization learn and get better (Ewell, 2013). Accreditation is a way to hold institutions accountable by making sure they meet certain minimum standards. This is more about inputs and processes, but it is assumed that meeting these basic standards will stop things that make learning less effective (Ulmer, 2015). In the end, an accreditation level doesn't directly guarantee better learning quality, but it does show a commitment to established standards and a framework for ongoing improvement, both of which are necessary for creating and maintaining high-quality learning environments. The hard part is still making sure that these promises and frameworks always lead to better learning experiences for all students.

2.4 Theoretical Framework

This study is based on the idea that oral argumentation is an important skill for the 21st century that is important for teaching science because it helps students learn how to think critically, communicate, and solve problems. It utilizes established theories of argumentation, highlighting the dynamic and interactive characteristics of verbal discourse in promoting enhanced cognitive engagement. Argumentation is not simply the articulation of claims; it encompasses a multifaceted cognitive and communicative process of evaluating information and formulating substantiated conclusions backed by evidence. Based on the work of Osborne et al.(2004) and Jiménez-Aleixandre & Erduran (2007), the study uses a discourse coding framework that finds indicators like information seeking, exposition, opposition, explanation, and clarification. This framework enables a comprehensive evaluation of the distinct elements in students' oral arguments, thereby indicating their degree of sophistication.

The theoretical framework recognizes the crucial function of instructional strategies in developing argumentation skills. It agrees with the idea that teacher-centered methods can limit students' ability to think critically and argue, and instead supports student-centered learning and structured conversation that give students a lot of chances to talk to each other and improve their argumentation skills. The framework also emphasizes the importance of using instructional media to keep students interested and motivated, which are both important for improving their argumentation skills (Putri & Solfema, 2019).

The theoretical framework also includes the effects of outside factors, like learning loss caused by interruptions in education like the COVID-19 pandemic (Bozkurt et al., 2020). This recognizes that things other than how teachers

teach in the classroom, like limited access to technology and inconsistent teaching quality during remote learning, can make it much harder to develop higher-order argumentation skills.

Lastly, the framework critically analyzes the presumption that elevated accreditation levels automatically ensure enhanced educational outcomes across all domains. The study aims to determine if attending highly accredited schools actually leads to the development of important 21st-century skills, such as oral argumentation, or if systemic gaps continue to exist despite perceived quality indicators. The theoretical foundations indicate that accreditation may indicate compliance with specific standards; however, it does not inherently guarantee the application of effective pedagogical practices essential for cultivating complex skills such as argumentation. This study aims to reconcile the disparity between curriculum objectives and classroom realities by methodically examining students' oral argumentation skills in these settings and suggesting pedagogical reforms informed by the results.

3. Method

3.1 Research Design

This study employed a descriptive qualitative survey design to examine the intricacies of students' oral argumentation in the context of biology education. In accordance with the methodologies delineated by (Connelly, 2016), the survey was utilized to elucidate the communicative behaviours and argumentative traits of the participants. A cross-sectional survey method was employed to gather comprehensive data within a specified timeframe, offering a snapshot of contemporary classroom discursive practices.

3.2 Participants and Sampling

The people who took part in the study were chosen using purposive sampling based on criteria that were meant to look into the "Accreditation Paradox." Schools had to have a "A" accreditation status and show that they had used the Scientific Approach in their teaching in order to be included. The sample included 132 students from two well-known schools in Lampung Province: Yunior High Scholl in Natar (65 students from Grade VIII) and Senior High School in Bandar Lampung (67 students from Grade XI).

3.3 Data Collection Instruments

Information was collected from two main sources: the structural elements of verbal argumentation in biology classes and the contextual factors that affect these skills. A multi-method approach was utilized audio-visual recording, structured observation, and questionnaires. High-definition cameras and audio recorders were used to record what was said in the classroom. These recordings were carefully transcribed into written discourse scripts to make sure that all argumentative events were accurately recorded. Observers used a special coding sheet to record the rise of argumentative discourse as they happened. This method made sure the data was correct and gave us a second layer of data to check the video transcripts. Google Forms were used to send out digital questionnaires to both students and teachers. These tools gathered information about learning materials, how often teachers led discussions, and any technological problems that came up during the lessons.

3.4 Discourse Coding Framework

The Toulmin Argument Pattern (TAP) was used as the basis for the analysis of verbal reasoning, along with a discourse coding framework created by Osborne et al. (2004). Ten specific indicators were used to look at the arguments: information seeking, exposition, opposition, support, explanation, clarification, open-ended questioning, closed-ended questioning, concise responses, and directive instructions (see Table 1). This framework made it possible to sort arguments into levels of sophistication. Levels 1 and 2 are for basic claims and data, while Levels 3 to 5 show that there are warrants, backings, and rebuttals.

Table 1: Refined Argumentative Discourse Indicators

No	Argumentative Discourse	Indicator Description
1	Information Seeking	Requests for data, clarification of tasks, or sharing viewpoints.
2	Exposition	Articulating personal ideas in response to others' comments.
3	Opposition	Expressing disagreement or offering alternative criticisms.
4	Peer Support & Elaboration	Elaborating, justifying, or modifying ideas presented by others.
5	Scientific Explanation	Providing causal links between system features and structural roles.
6	Clarification	Providing purposeful explanations to aid understanding of core material.
7	Open-Ended Questioning	Inquiries requiring extensive explanation or returning to core realities.
8	Closed-Ended Questioning	Questions with limited, specific, or predetermined answers.
9	Concise Responses	Direct answers (yes/no, agree/disagree) or simple factual recall.
10	Directive Instruction	Short verbal cues, names, symbols, or scripted sentences.

3.5 *Data Analysis*

There were four steps in the qualitative analysis for this study: transcription, data reduction, quantification, and synthesis. The first step was to turn all of the audio and video recordings of classroom interactions into detailed written scripts so that the discourse could be thoroughly reviewed. After this, the data was reduced, which meant that only the parts that were relevant were chosen and streamlined to focus only on argumentative content. During the quantification phase, a standard formula was used to figure out the frequency and percentage of each discourse indicator. This made it possible to do a strict comparison of how good people were at arguing at different levels of education. Finally, during the synthesis stage, we looked at these results to figure out what the systemic gaps are between the goals of the national curriculum and what actually happens in the classroom.

4. Results

This section shows what the study found about students' oral argumentation skills. It does this by looking at how discourse coding indicators came up during biology lessons. It also includes an analysis of the factors that affect how well students can argue orally, based on answers from teacher and student questionnaires. Tables 2 and 3 show a summary of the descriptive data.

4.1 Profile of Students' Oral Argumentation Skills

The comparative analysis of oral argumentation indicates distinct discourse patterns between educational levels, although both groups consistently exhibited performance within the "Very Low" proficiency range, with average scores remaining below (12% as in Table 2). Junior high school students were mainly defined by their information-seeking discourse, which made up 36.63% of their interactions. They did not show any signs of clarification, though, at 0%. On the other hand, 46.4% of senior high school students were better at explaining science, but none of them were looking for information or getting help from their peers. Ultimately, students at both levels remained predominantly restricted to Level 1 and Level 2 of the Toulmin Argument Pattern (TAP), characterized by straightforward assertions supported by basic data, lacking the critical engagement or counterarguments requisite for advanced reasoning.

Table 2: Coding argumentation

No	Argumentative Discourse	Senior High School (%)	Junior High School (%)
1	Information Seeking	0.00	36.63
2	Exposition	1.40	18.62
3	Opposition	1.40	7.35
4	Support	0.00	3.15
5	Scientific Explanation	46.40	0.25
6	Clarification	0.00	0.00
7	Open-Ended Questioning	38.00	10.88
8	Closed-Ended Questioning	0.00	16.75
9	Concise Responses	0.00	25.37
10	Directive Instruction	0.00	0.30
Average		8.72	11.93

4.2 Refined Descriptors for Influencing Factors

The factors influencing the development of students' oral argumentation skills are summarized in Table 3 and categorized into three primary domains: learning resources, teacher influence, and student characteristics. All students at both levels said that their teachers used learning media, but this widespread access did not lead to better argumentation skills. This suggests that just having resources is not enough; they need to be integrated into the classroom in a way that makes them useful. Also, even though a lot of students were independent (44.6% of junior high and 88.7% of senior high students looked for extra learning materials on their own), their argumentative skills were still very weak. This shows that there is a gap between the availability of resources and their use in the classroom.

One major problem was that teachers didn't lead discussions. Only 22.7% of junior high students said that teachers led class discussions, which is probably why students' verbal reasoning skills are so weak. Lastly, socio-technical issues made it very hard for students to get involved. About 70% of students had problems with their internet quota, and more than 45% had problems with their signal. These technological limitations made it very hard for students to stay interested and take part in complicated discussions during remote or hybrid learning settings.

Table 3: Analysis of Influencing Factors

Descriptor	Indicators of Influence	Junior (Yes %)	High Senior High (Yes %)
Learning Resources	Teachers utilize learning media during instruction	100	100
	Students seek additional learning resources independently	44.60	88.70
Teacher	Teachers facilitate class discussions	22.70	67.60
	Teachers provide opportunities for verbal expression	63.60	63.30
Student	Students experience difficulties in understanding material	60.00	39.50
	Students face internet signal/quota disruptions	70.00	70.00

5. Discussion

5.1 Analysis of Argumentation Levels through TAP

The results show a big difference in how argumentation indicators are spread out between the two levels of education. Senior high school students showed only four different signs, while junior high school students showed eight, though all of them were in the low-proficiency range. A comprehensive examination of classroom discourse structures through the Toulmin Argument Pattern (TAP) framework indicates that student interactions are primarily governed by fundamental elements at Level 1 and Level 2. The TAP model says that a strong argument must have at least three parts: a claim, data, and a warrant. However, observations at Yunior High School and

Senior High School indicate that the majority of interactions terminate at the point of articulating basic claims devoid of credible supporting data or theoretical justifications linking the data to the claim.

The "Information Seeking" indicator had the highest percentage at 36.63% in junior high school. This was very clear during food testing practicums, when students asked questions about how things worked or asked for more information about their tasks. This activity demonstrates participation; however, it is cognitively procedural and does not facilitate argument construction. Students could see that food samples changed color (data), but they often didn't know how to explain why these changes happened (warrant) or how to apply these findings to bigger ideas about metabolism.

On the other hand, senior high school students were more cognitively independent, with the "Scientific Explanation" indicator reaching 46.4%. At this level, students could make claims that were related to what they were learning, like talking about how uric acid is excreted through the kidneys. But this strength did not come with the rise of Rebuttals or Qualifiers. Rebuttals are the best signs of how good an argument is (Levels 3–5) because they show that a student can find flaws in the other side's arguments and back up their own with counter-evidence. The consistent lack of rebuttals suggests that a culture of "scientific critique" has not been cultivated in the classroom setting.

5.2 Pedagogy vs. Accreditation Realities

This research reveals the "Accreditation Paradox," indicating that a high level of institutional accreditation (Level A) does not necessarily equate to enhanced student argumentation skills. People often think that accreditation is a sign of good teaching, but in reality, this process tends to focus more on following rules and having the right materials than on how well students talk to each other in class.

The schools examined have sufficient facilities and educators who employ instructional media (100% at both levels). But the effectiveness of these kinds of media is still a problem. Teachers often use passive media like PowerPoint and YouTube videos, which only send information one way. These types of media do not provide enough support to encourage students to ask questions or make them argue. Students are not very interested in debating science unless they have access to interactive media or problem-based modules. This underscores that access to educational resources is inadequate without effective pedagogical integration.

5.3 Pedagogical Inertia and Teacher-Centered Models

One of the main things that keeps oral argumentation from growing is that most teaching models are centered on the teacher. Teachers give students chances to ask questions about 63% of the time, but real discussions led by the teacher in a dialogic way are still very rare, especially in junior high schools, where they happen only 22.7% of the time. Students become passive and don't want to share their scientific opinions when they don't get enough verbal stimulation.

Argumentation is a socially mediated process; knowledge is not simply transmitted but constructed through the negotiation of meaning. Students won't be able to practice using the language of science if teachers keep controlling the flow of information. When there aren't clear ways to talk about things in class, conversations tend to be shallow and disconnected. A teaching style that encourages argumentation requires teachers to ask not only "what," but also "why" and "how do you know," which means that students have to provide evidence and reasons within their TAP structures.

5.4 Socio-Technical Barriers and Learning Loss

The COVID-19 pandemic caused disruptions in education that will last forever, and this study shows that discursive skills have not improved. Teachers and students didn't talk to each other as much during the time of remote learning, which made it harder for students to work together and talk to each other.

Students in Lampung faced even more problems because of socio-technical barriers. Even though most people (over 95%) own smartphones, there were real problems with infrastructure, like unstable signals (45.5%–54.9%) and limited internet data (69%–69.7%). These technical problems are more than just small annoyances; they keep students from being able to join in on the real-time discussions that are needed to improve their oral argumentation skills. Limiting face-to-face interaction takes away the emotional and social cues that usually help ideas flow in scientific debates.

5.5 Transformative Solutions: Moving Toward Argument-Driven Inquiry

Radical changes to teaching methods are needed to close the gap between what students are supposed to learn and what they actually learn in class. Biology education needs to change from "learning about science" to "learning to argue in science." The Argument-Driven Inquiry (ADI) model is one suggested solution. It clearly plans classroom activities to include steps for collecting data, building arguments, and peer review sessions.

To use this strategy, teachers need special training so they can be more than just sources of information; they need to be able to help students talk about what they learn. Also, it is important to create comprehensive assessment tools like the 7C Instrument Guide (Critical Thinking, Creativity, Communication, Collaboration, Computational Thinking, Compassion, and Connectivity) in order to measure the overall growth of a student's skills. These tools will help teachers find specific flaws in the way students make their arguments and give them the help they need. In conclusion, the fact that Level A accredited schools in Lampung have poor oral argumentation skills is a warning sign for our education system. Not only should the completeness of administrative accreditation documents be used to judge the quality of education, but so should the students' ability to think critically, communicate clearly, and defend evidence-based arguments in a world that is getting more complicated every day.

6. Conclusion

This study shows that having a high level of institutional accreditation does not automatically mean that students will learn 21st-century skills, such as how to argue orally. Students in both junior and senior high schools demonstrated a significant deficiency in formulating complex arguments, particularly in offering justifications, elucidations, and proficient counterarguments. The study identifies three limiting factors: the inadequate use of interactive instructional media, the continuation of teacher-led models that stifle verbal discourse, and ongoing barriers to student comprehension. These results indicate that the existing educational framework in these institutions emphasizes administrative compliance rather than the effective application of scientific inquiry. To address this deficiency, pedagogical reforms must transition from "learning about science" to "learning to argue in science" via structured discussions and inquiry-based modules. Future interventions should concentrate on equipping teachers with specialized training in argumentation-driven strategies to prepare students for the communicative requirements of a globalized world.

Author Contributions: All authors have made substantial contributions to the development and execution of this study. Neni Hasnunidah was responsible for the conceptualization and methodology, including formulating the research problem regarding the gap between curriculum objectives and classroom realities, and managing the overall project administration. Dea Millony Putri contributed significantly to the formal analysis and data curation, ensuring the systematic organization of field observations and survey data. Technical support during the investigation phase, particularly in the management of audio-visual recordings and the development of discourse analysis visualizations, was provided by Dika Almunawaroh. Finally, Dina Maulina served as the supervisor, overseeing the validation of findings and performing critical reviews and final editing of the manuscript to ensure it meets international academic standards.

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Conflicts of Interest: The authors declare no conflict of interest

Informed Consent Statement/Ethics approval: All participants provided informed consent prior to their inclusion in this study, with specific consent for participants under the age of 18 obtained through their parents or legal guardians. The study was conducted in accordance with the research protocol received formal approval from the Ethics Committee of the University of Lampung. As a non-interventional study encompassing digital surveys, classroom observations, and audio-visual recordings, all participants were fully informed regarding the research objectives to analyze oral argumentation skills within the context of biology learning. Participants were guaranteed confidentiality and anonymity throughout the transcription and reporting process, with an assurance that all video recordings and questionnaire responses would be used exclusively for academic research purposes, ensuring no physical or psychological risks were associated with their participation.

Data Availability Statement: The qualitative data supporting the findings of this study, including anonymized discourse transcripts and questionnaire responses, are available from the corresponding author upon reasonable request. The raw audio-visual recordings are not publicly available due to ethical restrictions and the need to protect the privacy of the participants.

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Declaration of Generative AI and AI-assisted Technologies: This study has not used any generative AI tools or technologies in the preparation of this manuscript.

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