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# Enhancing Questioning and Communication Skills in Elementary Science Learning: Challenges and Pedagogical Insights

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## Abstract

Education in the 21st century requires students to master higher-order thinking and communication skills to navigate increasingly complex global challenges. In Indonesian primary education, these competencies are emphasized in the Merdeka Curriculum but remain underdeveloped in practice. This study explores the challenges and pedagogical strategies for enhancing questioning and communication skills in elementary science learning. Employing a descriptive qualitative design with a multi-class case study approach, the research was conducted at Madrasah Ibtidaiyah Swasta Nurul Hidayah, Jambi City, involving 24 students and four science teachers purposively selected to represent diverse achievement levels. Data were collected through structured observations, semi-structured interviews, and document analysis, and analyzed using the Miles, Huberman, and Saldaña interactive model with triangulation for validity. The analysis revealed that students' questioning and communication skills remain basic, constrained by psychological (low self-confidence), pedagogical (teacher-centered instruction), and structural (limited reflective time) factors. Three integrated strategies were identified: (1) question scaffolding to guide students in formulating meaningful questions; (2) dialogic learning environments to encourage open discussion; and (3) authentic assessment and reflective feedback to value students' inquiry and communication efforts. Fostering these competencies requires a synergistic framework of emotional support, pedagogical scaffolding, and curriculum redesign that strengthens critical thinking and scientific literacy in line with the principles of 21st-century and Merdeka Curriculum education.
**Keywords: questioning skills; communication skills; science learning**

## Introduction

The results of the Programme for International Student Assessment (PISA) placed Indonesia among the lowest-performing countries in reading and communication skills (OECD, 2022). This finding highlights the persistent challenge of improving Indonesian students' cognitive and communicative competencies to meet the complex demands of the twenty-first century. In this era, learners are required to master critical, creative, collaborative, and communicative abilities that enable them to adapt to rapid global change. Educational transformation can no longer rely solely on the transmission of knowledge but must emphasize the cultivation of thinking and interaction skills within

authentic social contexts. Indonesia's Merdeka Curriculum embodies this paradigm shift by promoting learner autonomy, inquiry-based learning, and character formation. Within primary education, science serves as a pivotal subject for developing these competencies, as it integrates scientific literacy with twenty-first-century skills in a holistic and contextualized manner (Şentürk, 2021).

Among the essential competencies emphasized in twenty-first-century science education, questioning skills and communication skills occupy central roles. These abilities are fundamental to scientific reasoning, logical argumentation, and deep conceptual understanding (Chusni et al., 2022; Hursen et al., 2023). Questioning enables students to construct meaning, identify gaps in understanding, and stimulate reflective thinking, while communication helps them articulate ideas, validate reasoning, and interpret information critically through collaboration (Hanaysha et al., 2023). When well developed, these skills foster productive scientific dialogue and strengthen students' engagement in classroom discourse.

Questioning skills refer to the ability of learners to identify scientific problems and formulate meaningful, measurable questions that lead to the discovery of new knowledge (Brownell et al., 2013; Gillies, 2014; Hidayat & Rineva, 2022; Kalsum et al., 2022). They reflect not only activeness in inquiry-based learning but also the depth of reasoning. Assessing questioning skills commonly involves evaluating the frequency, cognitive level, and relevance of questions generated during scientific inquiry ( Lobemato et al., 2022; Puger et al., 2024). Higher-level analytical and evaluative questions indicate advanced critical and reflective thinking. Similarly, communication skills involve the ability to express ideas clearly, respond to others constructively, and present arguments or data through appropriate scientific representations. According to Angganing et al. (2022) four key indicators represent communication skills in science learning: the ability to ask and answer questions, to express ideas coherently, and to respond meaningfully to peers' opinions.

Despite their importance, evidence shows that both questioning and communication skills remain underdeveloped in Indonesian primary classrooms. Field observations and previous studies reveal that many students are passive during science learning; they rarely ask questions and are hesitant to express opinions due to fear of mistakes or embarrassment (Wang, 2024). Teachers tend to dominate classroom

discourse, while students act as recipients of information. This teacher-centered pattern limits opportunities for reflection and dialogic learning (Aghnia, 2023). Similar challenges are found in the broader implementation of the Merdeka Curriculum, where limited teacher readiness, insufficient laboratory facilities, and restricted exploration time hinder the development of inquiry-based learning (Ahsani, 2020; Barlian et al., 2023; Utary & Anwar, 2023).

The barriers to developing these skills can be categorized into internal and external dimensions. Internally, students' low self-confidence, limited motivation, and anxiety about peer judgment discourage active participation. Externally, teachers' instructional dominance, lack of dialogic approaches, and rigid curriculum pacing restrict opportunities for interaction. These interrelated conditions create classroom environments that suppress curiosity and constrain inquiry-based communication.

While numerous studies have examined questioning or communication skills individually, relatively few have investigated how these two competencies interact in real primary classroom contexts particularly within the framework of the Merdeka Curriculum. Most previous research has focused on cognitive outcomes, neglecting the psychological and pedagogical dynamics that influence students' inquiry and communicative behaviors. Consequently, there remains limited understanding of how internal learner factors (e.g., self-confidence) and external classroom conditions (e.g., teacher scaffolding) jointly shape the development of questioning and communication in science learning. Addressing this gap is essential for achieving the Profil Pelajar Pancasila, which envisions Indonesian students as critical, collaborative, and communicative learners.

From a social constructivist perspective, students' questioning and communication abilities are deeply tied to classroom interactions that promote dialogue and reflection. Vygotsky & L. S. (1978) concept of the Zone of Proximal Development (ZPD) emphasizes that learning occurs when teachers and peers provide scaffolding that enables students to move beyond their current level of understanding. In science classrooms, scaffolding can take the form of modeling questions, giving feedback, and guiding conceptual clarification through discussion. Teachers thus serve as facilitators who help students construct knowledge, rather than as transmitters of information.

However, observations indicate that many teachers lack the pedagogical competence to implement such scaffolding effectively at the primary level.

International research supports the importance of scaffolding in promoting questioning behavior. Øyehaug et al. (2024) found that well-structured scaffolding interventions increased the quality and frequency of student-generated questions by 40% in inquiry-based environments. Similarly, Fatmawati (2024)developed tools to assess teacher competencies in facilitating questioning and confirmed that the effectiveness of questioning development depends on the quality of teacher–student interaction. Nevertheless, these studies have focused primarily on secondary or pre-service education, leaving a gap in evidence regarding elementary classrooms, particularly in the Indonesian context.

Moreover, only a few studies, such as those by Fakhruddin et al. (2024); Øyehaug et al. (2024) have connected the challenges of developing questioning and communication skills with their broader implications for students' readiness to meet twenty-first-century demands. This reveals a critical research gap: the need to examine these skills together as interdependent competencies within primary science learning. In the context of the Merdeka Curriculum, where inquiry, reflection, and collaboration are prioritized, an integrated understanding of questioning and communication is essential for fostering scientific literacy and active engagement from the earliest grades.

Based on this identified gap, the present study was designed to analyze the challenges students face in developing questioning and communication skills during science learning in primary schools. It specifically aims to: (1) identify the psychological, pedagogical, and structural factors that hinder these skills; (2) examine how classroom practices influence students' inquiry and communicative behaviors; and (3) propose pedagogical strategies that can enhance these competencies in alignment with twenty-first-century learning goals. Grounded in Vygotsky's social constructivism, this study conceptualizes questioning and communication as intertwined dimensions of higher-order thinking and social interaction that must be developed through collaborative and reflective classroom practices.

Theoretically, this research contributes to the growing body of literature on twenty-first-century learning skills in primary education by integrating psychological, pedagogical, and structural perspectives into a unified framework of inquiry and

communication. Practically, it provides actionable recommendations for teachers and policymakers, including the creation of emotionally supportive classroom environments, professional development in scaffolding techniques, and the incorporation of authentic assessments that value students' questioning and communicative efforts. By addressing both the barriers and opportunities in current practice, this study bridges the gap between theoretical ideals and classroom realities, proposing a comprehensive model for strengthening questioning and communication skills within the Merdeka Curriculum. Ultimately, it aims to improve the quality of science learning and prepare Indonesian students to face global challenges with curiosity, confidence, and critical awareness.

## Research Methods

This study employed a qualitative descriptive approach with a multi-class case study design to provide an in-depth understanding of how questioning and communication skills develop in elementary science learning. This approach was appropriate for capturing students' behaviors and classroom interactions in a natural context without manipulating variables. The case study design enabled the researcher to examine the characteristics and dynamics of science learning across several classes within the same school, allowing for a holistic view of the phenomenon. Rather than focusing on statistical measurement, this qualitative approach emphasized meaning, interpretation, and contextual understanding. Data were collected through direct engagement with participants and classroom settings, and analyzed to describe systematically how students' learning experiences, teacher strategies, and classroom practices influence the development of questioning and communication skills.

The study was conducted at Madrasah Ibtidaiyah Swasta Nurul Hidayah in Jambi City during the second semester of the 2024/2025 academic year. The school was purposively selected as an Islamic primary institution implementing the Merdeka Curriculum, offering a relevant context for examining science learning in urban primary settings. The research involved four classes (Grades III–VI) with a population of about 120 students, from which 24 students were purposively chosen based on three criteria: learning motivation (high, moderate, low), gender balance, and science achievement ($\geq 85$ = high, $\leq 75$ = low).

Additionally, four science teachers served as key informants, each with more than five years of teaching experience and active involvement in lesson planning and implementation. Their participation provided pedagogical and professional perspectives on students' questioning and communication development. To contextualize the findings, direct observations were also conducted during regular science lessons to capture classroom interactions, communication patterns, and the overall learning environment influencing students' behaviors.

Table 1.
Detail Participation

| Participant Code | Role | Grade Level | Gender | Learning Motivation | Science Achievement | Teaching Experience (for teachers) | Remarks / Role in Data Collection |
|---|---|---|---|---|---|---|---|
| S1–S6 | Student | Grade III | 3M / 3F | Low to Moderate | 70–78 | — | Representing lower–middle achievers |
| S7–S12 | Student | Grade IV | 3M / 3F | Moderate to High | 80–85 | — | Active respondents in interviews |
| S13–S18 | Student | Grade V | 3M / 3F | Moderate | 75–83 | — | Observed for questioning frequency |
| S19–S24 | Student | Grade VI | 3M / 3F | High | ≥85 | — | Frequent participants in discussions |
| T1 | Teacher | Grade III | F | — | — | 6 years | Provided classroom scaffolding data |
| T2 | Teacher | Grade IV | M | — | — | 8 years | Shared lesson planning and reflection |
| T3 | Teacher | Grade V | F | — | — | 10 years | Provided interview and observation data |
| T4 | Teacher | Grade VI | M | — | — | 9 years | Participated in member checking stage |

Source: Personal Documents

Data were collected using three main techniques: structured observation, semi-structured interviews, and document analysis (Nugrahani, 2014). A total of twelve classroom sessions were observed across all grade levels, using an instrument developed from the Revised Bloom's Taxonomy and Angganing et al. (2023) indicators of scientific communication. The observation focused on the frequency, type, and quality of students'

questions, as well as their clarity of speech, willingness to respond, and argument accuracy. Instrument validity was confirmed by three experts in science education, and inter-rater reliability (Cohen's Kappa = 0.75) indicated high consistency.

Interviews were conducted with 24 students and four teachers using a ten-item open-ended guide to explore their experiences, perceptions, and challenges in developing questioning and communication skills. All interviews were audio-recorded, transcribed verbatim, and analyzed thematically (Imani et al., 2021).

Complementary document analysis was applied to lesson plans, laboratory reports, and assessment rubrics to identify how questioning and communication were embedded in instructional design. The findings were triangulated with observation and interview data to ensure validity. Throughout the process, the researcher maintained field notes and reflexivity memos to minimize bias and enhance transparency of interpretation.

Data were analyzed concurrently with data collection using the interactive model by Cope & Kalantzis (2016) through three stages: data reduction, data display, and conclusion drawing. Observation notes, interview transcripts, and lesson plan documents were coded according to indicators of questioning and communication skills. Verbal and nonverbal expressions, types of questions, and responses were grouped to identify recurring patterns. The coded data were then summarized in thematic matrices describing student participation, teacher scaffolding, and classroom interaction. Triangulation of observation, interview, and document data, along with member checking, ensured credibility and accuracy (Kiki Fatmawati, 2024). The trustworthiness of findings followed Lincoln and Guba's (1985) criteria. The analysis produced three main themes reflecting psychological, pedagogical, and structural factors influencing students' questioning and communication in science learning.

## Result

The triangulated data obtained from classroom observations, in-depth interviews with teachers and students, and document analysis revealed that the greatest challenges in developing students' questioning and communication skills lie in their low learning motivation and limited self-confidence to participate actively in class. Observations conducted over twelve science lessons across four classes showed that only two out of twenty-four students, or approximately 8.3 percent, spontaneously asked questions to the

teacher. When the teacher provided open-ended prompts, most students chose to remain silent or displayed hesitant and anxious expressions. Only a few students attempted to respond with short or incomplete answers.

These findings indicate that questioning has not yet become an integral or natural part of students' learning behavior. The learning environment has not fully encouraged curiosity-driven inquiry, and as a result, students' questioning and communication skills have not developed optimally.

Table 2.
Frequency of Questioning and Speaking Participation

| Category | n | Percent |
|---|---|---|
| Students actively ask questions | 2 | 8,3% |
| Average speaking participation per session | 5 | 20,8% |

Source: Personal Documents

Data were obtained from twelve classroom observations conducted across four classes (Grades III–VI) at MI Swasta Nurul Hidayah, Jambi City, and were further corroborated through in-depth interviews and document analysis to ensure data triangulation. The observation findings, supported by teachers' statements during interviews and reflection notes in lesson plans, consistently showed that the level of student participation in the questioning process remained very low. In most sessions, the classroom atmosphere tended to be quiet when the teacher encouraged students to pose questions, and most students responded only nonverbally, such as by nodding or taking notes, without participating in the discussion. Triangulated evidence from interviews also revealed that teachers perceived active questioning behavior to appear mainly among high-achieving students. As one fifth-grade teacher explained, "The ones who often ask questions in class are the students who already have good grades. The others often stay silent because they are afraid of making mistakes or feel embarrassed if their questions sound strange." These consistent findings across observation, interview, and documentation confirm that questioning activities have not yet become a natural part of classroom culture.

This quotation illustrates that questioning activity remains exclusive to students who have high self-confidence, while most students feel awkward or worried about making mistakes. The results of student interviews supported this finding. A sixth-grade student revealed, "Sometimes I want to ask questions, but I'm afraid my friends will laugh at me. Sometimes I'm also confused about what to ask because I don't really understand

the material". This statement shows that psychological barriers, such as fear and low self-confidence, are important factors that limit students' active participation. These barriers cause the process of scientific communication to not develop naturally in the classroom.

The results of observations and interviews were reinforced by the analysis of instructional documents, particularly the lesson plans (Rencana Pelaksanaan Pembelajaran or RPP) used by the teachers. In the RPPs, students' questioning activities were still positioned as additional activities in the reflection stage, not as a main component in the exploration or inquiry phase. Teacher reflection notes in the RPPs indicated that "students tend to wait for directions before asking questions" and that "questions that arise are often not directly related to the science concepts being studied." This documentary evidence confirms that the learning process has not yet fully positioned questioning as an integral part of inquiry-based learning in science classes.

Figure 1
Learning Activity
Source: Personal Documents

These findings confirm a consistent pattern showing that students tend to remain cognitively and affectively passive. Classroom communication is still dominated by teachers, while students have limited opportunities to ask questions or provide responses. Teachers often deliver lengthy explanations without opening space for students to explore their own ideas. Under such conditions, questioning activities do not develop naturally because students are neither exposed to meaningful examples of questions nor provided with feedback that encourages them to take risks in asking.

In addition, field observations revealed that the structure of classroom activities tended to be linear. Lessons usually began with a lecture, followed by written exercises, and ended with a brief evaluation. Activities that could foster two-way interaction, such as group discussions or simple experimental explorations, were conducted only occasionally. This pattern reinforces the position of students as passive recipients of information. As a result, questioning skills did not grow naturally because students lacked both stimuli and challenging contexts that could trigger the emergence of scientific questions.

Time constraints were another contributing factor to the limited questioning activities. Teachers admitted that the heavy curriculum load often forced them to shorten question-and-answer or reflection sessions. One teacher explained,

"If there were enough time, I would actually like to give students more time for discussion and questions, but because I have to meet the material targets, we often move straight to practice exercises."

This statement illustrates the tension between the pedagogical need to develop scientific thinking skills and the administrative demand to complete the curriculum. Such conditions reduce the frequency of reflective learning moments that should serve as important opportunities for students to practice questioning and expressing their ideas.

Triangulated findings also revealed a link between learning motivation and questioning participation. Students with high motivation were generally more active and willing to ask questions compared to those with lower motivation. However, without a supportive learning environment, individual motivation rarely spread to classmates. Teachers noted that classes with a more competitive atmosphere tended to generate more questions than those that were passive and homogeneous.

Overall, the challenges in developing students' questioning and communication skills encompass three main dimensions: psychological, pedagogical, and structural. Psychologically, students face low self-confidence and social anxiety that hinder active participation. Pedagogically, teachers continue to rely on content-delivery models that limit opportunities for dialogic and inquiry-based learning. Structurally, time constraints and dense curricular demands restrict reflective learning activities that could stimulate students' questioning abilities.

These findings align with the research of (Hafizo & Lian, 2022) which emphasize the importance of creating dialogic and supportive learning environments to foster questioning in science education. Within the context of Indonesian primary education, the present study provides empirical evidence that the development of questioning and communication skills requires a paradigm shift from transmissive models of teaching toward participatory learning that positions questioning as the core of scientific thinking and academic communication in the classroom.

Barriers to Developing Questioning Skills

The main barriers to developing students' questioning skills fall into three interrelated aspects: psychological, pedagogical, and the social environment of the classroom. The psychological aspect emerged as the dominant factor influencing students' reluctance to ask questions during science learning. Based on classroom observations, most students appeared hesitant or lowered their gaze when the teacher offered them the opportunity to ask questions. Many students looked at the teacher silently without any verbal expression, indicating their lack of readiness to respond to learning stimuli.

In-depth interviews with students confirmed these observations. Many of them mentioned fear of making mistakes as the primary reason they refrained from asking questions. A fifth-grade student stated, *"If I say something wrong, my classmates will laugh. So it's better to stay quiet."* Another student added, *"Sometimes I already think of a question, but I'm afraid it's too easy. They might think I'm not smart*."

These statements illustrate the strong social pressure present in the classroom. Anxiety about negative peer judgment prevents students from asking questions, even when they genuinely wish to understand the material more deeply. This type of barrier is referred to as social anxiety in classroom interaction, which is common in learning environments that rely heavily on verbal communication (Daud, 2020).

In addition to psychological factors, pedagogical barriers also contribute to the low development of questioning skills. Observations revealed that teachers often used lecturing and limited question–answer formats, in which questions were mostly initiated by the teacher rather than the students. Two-way interaction had not been fully established

because teachers tended to focus on content delivery and meeting curriculum targets. One teacher explained,

"*I rarely ask students to make their own questions because there isn't enough time. Usually, I ask the questions myself so that the lesson stays on schedule*."

This statement indicates that questioning activities are still viewed primarily as a tool to check understanding rather than as a learning strategy that nurtures scientific curiosity. Consequently, students are not accustomed to constructing reflective questions that promote higher-order thinking.

Interviews with teachers also revealed that not all of them had well-structured strategies to cultivate questioning skills. A fourth-grade teacher admitted, "*Sometimes I find it hard to create triggering questions that make students think. When the material is difficult, I just explain it in detail to finish faster."* This statement shows that teachers' capacity to facilitate questioning-based learning remains limited. Teachers still tend to play the role of information providers rather than facilitators of scientific dialogue. As a result, students receive few examples of meaningful questions and limited opportunities to practice active questioning.

Document analysis reinforced these findings. In the lesson plans (Rencana Pelaksanaan Pembelajaran or RPP) used by teachers, activities that emphasize the development of questioning skills only appeared in the final reflection section, and there were no specific rubrics to assess the quality of students' questions. Assessment indicators such as clarity, relevance, or depth of questioning were not included. The evaluation still focused mainly on conceptual mastery rather than critical thinking through questioning. These documents demonstrate that cognitive processes have not yet become a primary focus in the planning of science instruction at the primary level.

Observations also revealed that teachers who tried to provide questioning opportunities without structured guidance often faced difficulties because students tended not to respond. In such situations, teachers usually reverted to one-way instruction. This cycle reinforces classroom passivity and hinders the emergence of a questioning culture. One teacher noted, "When I ask, 'Does anyone have a question?' the class is usually silent. But if I call on someone by name, they start talking." This phenomenon shows that student participation still depends on external stimuli in the form of direct prompts from

the teacher, rather than intrinsic motivation to ask questions as part of the learning process.

Furthermore, the classroom social environment also influenced students' willingness to ask questions. Interviews showed that students who had close friends were more active in asking questions when placed in the same discussion group, whereas those who felt isolated tended to remain passive. Students in more competitive friendship groups admitted that they feared appearing less intelligent in front of their peers. These findings demonstrate that emotional climate and peer relationships play a significant role in shaping students' confidence to ask questions.

Overall, triangulated data reveal that barriers to questioning skills result from a complex interaction among psychological, pedagogical, and social factors. Students need emotional safety to feel confident asking questions. Teachers require pedagogical competence to support the emergence of reflective questions, while classroom environments must cultivate a culture that values the thinking process rather than only final outcomes.

These findings are consistent with the study by Øyehaug et al. (2024) which emphasizes that teacher scaffolding through open-ended questions and positive feedback can enhance students' confidence in posing scientific questions. Therefore, efforts to develop questioning skills cannot be implemented partially. They require a comprehensive strategy that includes teacher training, the creation of supportive classroom climates, and the design of exploratory learning environments that allow students to ask questions without fear or social pressure.

## Implications of Developing Questioning and Communication Skills in Science Learning

The development of questioning and communication skills has broad implications for the quality of science education in primary schools. Students who are able to pose reflective questions and articulate their ideas clearly are more likely to develop deep conceptual understanding. Questioning is not only a tool for obtaining information but also a means of scientific thinking that nurtures curiosity, stimulates exploration, and encourages discovery. When questioning skills are integrated with effective communication, science learning becomes a dialogic process that allows students to construct meaning socially rather than passively receiving knowledge.

Field findings show that low levels of questioning and communication skills make it difficult for students to engage in inquiry-based learning. Many students understand concepts only at a surface level because they are not accustomed to challenging ideas or seeking clarification about phenomena that they do not yet understand. In this context, the lack of verbal interaction between teachers and students creates a domino effect on students' critical thinking abilities. Teachers acknowledged that students often struggle to restate what they have learned. A sixth-grade teacher explained, "*After I give a long explanation and ask them to retell it in their own words, most of them stay silent. Only one or two students can speak fluently*." This statement shows that scientific communication is not only about speaking ability but also about processing and reconstructing knowledge into meaningful explanations. Without questioning and communication skills, science learning loses the reflective dimension that helps students connect concepts to real-world contexts.

The pedagogical implications of these findings highlight the importance of dialogic and collaborative learning. Science should be taught through experiences that allow students to ask questions, debate, and build arguments collaboratively with peers. Strategies such as project-based learning, guided experiments, and reflective discussions provide opportunities for students to express ideas and reassess their understanding. Teachers need to act as facilitators who create a safe and supportive environment where students feel comfortable experimenting with ideas and are not afraid of making mistakes.

This approach aligns with Vygotsky's concept of the zone of proximal development, where social interaction serves as a bridge between students' actual and potential development. Through appropriate scaffolding, students can learn to formulate more meaningful questions and gradually develop scientific argumentation. Research by Øyehaug, Kouns, and Savelsbergh also confirms that questioning skills developed in collaborative learning environments enhance the quality of scientific dialogue and strengthen higher-order thinking skills.

Within the framework of the Kurikulum Merdeka or Independent Curriculum, these implications hold significant practical relevance. The Profil Pelajar Pancasila or Pancasila Student Profile emphasizes critical, communicative, and collaborative thinking as key attributes of twenty-first century learners. The findings of this study suggest that achieving these attributes must begin with the strengthening of two fundamental skills,

questioning and communication, at the primary level. Teachers need to cultivate habits of reflection and open discussion at every stage of instruction so that students become accustomed to articulating scientific ideas and evaluating arguments constructively.

Strong questioning and communication skills also have direct implications for students' readiness to face global challenges. Students who can ask critical questions tend to be more adaptive to change and better able to understand new information. In a knowledge-based society, the ability to communicate ideas and pose sharp and relevant questions becomes a vital foundation for developing both scientific and digital literacy. Science learning that promotes these two skills will produce learners who not only master concepts but also demonstrate awareness of social and environmental issues in their surroundings.

At the institutional level, the findings indicate the need to revise lesson plans and assessment rubrics to include questioning and communication as core competencies. This aligns with Amaliah et al. (2021) and Angganing et al. (2023) who found that most primary science lessons remain content-focused and have not yet integrated reflective and dialogic components.

In this study, the average questioning rate was about 0.9 questions per lesson, lower than dialogic classrooms reported by Puger et al. (2024) where students actively exchange questions and ideas. This comparison shows that science learning in Jambi still lacks dialogic engagement and requires structured scaffolding. The proposed approaches, including question scaffolding and reflective feedback, should be viewed as promising signals rather than causal effects, given the limited pilot scope. Similar to Poonputta & Nuangchalerm (2024) continuous teacher development and alignment with curriculum goals are necessary for sustainable improvement.

Equity was also noted as quieter and low-achieving students began participating after teachers applied supportive feedback, confirming Osadchyi et al. (2021)view that emotionally safe classrooms foster active communication. Overall, strengthening questioning and communication requires change at all levels: teachers must promote inclusive dialogue, schools must renew assessment systems, and policymakers must formally recognize these skills as essential elements of twenty-first-century science learning.

Limitations in Lesson Planning and Assessment

The limitations identified in the lesson planning documents and teachers' assessment systems indicate that questioning and communication have not yet become priorities in the implementation of science learning in primary schools. Analysis of lesson plans (Rencana Pelaksanaan Pembelajaran or RPP), teaching modules, and assessment rubrics used by teachers revealed that questioning and communication competencies are still positioned as complementary activities rather than integral components of learning objectives. Almost all of the reviewed RPPs emphasized conceptual mastery of science, while process indicators such as students' ability to formulate questions, construct arguments, and explain scientific ideas were not explicitly stated in either learning objectives or assessment criteria.

Teachers tend to use conventional lesson plan formats in which learning activities focus on concept exploration and written exercises. In the closing stage, there is typically a reflective component such as "the teacher asks guiding questions," but no component exists for assessing the quality of students' questions. This finding highlights a gap between curriculum policies that promote active learning and planning practices in the field that remain instructional and outcome-oriented. A fourth-grade teacher explained, "There is a question-and-answer section in the lesson plan, but it is usually just to check students' understanding. I have never made a specific assessment for questioning activities." This statement shows that questioning is not yet regarded as a measurable competency but merely as a tool for checking comprehension. This tendency indicates that the dimension of scientific thinking processes, particularly reflective questioning and two-way communication, has not received adequate attention in the instructional system.

Furthermore, interviews with students supported this finding. Several students stated that they were rarely given the opportunity to ask questions openly because teachers often spent most of the time explaining material and asking them to write answers. A fifth-grade student said, "Usually the teacher is the one who asks questions, not us. Sometimes we want to ask, but there is no time." Another student added, "Asking questions does not give extra marks, so it's better to stay quiet." These statements demonstrate that limitations in lesson planning have a direct impact on students' motivation. When questioning and communication activities are not recognized within the assessment system, students lose the incentive to participate actively. In the

framework of the Kurikulum Merdeka (Independent Curriculum), however, learning is expected to foster engagement and reflection, not only cognitive achievement.

Analysis of teachers' assessment rubrics also showed a similar pattern. The instruments primarily measured final outcomes such as correctness of answers, completeness of laboratory reports, and ability to state concepts, without including indicators of scientific communication processes. There were no criteria assessing aspects such as clarity of expression, ability to respond to peers' ideas, or confidence in asking questions. Teachers admitted that they did not yet have specific guidelines for assessing these aspects. A sixth-grade teacher explained, "*There is no clear rubric for evaluating students when they speak or ask questions, so we focus on test results because those are what need to be reported."*

This condition illustrates that the assessment system in schools remains cognitively oriented and does not yet support the development of scientific thinking and communication skills. Authentic assessment, in fact, requires teachers to evaluate learning processes that reflect students' real abilities, including how they interact, express opinions, and solve problems collaboratively.

From a pedagogical perspective, these limitations in planning and assessment reflect an incomplete understanding of the importance of higher-order learning processes in science education. Teachers tend to regard questioning as an indicator of learning readiness rather than as a higher-order thinking skill that needs to be continuously practiced and evaluated. As a result, students are not accustomed to reflecting on what they have learned and are not trained to communicate their reasoning effectively.

Additional limitations were also found in the use of teaching modules. Most modules contained predetermined exploration activities without open-ended space for students to write or discuss their own questions. The laboratory modules examined showed that students were only required to fill in observation tables and answer closed questions such as "*What happened in this experiment?"* or *"State your observation results."* There were no prompts asking students to formulate follow-up questions based on the observed phenomena. Consequently, critical thinking activities that should emerge through questioning were not adequately facilitated.

These findings confirm that the development of questioning and communication skills cannot stand alone without systemic support from lesson planning and assessment

structures. To strengthen these skills, schools need to revise operational curriculum documents and assessment instruments by including indicators that evaluate students' willingness to ask questions, ability to respond to peers' ideas, and quality of scientific explanations. In addition, teacher training on authentic assessment and formative feedback is essential so that teachers can evaluate students' thinking processes more comprehensively.

Through these changes, science learning in primary schools is expected to shift its focus from grades and outcomes toward thinking processes and scientific interaction that shape active, reflective, and communicative learners. Lesson plans that incorporate questioning and communication indicators will create more participatory learning environments, while assessment systems that value the learning process will foster a culture of reflection and appreciation for students' learning efforts

## Discussion

Questioning and communication skills are fundamental to science learning in elementary education. These two competencies help students develop a deeper understanding of scientific concepts and train them to think scientifically. However, the findings of this study show that questioning and communication activities in the classroom are still very limited. Students tend to listen to the teacher rather than ask questions or engage in discussions. This indicates that classroom learning remains teacher-centered rather than student-centered.

The gap between the ideals of 21st-century education and classroom practice is evident. The Merdeka Curriculum emphasizes curiosity, critical thinking, and collaboration, yet classroom instruction continues to rely heavily on lectures. Science, which should encourage students to think through questioning and exploration, often focuses on memorization. This situation restricts the growth of scientific reasoning and curiosity among students. Therefore, classroom practice must shift toward inquiry-based learning that allows students to question, explore, and communicate their understanding more freely.

According to Vygotsky's theory, effective learning occurs when teachers act as facilitators who help students think beyond their current capabilities through a process known as scaffolding (Merchie & Van Keer, 2016; Schons et al., 2023). In this study,

teachers provided limited scaffolding during science lessons. Social interactions in the classroom were not fully utilized to stimulate inquiry and scientific reasoning. This finding suggests that one strategy to improve questioning and communication is to strengthen scaffolding practices by providing gradual guidance that encourages students to ask "why" and "how" questions. When teachers respond with follow-up prompts or reflective feedback, students learn to clarify and extend their ideas, which builds both reasoning and communication skills.

Psychological barriers also play a major role. Many students feel anxious or embarrassed when they want to ask questions. They worry about making mistakes or being laughed at by their peers, which causes them to remain silent even when they do not understand the lesson. A classroom atmosphere that does not create emotional safety discourages students from speaking up. To overcome this, teachers need to establish an emotionally supportive environment that values every contribution, provides encouragement, and models respectful communication. When students feel safe and appreciated, their confidence and willingness to participate increase, leading to more active questioning and discussion.

From a pedagogical perspective, teachers seldom use open-ended questions that can stimulate higher-order thinking. Most questions are closed-ended and require short factual answers such as "what" or "mention." In contrast, open-ended questions such as "why" and "how" can help students analyze phenomena more deeply. Chin and Osborne emphasize that such questions promote reflective dialogue and strengthen conceptual understanding. Thus, teachers should intentionally integrate open-ended questioning strategies into their teaching routines and provide sufficient time for students to respond, reflect, and discuss their answers. This practice helps cultivate critical thinking and communication, two of the key competencies in 21st-century education.

Similar limitations appear in lesson planning documents, including lesson plans (RPP) and teaching modules. Questioning and communication have not been positioned as the main focus (Ardianti & Amalia, 2022; Nafi'ah & Faridah, 2022). There are no clear indicators for assessing questioning or communication skills. Teachers' assessments are still outcome-oriented and do not fully consider students' thinking processes. As a result, students receive little recognition for their attempts to ask questions or participate in discussions, which prevents these skills from developing consistently. To address this

structural issue, schools should revise assessment rubrics to include questioning and communication indicators. Such improvement aligns with the goals of the Merdeka Curriculum, which encourages active learning, reflection, and collaboration.

Time constraints also contribute to the low frequency of questioning in class. Teachers often shorten discussion sessions in order to complete material according to schedule. This limits opportunities for reflection and dialogue. Allocating more time for student discussion and interaction can serve as a simple but effective strategy to strengthen questioning and communication practices.

These findings are consistent with research by Dillon and Osborne, who emphasize that questioning is central to science learning. Through questioning, students connect new concepts with prior experiences and construct meaningful understanding. Without opportunities to ask questions, learning becomes superficial and focuses more on results than on cognitive processes. Therefore, teachers must treat questioning and communication as integral parts of the learning process rather than additional activities.

Nevertheless, this study identifies opportunities for improvement. Both teachers and students show a shared willingness to create more interactive learning environments. Teachers recognize the importance of engaging students, while students express a desire to share their ideas. This forms a strong basis for implementing question scaffolding, which is a gradual guidance process that helps students formulate their own questions. Øyehaug et al. (2024) found that this strategy improves the quality of classroom dialogue and promotes more effective scientific discussion.

The results also reveal that questioning and communication are mutually reinforcing. Students who frequently ask questions become more articulate in expressing ideas, while students who regularly communicate become more skilled at formulating meaningful questions. These two competencies should therefore be developed simultaneously as integral components of scientific reasoning.

The implications are clear. Teachers need to view questioning and communication as the core of science learning rather than as supplementary activities. Schools must reform assessment systems to evaluate not only outcomes but also thinking processes. When classrooms foster dialogue and reflection, students learn to think critically, communicate clearly, and collaborate meaningfully (Jannah & Atmojo, 2022, p. 21; Poonputta & Nuangchalerm, 2024; Sitompul et al., 2021). Science learning that

promotes questioning and communication enriches the educational experience and helps shape students into confident, curious, and open-minded individuals. This represents the true essence of 21st-century education, which aims to transform students from passive recipients of knowledge into active and reflective creators of understanding.

## Conclusion

This study concludes that elementary students' questioning and communication skills remain limited and are not yet fully integrated into science learning. The findings indicate that psychological barriers such as low self-confidence and pedagogical constraints including teacher-centered instruction restrict students' participation and reflective dialogue. To overcome these challenges, teachers need to create supportive classroom environments and implement inquiry-based and dialogic approaches that encourage curiosity and open expression. Schools should also revise lesson plans and assessment systems to include questioning and communication as key learning outcomes. These improvements are essential to strengthening critical thinking, collaboration, and communication among primary learners as part of twenty-first-century competencies. The scientific contribution of this study lies in its integrated analysis of questioning and communication within the framework of the Merdeka Curriculum, providing a practical model for transforming elementary science learning into a more participatory and reflective process aligned with modern educational goals.

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The authors declare that there is no conflict of interest regarding the publication of this paper.

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