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Teacher Feedback and Wait-Time in Primary Science Classroom Dialogue: A TBLA Study

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Abstract
This study explores how teacher feedback and wait-time shape the quality of classroom dialogue in primary science learning. Using a qualitative descriptive approach with Transcript-Based Lesson Analysis (TBLA), the study involved one sixth-grade science teacher and 19 students in an urban primary school in Tangerang Selatan, Indonesia. Data were collected through audio-visual recordings of three science lessons, classroom observations, and semi-structured interviews. The findings showed that accepted feedback was the most dominant type, mainly functioning to confirm students' responses and maintain classroom flow. Modified feedback contributed more significantly to extending dialogue through probing questions and clarification prompts. Short wait-time tended to produce rapid and simple responses, whereas extended wait-time supported elaboration, reflection, and deeper reasoning. Furthermore, feedback and wait-time jointly contributed to the transformation of conventional IRF patterns into more dialogic IRFRF interaction sequences characterized by elaboration, reciprocity, reflection, and collaborative reasoning in primary science classroom discourse.

Keywords: Classroom Dialogue; Teacher Feedback; Wait-time; Dialogic Teaching; TBLA

Introduction

Science learning in primary schools plays a fundamental role in shaping students' scientific reasoning, reflective thinking, and conceptual understanding. Contemporary science education emphasizes that learning should not be limited to the transmission of factual knowledge, but should actively engage students in constructing meaning through inquiry, dialogue, and social interaction (Carpentier et al., 2026; Mercer & Howe, 2012). Within this perspective, classroom dialogue is recognized as a core mechanism through which students articulate ideas, test assumptions, justify reasoning, and collaboratively build scientific understanding.

High-quality classroom dialogue has been shown to positively influence students' cognitive engagement, conceptual development, and scientific literacy (Alexander, 2020; Mercer & Howe, 2012). Dialogic interaction enables learners to move beyond memorization toward deeper reasoning, argumentation, and reflection. Consequently, dialogue quality is increasingly viewed as a key indicator of instructional effectiveness in science education.

Despite this theoretical emphasis, empirical evidence suggests that classroom interaction in primary science education remains largely teacher-centered. Verbal exchanges are commonly structured through Initiation–Response–Evaluation (IRE) or Initiation–Response–Feedback (IRF) patterns, where teachers dominate discourse while students provide brief and convergent responses (Vrikki et al., 2023; Mortimer & Scott, 2003; Boye et al., 2026). Although the two terms are closely related, this study adopts IRF as the primary analytical framework because the concept of "feedback" better reflects dialogic interaction than "evaluation." Evaluation tends to emphasize judgment of correctness, whereas feedback may extend, scaffold, or redirect students' thinking and classroom dialogue. Although IRF supports classroom control and instructional efficiency, it often constrains opportunities for students to elaborate ideas, challenge perspectives, and engage in higher-order reasoning. As a result, classroom dialogue frequently functions as a tool for confirming answers rather than fostering collaborative knowledge construction.

Dialogic teaching theory argues that learning becomes more meaningful when classroom interaction is extended, reciprocal, and cognitively demanding (Alexander, 2020; Skidmore & Murakami, 2016). In dialogic classrooms, teachers are expected not only to ask questions, but also to manage interaction strategically in order to sustain dialogue. This management depends heavily on how teachers respond to students' answers and how much cognitive space they provide for students to think.

Two pedagogical components that play a decisive role in shaping dialogue quality are teacher feedback and wait-time. Feedback represents a core element of formative assessment and functions as a bridge between student performance and learning improvement. According to Hattie and Timperley (2007), effective feedback should reduce the gap between current understanding and learning goals by encouraging reflection, clarification, and deeper reasoning. In classroom dialogue, feedback that invites explanation, justification, or reconsideration has been shown to stimulate more elaborative student responses (Chin, 2006, 2007; Chen, 2017). In addition, adequate wait-time provides students with cognitive space to process information and formulate responses more thoughtfully (Rowe, 1986). Conceptually, this study positions teacher feedback and wait-time as interconnected pedagogical mechanisms that influence students' response depth and shape classroom dialogue structures. Prompting feedback combined with extended wait-time is expected to encourage elaborative and reflective responses, thereby transforming conventional IRF (Initiation–Response–Feedback) patterns into more extended and dialogic IRFRF interactions.

However, many classroom practices still rely on affirmative feedback such as "correct" or "good," which often terminates interaction rather than extending it. Black and Wiliam (2009) argue that such feedback limits students' opportunities to engage in metacognitive processes and constrains the formative potential of classroom discourse (Harris et al., 2023). Consequently, feedback quality directly influences whether dialogue evolves or ends.

In parallel, wait-time serves as a critical temporal dimension of classroom interaction. Rowe's (1986) seminal work demonstrated that increasing wait-time significantly improves the length, complexity, and cognitive quality of student responses. Subsequent studies confirmed that extended wait-time enhances students' participation, reasoning, and willingness to ask questions (Ingram & Elliott, 2015; Tobin & Capie, 1985; Ali, 2025). Nevertheless, in many instructional contexts, teachers provide very limited wait-time, thereby restricting students' opportunities to process information and formulate thoughtful responses.

When prompting feedback is combined with adequate wait-time, classroom dialogue can evolve beyond the basic IRF pattern into extended IRFRF sequences (Mortimer & Scott, 2003; Chin, 2007). In this study, IRFRF sequences are not viewed merely as longer interaction patterns, but as indicators of higher-quality dialogue characterized by elaboration, reflection, reciprocity, and collaborative reasoning. Dialogue quality is therefore understood not simply in terms of interaction length, but in the extent to which students actively construct, justify, and refine scientific understanding through sustained interaction. These extended structures allow students to clarify ideas, respond to peers, and engage in collaborative reasoning, which reflects the core principles of dialogic pedagogy.

Wait-time can be understood as an interactional pause that provides cognitive space for listening, processing information, and formulating responses during classroom dialogue. In learning interactions, pauses between speakers often function as thinking time that supports students' reasoning and participation (Walsh, 2006, 2011; Ingram & Elliot, 2015). Previous studies have classified wait-time into several categories based on the position and function of pauses within classroom interaction. Early classifications proposed by Rowe (1974), Lake (1973), and Fowler (1975) continue to serve as important references in contemporary wait-time research. The classifications used by these researchers are summarized in Table 1.

Table 1. Systematic Representation of the Differences in Wait-Time Definitions

Definition of Wait-Time according to Rowe			
Wait-time I	Teacher's question	Pause	Teacher or student speaking
Wait-time II	Student's response	Pause	The teacher gives comments or questions
Definition of Wait-Time according to Lake			
Wait-time Teacher			
Example 1	Student speaks	Pause	Teacher speaks
Example 2	Teacher speaks	Pause	Teacher speaks
Wait-time Student			
Example 1	Teacher speaks	Pause	Teacher speaks
Example 2	Student speaks	Pause	Teacher speaks
Definition of Wait-Time according to Fowler			
Teacher's reaction during wait-time			

Example Student's reaction during wait-time	Student speaks	Pause	Teacher speaks
Example Wait-time initiated by teacher	Teacher speaks	Pause	Student speaks
Example Wait-time initiated by student	Student speaks	Pause	Student speaks
Example	Teacher speaks	Pause	Teacher speaks

Systematic Representation of the Differences in Wait-Time Definitions (Tobin & Capie, 1983)

Previous studies have highlighted the important role of wait-time, often understood as intentional pauses during classroom interaction, in shaping students' learning processes and response quality. Research by Lake (1973), Rowe (1974), and Rice (1977), as cited in Tobin and Capie (1985), demonstrated that extended teacher wait-time is strongly associated with increased cognitive complexity in students' responses. Longer pauses not only improve students' participation but also encourage higher-order questioning and deeper reasoning (Tobin & Capie, 1985). Similarly, Ingram and Elliot (2015) found that extended wait-time supports richer classroom dialogue and promotes more varied interaction patterns within initiation–response–feedback (IRF) sequences. These studies suggest that wait-time functions as an important interactional space that enables students to process information, formulate explanations, and participate more meaningfully in classroom dialogue.

Despite these insights, previous studies have generally examined questioning strategies, dialogic teaching, feedback, and wait-time as separate aspects of classroom interaction. Research specifically investigating feedback and wait-time as interconnected pedagogical mechanisms shaping dialogue quality remains limited, particularly in primary science contexts. Most existing studies focus mainly on teacher questioning patterns or general dialogic interaction without closely examining how feedback and wait-time jointly influence students' response depth and the transformation of dialogue structures from conventional IRF patterns into more extended IRFRF interactions.

In addition, only a limited number of studies have employed Transcript-Based Lesson Analysis (TBLA) as a microanalytic tool for examining the detailed dynamics of classroom discourse in primary science learning. Although TBLA provides a powerful analytical lens for capturing interaction patterns, turn-taking processes, and dialogue development at the micro level, its application to the analysis of feedback and wait-time remains relatively scarce. This methodological limitation highlights an important gap in classroom discourse research.

The novelty of the present study lies in its use of Transcript-Based Lesson Analysis (TBLA) to examine how teacher feedback and wait-time jointly influence students' response depth and the transformation of classroom dialogue structures in primary science learning. Unlike previous TBLA studies that mainly focus on general interaction patterns or questioning strategies, this study specifically analyzes feedback and wait-time as interconnected dialogic mechanisms shaping the development of IRF and IRFRF sequences. The study also contributes to the dialogic pedagogy of elementary science by demonstrating how prompting feedback and extended wait-time can support elaborative reasoning, reflective responses, and collaborative meaning-making in classroom interaction.

Based on these considerations, this study seeks to explore how teachers' feedback and wait-time shape the quality of classroom dialogue in primary science learning. Specifically, the study examines the types of teacher feedback used during classroom interaction, how feedback influences students' response depth, the role of wait-time in sustaining dialogue, and how feedback and wait-time contribute to the transformation of IRF patterns into more extended dialogic interactions

Method

This study employed a qualitative descriptive approach using Transcript-Based Lesson Analysis (TBLA). This approach was selected because the study aimed to explore in depth the dynamics of classroom dialogue in primary science learning, particularly the roles of teacher feedback and wait-time in shaping dialogue quality, without manipulating instructional variables. A qualitative descriptive design allows the researcher to capture natural classroom interactions and interpret the meaning behind emerging communication patterns. TBLA was adopted as the primary analytical framework because it enables detailed micro-level analysis of classroom discourse through lesson transcripts and interaction sequences. Compared with broader approaches to classroom discourse analysis, TBLA is particularly well-suited to examining how dialogue

develops moment-by-moment through teacher and student interactions. In this study, TBLA was applied by segmenting classroom transcripts into interaction episodes consisting of teacher initiation, student responses, feedback moves, and subsequent interaction sequences. The analysis focused on turn-taking patterns, wait-time duration, feedback types, and the transformation of dialogue structures from IRF to IRFRF interactions.

The study was conducted in a partner primary school located in Tangerang Selatan, Banten, Indonesia, during the second semester of the 2024/2025 academic year. The participants consisted of one sixth-grade science teacher and 19 sixth-grade students, comprising 10 girls and 9 boys, aged approximately 11–12 years. The school represents an urban primary school context with diverse student academic ability levels. Participants were selected through purposive sampling based on the teacher's willingness to participate and the suitability of the classroom for audio-visual recording. The observed science lessons focused on topics related to properties and changes (heat transfer and changes in matter). These topics were selected because they frequently involved classroom questioning, explanation, and dialogic interaction, making them suitable for analyzing feedback, wait-time, and classroom dialogue patterns.

Data were collected using multiple techniques, including audio-visual recordings of classroom lessons, classroom observations, and semi-structured interviews with the teacher. Three science lessons were recorded over two weeks, with each lesson lasting approximately 2 periods (70 minutes). Video cameras were positioned in the side areas of the classroom to capture teacher–student interactions, turn-taking patterns, and student responses from different seating positions.

The researcher acted as a non-participant observer during the lessons and documented classroom interaction patterns, student engagement, and nonverbal responses through observation notes. Teacher interviews were conducted after the recorded lessons to obtain reflective insights into instructional decisions, questioning strategies, feedback practices, and the use of wait-time during classroom dialogue. Each interview lasted approximately 15–20 minutes. Sample interview questions included: "How do you decide when to provide prompting feedback?" and "What considerations influence your use of wait-time during classroom discussions?"

All recorded lessons were transcribed verbatim immediately after data collection. The transcription process included pauses, overlapping speech, and interaction sequences relevant to the analysis of feedback, wait-time, and dialogue structures. These transcripts served as the primary data source for Transcript-Based Lesson Analysis (TBLA).

Within this framework, Initiation generally denotes the teacher's initial instructional move, commonly delivered through questions or statements designed to achieve particular pedagogical objectives (Chin, 2006). Alexander (2005, as cited in Davies et al., 2017; Szelei et al, 2020) explains that these objectives may take the form of: (1) rote activities, which emphasize repetition to strengthen memory rather than conceptual understanding; (2) recitation, which involves eliciting previously learned knowledge through questioning; and (3) exposition, referring to the explanation of facts, principles, or procedures that support student learning.

Table 2. Types of Feedback Based on Students' Responses

Student Response	Types of Feedback	Key Elements of Dialogue	Description
Accepted Feedback	Affirmation-direct instruction	Comments-Questions, Comments-Statements	The response is received and reinforced with further explanation or direct instruction.
Modified Feedback	Expansion Through Sequential Questioning: Focusing and Zooming	Comments-Questions,	Student responses are received, followed by a series of questions related to the idea that either strengthens the proof of the idea or broaden the concept of thinking.
Rejected Feedback	Explicit correction Direct instructions	Statement-Question, statement	Immediate corrections are followed by further explanations of the correct scientific concepts.
	Constructive Challenges	Comments-Questions, Questions	Neutral or evaluative comments are followed by a reformulation of a question or challenge.

Types of Feedback Based on Students' Responses (Chin, 2006)

The trustworthiness of the study was ensured through methodological triangulation, peer debriefing, and systematic audit trail documentation. Triangulation was conducted by comparing findings from classroom

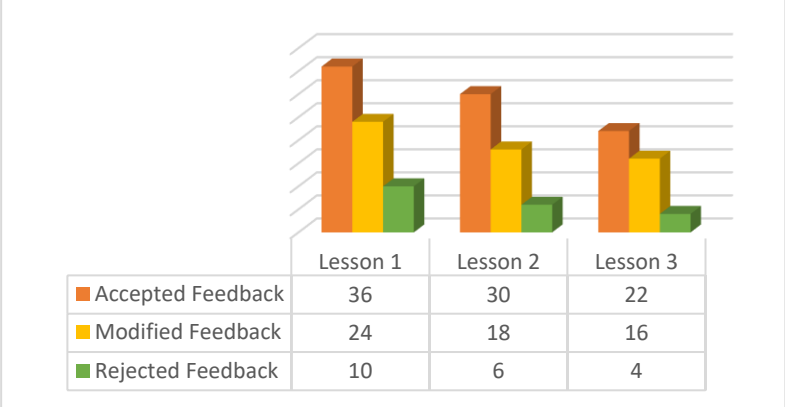
transcripts, observation notes, and teacher interview data to verify the consistency of interpretations related to feedback patterns, wait-time, and dialogue structures. Peer debriefing involved two researchers in primary education who reviewed the coding categories and selected transcript excerpts. Coding discussions were conducted in several stages, focusing on the classification of feedback types, response depth, and IRF/IRFRF interaction patterns. Differences in interpretation were discussed until agreement was reached. An audit trail was maintained through systematic documentation of transcription procedures, coding revisions, analytical memos, and interpretation decisions throughout the research process. In addition, thick descriptions of the classroom context, interaction episodes, and dialogue excerpts were provided to support the transferability and transparency of the findings.

Ethical considerations were carefully addressed. Informed consent was obtained from the school, the teacher, and the students' guardians before data collection. All participants' identities were anonymized, and the data were used solely for academic purposes.

Results and Discussion

Teacher feedback became one of the central interactional features because it reflected how the teacher responded to students' ideas, maintained classroom communication, and supported conceptual understanding during science learning activities. Through the three lessons, feedback was not only used to evaluate students' answers but also functioned as a pedagogical strategy to encourage participation, extend dialogue, and clarify scientific concepts.

The analysis focuses on three major categories of teacher feedback: accepted feedback, modified feedback, and rejected feedback. The findings indicate that accepted feedback was the most dominant feedback type during classroom interaction. This type of feedback mainly functioned to confirm students' answers and maintain classroom flow. Modified feedback appeared less frequently but played an important role in extending dialogue and encouraging students to elaborate on their reasoning. Rejected feedback was used least frequently and mainly focused on addressing misconceptions and guiding students toward more accurate scientific understanding.



	Lesson 1	Lesson 2	Lesson 3
Accepted Feedback	36	30	22
Modified Feedback	24	18	16
Rejected Feedback	10	6	4

Figure 1: Distribution of Teacher Feedback based on Student Response

The diagram illustrates the distribution of teacher feedback patterns across the three lessons, consisting of accepted feedback, modified feedback, and rejected feedback. Overall, accepted feedback appeared as the most dominant feedback type in all lessons, followed by modified feedback, while rejected feedback occurred least frequently. This pattern indicates that the teacher primarily used feedback to acknowledge and reinforce students' responses during classroom interaction. These findings are consistent with Hattie and Timperley's (2007) framework and Hajar's findings (2019), which emphasize that feedback plays an important role in reducing the gap between students' current understanding and learning goals. In this study, accepted feedback mainly functioned to confirm students' responses and maintain classroom flow, while modified feedback supported deeper conceptual engagement by encouraging students to clarify and elaborate their ideas.

In Lesson 1, the teacher produced the highest number of feedback instances, with 36 accepted feedbacks, 24 modified feedbacks, and 10 rejected feedbacks. This finding suggests that classroom interaction during the first lesson was highly active, with the teacher frequently responding to students' ideas through confirmation and follow-up interaction. The relatively high occurrence of modified feedback also indicates that the teacher

often attempted to sustain dialogue by asking probing questions and encouraging students to elaborate their responses.

This interaction pattern can be observed in the following transcript excerpt:

Table 3. Transcript Excerpt of Teacher Feedback in Lesson 1

Timestamp	Code	Learning Dialogue	Feedback Type
00.04.07	Mik	Yes… If the hot water is very hot, the metal object will become hot. And the plastic… the plastic will stay normal.	Response
00.04.15	T9	Oh, stay normal *(showing plastic ruler).* Okay, good! Yes, Rukiye!	Accepted Feedback
00.04.18	Ruk	Hm, the plastic one if the water is so hot it's going to melt…	Response
00.04.27	T10	Of course, this one? *(Showing metal ruler).* What happened to this metal?	Modified Feedback
…….			
00.07.45	Ali	The object can conduct heat and become hot	Response
00.07.55	T21	So the substances that can conduct heat mean that the substances can transfer the heat. The heat energy from the hot water will transfer to the metal.	Rejected Feedback

The excerpt demonstrates how different feedback types emerged within the same interaction sequence. Accepted feedback appeared when the teacher confirmed students' responses through expressions such as "Okay, good!", which mainly functioned to maintain classroom flow and acknowledge participation. However, the teacher did not always terminate the interaction after confirmation. Instead, modified feedback frequently appeared through follow-up questions such as "What happened to this metal?", encouraging students to continue elaborating their reasoning and sustaining classroom dialogue.

The transcript also illustrates the use of rejected or corrective feedback when the teacher clarified misconceptions related to heat transfer concepts. Rather than simply rejecting students' answers, the teacher redirected students toward a scientifically accurate understanding by providing a conceptual explanation. This interaction pattern reflects dialogic teaching practices in which feedback functioned not only as evaluation but also as a pedagogical tool for extending interaction and supporting collaborative meaning-making during classroom discussion.

A similar interaction pattern appeared in Lesson 2, although the total frequency of feedback decreased slightly. Accepted feedback remained dominant with 30 occurrences, while modified feedback appeared 18 times and rejected feedback 6 times. The reduction in rejected feedback may indicate that students demonstrated better conceptual understanding during the second lesson, reducing the need for corrective intervention from the teacher. According to Hattie and Timperley (2007), effective feedback should not only evaluate students' responses but also guide learners toward improved understanding. In this context, the dominance of accepted and modified feedback suggests that the teacher focused more on supporting conceptual development rather than merely correcting mistakes.

This interaction pattern can be observed in the following transcript excerpt:

Table 4. Transcript Excerpt of Teacher Feedback in Lesson 2

Timestamp	Code	Learning Dialogue	Feedback Type
00.09.20	Tal	Hm, from solid to liquid	Response
00.09.22	T9	Hah?	Modified Feedback
00.09.25	Tal	From solid to liquid.	Response
00.04.27	T10	From solid to liquid. Okay, Liandra	Accepted Feedback
00.09.29	Lia	The melting point is the point at which the solid turns into a liquid	Response
00.09.30	Amo	Yes, correct!	Accepted Feedback
00.09.32	T65	Okay, good	Accepted Feedback
…….			
00.09.58	T69	Okay, melting point is…	Accepted Feedback
00.09.59	SS	Ms Ms! (raise hand)	Response
00.10.00	T70	Okay, thank you so much. The melting point is the temperature at which a solid starts to become liquid	Rejected Feedback

The excerpt demonstrates how modified feedback was used to sustain interaction and encourage students to refine their responses. Instead of directly evaluating the initial answer, the teacher continued the dialogue through clarification requests like "Hah?", encouraging students to restate and improve their explanations. These dialogic moves created opportunities for students to elaborate on their understanding collaboratively.

These findings support Hattie and Timperley's (2007) view that effective feedback should guide students toward improved understanding rather than simply evaluate correctness. The interaction also aligns with Chin's (2006, 2007) argument that probing questions and dialogues contribute to deeper conceptual reasoning and collaborative meaning-making in classroom discourse.

In Lesson 3, the overall number of feedback instances became lower compared to the previous lessons, with 22 accepted feedbacks, 16 modified feedbacks, and 4 rejected feedbacks. Despite the decline in total interaction frequency, the proportional pattern remained relatively consistent across all lessons. Accepted feedback continued to dominate classroom interaction, while modified feedback consistently contributed to sustaining discussion and encouraging student participation. The frequent use of modified feedback demonstrates that the teacher attempted to maintain dialogic interaction through clarification requests, elaborative prompts, and follow-up questioning.

This interaction pattern can be observed in the following transcript excerpt:

Table 5. Transcript Excerpt of Teacher Feedback in Lesson 3

Timestamp	Code	Learning Dialogue	Feedback Type
00.08.56	T21	Next one, number three. Why do you think the handles of the metal pan and Teflon are made from plastic?	Initiation
00.09.05	SS	Meee…	Response
00.09.11	T22	Later, later, later. Okay Mahira	Modified Feedback
00.09.12	Mah	So we don't get burned by the handle	Response
00.09.14	SS	Exactly	Accepted Feedback
00.09.30	T23	Okay, another one? Now Mayra	Accepted Feedback
00.09.32	May	So we don't get burned	Response
00.09.35	T24	Okay?	Modified Feedback
00.09.37	May	If we cook the egg, the pan is made from metal and connected with handles, so our hands will not be hurt when touching it	Response
00.09.44	T25	Ya, so we don't get burned yaa	Accepted Feedback

In Lesson 3, the overall number of feedback instances became lower compared to the previous lessons, with 22 accepted feedbacks, 16 modified feedbacks, and 4 rejected feedbacks. Despite the decline in total interaction frequency, the proportional pattern remained relatively consistent across all lessons. Accepted feedback continued to dominate classroom interaction, while modified feedback consistently contributed to sustaining discussion and encouraging student participation. The frequent use of modified feedback demonstrates that the teacher attempted to maintain dialogic interaction through clarification requests, elaborative prompts, and follow-up questioning.

The diagram also demonstrates that modified feedback occurred frequently across the three lessons, highlighting its important role in promoting dialogic interaction. Unlike accepted feedback, which mainly confirmed answers, modified feedback functioned to extend classroom dialogue through clarification requests, probing questions, and elaborative prompts. This interaction pattern supports the development of IRFRF dialogue structures because the teacher continued the discussion rather than terminating interaction after evaluating students' responses. These findings strongly align with Chin's (2006, 2007) and Rahayu et al. (2020) view that dialogic feedback functions not only as evaluation but also as a pedagogical mechanism for sustaining interaction and supporting collaborative knowledge construction.

Meanwhile, rejected feedback appeared least frequently in all lessons. This finding suggests that corrective feedback was used selectively, mainly to address misconceptions or inaccurate scientific explanations. The relatively limited use of rejected feedback may have helped maintain a supportive classroom atmosphere and encouraged students to participate more confidently in the discussion. Furthermore, this finding supports Prianggita's (2022) finding that corrective feedback becomes more effective when accompanied by supportive explanation and follow-up questioning rather than direct evaluation alone.

Overall, the diagram indicates that teacher feedback patterns remained relatively consistent across the three lessons. The dominance of accepted feedback helped maintain classroom flow and student participation, while modified feedback played a crucial role in extending interaction and encouraging deeper reasoning. These findings suggest that feedback functioned not only as evaluative commentary but also as a dialogic strategy for sustaining classroom discourse and promoting students' conceptual understanding.

In addition to feedback patterns, the analysis of classroom interaction also revealed that wait-time varied across different speech transitions and significantly influenced the continuity and quality of classroom dialogue. Five major speech transitions were identified during the learning interaction: Teacher Initiation –

Student Response, Student Response – Teacher Feedback, First Feedback – Follow-up Teacher Feedback, Teacher Feedback – Student Follow-up Response, and Student Response – Teacher Initiation. The variation in wait-time across these transitions reflects how teachers managed interactional pauses to support students' participation, reflection, and response development. The average wait-time for each speech transition during the whole-class discussion is presented in the following table.

Table 6. Average Wait-Time in Whole-Class Learning Dialogue Discussion

Speech Transition	Average Wait-Time (hh.mm.ss)		
	Lesson 1	Lesson 2	Lesson 3
Teacher Initiation – Student Response	00.00.03	00.00.02	00.00.03
Student Response – Teacher Feedback	00.00.09	00.00.10	00.00.10
First Feedback – Follow-up Teacher Feedback	00.00.07	00.00.09	00.00.07
Teacher Feedback – Student Follow-up Response	00.00.02	00.00.02	00.00.03
Student Response – Teacher Initiation	00.00.20	00.00.17	00.00.17

The table presents the average wait-time across different speech transitions during whole-class classroom dialogue in three lessons. Overall, the findings indicate that wait-time varied depending on the interaction pattern between teachers and students. The shortest wait-time occurred in the Teacher Initiation – Student Response transition, ranging from 2 to 3 seconds, indicating that students tended to respond quickly after the teacher-initiated questions or instructions. This finding can be illustrated through the following excerpt from the whole-class discussion in Lesson 1, accompanied by the wait-time duration and the resulting student responses.

Table 7. TBLA Excerpt of Classroom Dialogue in Lesson 1 (I-R Wait-Time)

Timestamp	Code	Learning Dialogue	Speech Transition	Wait-Time
00.03.51	T6	Okay, so I have two objects. This one is made of metal. This one is made of….	I–T	–
00.03.54	SS	Plastic!	R–S (all)	00.00.03
00.04.04	T7	Plastic. Imagine that I have hot water. And I put these two rulers into the hot water. What will happen to them?	F–T	00.00.10
00.04.07	SS	Hm… *(inaudible)*	R–S (all)	00.00.03
00.04.06	T8	Ssh… One by one. Yes, Mika!	F–T	00.00.01
00.04.07	Mik	Yes… If the hot water is very hot, the metal object will become hot. And the plastic… the plastic will stay normal.	R–S	00.00.01
00.04.15	T9	Oh, stay normal *(showing plastic ruler).* Okay, good! Yes, Rukiye!	F–T	00.00.08
00.04.18	Ruk	Hm, the plastic one if the water is so hot it's going to melt…	R–S	00.00.03

Similarly, the Teacher Feedback – Student Follow-up Response transition showed relatively short wait-times of approximately 2–3 seconds, suggesting that students responded promptly after receiving teacher feedback. For example:

Table 8. TBLA Excerpt of Classroom Dialogue in Lesson 2 (F-R Wait-Time)

Timestamp	Code	Learning Dialogue	Speech Transition	Wait-Time
00.07.27	T52	Ssh… What do you know about boiling point?	I–T	–
00.07.29	SS	Aaahhh (raise hand)	R–S (all)	00.00.02
00.07.31	T53	Okay, Amora!	F–T	00.00.03
00.07.33	Amo	It is bubbles	R–S (all)	00.00.02
00.07.34	T54	Bubbles, is it about bubbles?	F–T	00.00.01
00.07.35	Amo	No..	R–S	00.00.01
00.07.36	T55	Okay, Abi first, abi first!	F–T	00.00.01
00.07.38	Abi	Temperature,	R–S	00.00.02
00.07.39	T56	Temperature at?	F–T	00.00.01
00.07.42	Abi	At, ehm… I don't know…hm, when does it start boiling?	R–S	00.00.03
00.07.48	T57	When start boiling. Mika?	F–T	00.00.06
00.07.50	Mik	Hm, so boiling is the liquid that turns into a gas at a specific temperature	R–S	00.00.02
00.07.58	T58	Okay, good.	F–T	00.00.08

The excerpt in Table 5 demonstrates that the Teacher Feedback – Student Follow-up Response transition was characterized by relatively short wait-times, ranging from 2 to 3 seconds. These short pauses indicate that students tend to respond immediately after receiving teacher feedback or follow-up prompts. The interaction pattern reflects a highly responsive classroom atmosphere in which students actively attempted to participate in the discussion about boiling point concepts.

The dialogue also shows how the teacher's prompts contributed to sustaining interaction sequences. For example, after the student answered, "It is bubbles," the teacher responded with a follow-up question, "Bubbles, is it about bubbles?" This feedback encouraged students to reconsider and refine their understanding rather than simply accepting the initial response. Similarly, the teacher's prompt "Temperature at?" guided students toward a more scientifically accurate explanation of the boiling point. These interaction patterns demonstrate the use of modified feedback that extended dialogue beyond simple answer confirmation.

Although the wait-time remained relatively short, the interaction gradually developed from brief responses into more elaborate explanations. Early student responses, such as "It is bubbles" and "Temperature," were simple and incomplete, while later responses became more conceptually developed, as shown in Mika's explanation: "Boiling is the liquid that turns into a gas at a specific temperature." This progression suggests that even short wait-time can support conceptual development when combined with sequential prompting and dialogic feedback.

In contrast, longer wait-time appeared in the Student Response – Teacher Feedback transition and the First Feedback – Follow-up Teacher Feedback transition, indicating that the teacher frequently provided pauses before delivering feedback or extending the dialogue. This interaction pattern can be observed in the following transcript excerpt from Lesson 3.

Table 9. TBLA Excerpt of Classroom Dialogue in Lesson 3 (R-F Wait-Time)

Timestamp	Code	Learning Dialogue	Speech Transition	Wait-Time
00.08.56	T21	Next one, number three. Why do you think the handles of the metal pan and Teflon are made from plastic?	I–T	–
00.09.05	SS	Meee…	R–S (all)	00.00.09
00.09.11	T22	Later, later, later. Okay Mahira	F–T	00.00.06
00.09.12	Mah	So, we don't get burned by the handle	R–S	00.00.01
00.09.14	SS	Exactly	R–S (all)	00.00.02
00.09.30	T23	Okay, another one? Now Mayra	F–T	00.00.16
00.09.32	May	So we don't get burned	R–S	00.00.02
00.09.35	T24	Okay?	F–T	00.00.03
00.09.37	May	If we cook the egg, the pan is made from metal and connected with handles, so our hands will not be hurt when touching it	R–S	00.00.02
00.09.44	T25	Ya, so we don't get burned yaa	F–T	00.00.07

The excerpt demonstrates that longer wait-time frequently occurred before the teacher delivered follow-up feedback or invited additional responses from students. For example, a 9-second pause appeared after the teacher's initiation before students collectively responded, indicating that students were given time to process the question and prepare their ideas. The First Feedback – Follow-up Teacher Feedback transition (7–9 seconds), indicating that the teacher often provided pauses before delivering feedback or extending the dialogue.

These extended pauses contributed to the continuity of classroom dialogue by allowing students to elaborate their reasoning gradually. Initially, students produced short responses such as "So we don't get burned," but the dialogue later developed into a more elaborate explanation when Mayra explained the relationship between metal, heat, and the function of plastic handles. This finding indicates that longer wait-time supported the development of more conceptually detailed responses and sustained interaction sequences.

From a dialogic perspective, the teacher's pauses functioned not merely as silence between utterances but as cognitive and interactional space for listening, reflection, and collaborative meaning-making. This finding aligns with Rowe's (1974) argument that extended wait-time increases the quality and complexity of students' responses. It also supports Walsh's (2006) view that interactional pauses play an important role in classroom communication by creating opportunities for thinking and response formulation. Similarly, Ingram and

Elliot (2015) emphasized that extended wait-time contributes to richer classroom dialogue and more sustained participation patterns.

The longest wait-time was found in the Student Response – Teacher Initiation transition, ranging from 17 to 20 seconds. This finding suggests that after students respond, the teacher tends to allow longer pauses before initiating the next instructional move. Such pauses may provide cognitive space for reflection and support more sustained classroom interaction (Winarti, et.al, 2023) . Overall, the variation in wait-time demonstrates an important role in shaping classroom dialogue patterns. Longer wait-times tended to occur during reflective or transitional phases of interaction, whereas shorter wait-times were associated with direct responses to questions or feedback. These findings support the view that wait-time functions as an important pedagogical strategy for promoting more dialogic and elaborative classroom discourse.

The analysis of classroom interaction revealed that feedback and wait-time jointly contributed to the transformation of classroom dialogue from conventional IRF (Initiation–Response–Feedback) structures into more extended IRFRF (Initiation–Response–Feedback–Response–Feedback) interaction patterns. During classroom discussion, dialogue did not always terminate after the teacher evaluated students' responses. Instead, the teacher frequently sustained interaction through prompting feedback, clarification requests, and follow-up questioning, allowing students to continue elaborating their ideas. This finding suggests that feedback functioned not only as evaluation but also as a dialogic move that extended classroom interaction and supported collaborative meaning-making.

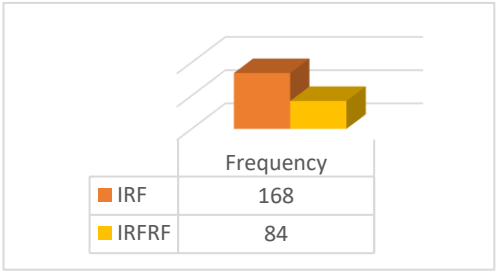


Figure 2: Distribution of Dialogue Structures

The table shows that IRF remained the dominant classroom dialogue structure. This indicates that many classroom interactions still followed a conventional pattern in which the teacher initiated a question, students responded, and the teacher provided feedback. However, one-third of the observed interaction episodes developed into IRFRF sequences. This finding suggests that classroom dialogue was not limited to brief answer-confirmation exchanges but also included extended interaction sequences that created opportunities for students to elaborate, clarify, and refine their ideas.

Wait-time also supported this transformation by providing interactional space between turns. The pauses between teacher feedback and student responses allowed students to process the question, reconsider previous answers, and formulate more meaningful responses. In this way, wait-time did not function merely as silence, but as a cognitive space that supported reflection and participation.

In the IRFRF structure, teacher feedback becomes a bridge for continuing the dialogue. The teacher's follow-up feedback encourages students to elaborate, clarify, or justify their ideas. Therefore, IRFRF should not be interpreted simply as a longer dialogue. A long exchange does not automatically indicate high-quality dialogue. In this study, IRFRF is used as an indicator of dialogue quality when the extended interaction demonstrates elaboration, reciprocity, reflection, and collaborative reasoning.

Elaboration appeared when students moved beyond short answers and produced more complete explanations. Reciprocity appeared when the teacher and students responded to each other's ideas in a connected sequence. Reflection appeared when students reconsidered and refined their initial responses. Collaborative reasoning appeared when meaning was gradually constructed through repeated teacher–student interaction. These features indicate that dialogue quality depends not only on the number of turns, but also on the extent to which interaction supports reasoning and shared understanding.

This finding is consistent with Mortimer and Scott (2003), who argued that classroom discourse can move beyond simple recitation when teachers use follow-up moves to support meaning-making. It also aligns with Alexander's (2020) concept of dialogic teaching, which emphasizes reciprocal, cumulative, and purposeful classroom talk. In this study, prompting feedback and extended wait-time helped transform classroom interaction from teacher-centered confirmation into more dialogic and reflective learning exchanges.

Overall, the transformation from IRF to IRFRF demonstrates that classroom dialogue quality is shaped by how teachers respond to students and how much interactional space they provide for thinking. Feedback served as a dialogic move that directed students toward deeper reasoning, while wait-time served as an interactional space that allowed students to process and elaborate their ideas. Together, these two elements supported dialogue continuity, extended interaction sequences, and collaborative meaning-making in primary science learning.

Conclusion

This study demonstrates that teacher feedback and wait-time played important roles in shaping the quality and continuity of classroom dialogue in primary science learning. Across the three lessons, accepted feedback emerged as the most dominant feedback type, functioning mainly to confirm students' responses and maintain classroom flow. Meanwhile, modified feedback contributed significantly to sustaining interaction through probing questions, clarification requests, and elaborative prompts, while rejected feedback was used selectively to address misconceptions and guide students toward more accurate scientific understanding. These findings indicate that feedback functioned not only as evaluative commentary but also as a dialogic strategy that supported student participation and conceptual development.

The findings also reveal that wait-time varied across different speech transitions and influenced the depth and continuity of classroom interaction. Short wait-times were generally associated with rapid and simple responses, whereas extended wait-times provided cognitive and interactional space that enabled students to elaborate, reflect, and refine their ideas. Longer pauses frequently appeared before follow-up feedback or new teacher initiations, supporting more sustained participation and collaborative meaning-making during discussion.

Furthermore, the combination of dialogic feedback and intentional wait-time contributed to the transformation of classroom interaction from conventional IRF (Initiation–Response–Feedback) structures into more extended IRFRF (Initiation–Response–Feedback–Response–Feedback) sequences. In this study, IRFRF was not interpreted merely as longer interaction, but as an indicator of higher-quality dialogue characterized by elaboration, reciprocity, reflection, and collaborative reasoning. The findings support Mortimer and Scott's (2003) view that follow-up interaction can extend classroom discourse beyond simple recitation, as well as Alexander's (2020) concept of dialogic teaching that emphasizes reciprocal and cumulative classroom talk.

Overall, this study highlights that effective classroom dialogue in primary science learning is strongly influenced by how teachers provide feedback and manage wait-time during interaction. Feedback acted as a dialogic move that guided students toward deeper reasoning, while wait-time functioned as interactional space that allowed students to think, respond, and collaboratively construct understanding. These findings suggest that the integration of dialogic feedback and intentional wait-time can support more meaningful, reflective, and student-centered classroom discourse.

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