How to Cite (APA Style):
Nurhairani, Suyanta, & Haryanto. (2026). Teachers' knowledge and implementation of inquiry-based-learning in elementary science education: a phenomenological study in indonesia. *Jurnal Ilmiah Pendidikan Dasar, 13* (1), 226-244. http://dx.doi.org/10.30659/pendas.13.1.226-244

JURNAL ILMIAH PENDIDIKAN DASAR
p-ISSN: 2354-9580
e-ISSN: 2685-211X

Teachers' knowledge and implementation of inquiry-based-learning in elementary science education: a phenomenological study in indonesia

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Submitted: September 29th, 2025 **DOI: 10.30659/pendas.13.1.226-244**
Revised: January 28th, 2026
Accepted: January 31st, 2026

Keywords:
inquiry-based learning; science learning; elementary school teachers

Abstract

Science education in Indonesian elementary schools currently faces significant challenges in fostering students' critical and scientific thinking skills and positioning them as active learning subjects. A key contributing factor is teachers' insufficient knowledge regarding the effective implementation of Inquiry-Based Learning (IBL), which consequently diminishes student engagement. This phenomenological study, utilising a qualitative approach, investigates elementary school teachers' understanding of IBL and analyses its practical application in science classrooms. Data were gathered through open-ended questionnaires, interviews, and literature review, involving 74 in-service teachers distributed across Indonesia's Western, Central, and Eastern regions. The findings reveal significant conceptual gaps among teachers. Particularly, teachers demonstrated a limited and often inaccurate understanding of IBL's core principles, indicating prevalent misconceptions. This knowledge deficit critically hinders the effective implementation of IBL in science instruction. Furthermore, the study identified pronounced disparities in IBL knowledge between teachers in the Western, Central, and Eastern regions, highlighting distinct regional inequities. The study emphatically concludes that the systemic integration of IBL into elementary science education is imperative. Achieving this necessitates targeted professional *development programs specifically designed to address the identified knowledge gaps and regional disparities among teachers.*

INTRODUCTION

Background of the Study

Until now, elementary school teachers in Indonesia's knowledge of inquiry-based learning (IBL) practices in science learning is not convincing enough to be able to compete with Asian countries, especially in Southeast Asia. We started this argument based on PISA 2018 data showing that students in Indonesia received the lowest scores out of 79 participating countries. The average science ability of Indonesian students is below the average of students in ASEAN. Only around 34% of Indonesian students have a minimum level of science competency, and science scores have decreased by 7 points compared to 2015. Compared with the average for developing countries in Southeast Asia, Indonesian students' science achievement is 13 points lower; 40% of students can only reach a basic level of proficiency. Science instruction in elementary schools lacks sufficient emphasis on cultivating critical thinking skills (Sari et al., 2025).

Based on the results of the available reports, we carried out four codifications of why science learning in elementary schools is not very convincing in a better direction. First, the labelling of Indonesia's low ranking allegedly originates from weak teaching in early grades and elementary schools, which results in the quality of Indonesian education lagging behind the standards of other countries (Anwas et al., 2022; Sunarti et al., 2022). Second, the low science competency of Indonesian students is caused by teachers' teaching practices. Third, elementary school teachers in Indonesia generally have diverse educational backgrounds, and most are prepared to teach five subject areas. Of course, this makes the situation even more complicated, even though elementary school teachers have participated in various training and education to improve their competency. Fourth, teachers do not have good knowledge about IBL, and teachers' abilities in inquiry activities, such as conceptualizing and planning design, implementation, analysis, and interpretation, and communicating, are in the weak category (Rahayu et al., 2022). If that is the case, the justification that Indonesian education is ranked 67th, far below ASEAN countries, deserves serious attention for Indonesian education.

Following up on the above, the issue of teachers' knowledge of IBL practices in science learning is the focal point of why primary school education in Indonesia is considered to be lagging behind countries in the Southeast Asia region. On this basis, our article will focus particular attention on teachers' knowledge of IBL practices. To improve the learning process in science learning in elementary schools, we believe that IBL is the right step to develop students' critical thinking and problem-solving abilities in solving problems (Rahmawati et al., 2025; Jusuf et al., 2024).

IBL was chosen referring to the constructivist view, which emphasizes that science learning should be based on efforts to build knowledge sourced from direct experience. This is supported by several academics who say that IBL is the keyword for successful science learning because this learning involves a series of processes to stimulate students' critical thinking abilities in solving a problem that is in front of them (Syamsudin, 2023). The IBL process is needed because it contains essential characteristics, such as how students are involved in making scientifically oriented questions, answering questions, and formulating explanations from the evidence obtained, connecting explanations with scientific knowledge, being able to carry out the communication process, and being able to validate the results that have been found (Ambarwati et al., 2025; Syahrial et al., 2021).

Combining the above, we recommend IBL as a lesson for elementary school teachers in Indonesia to use in science learning. We have a reason that IBL will provide students with opportunities to be involved in science learning optimally, increasing students' motivation and interest in science learning. This is directly proportional to the results of a synthesis of 138 studies conducted (Setiani, 2023). IBL shows a positive trend, and IBL is appropriate to use in science learning, provided that IBL practice places students as learners, emphasizing active thinking. Students will be able to draw conclusions from the data obtained by students. The same thing from the meta-analysis results shows that IBL implemented in elementary schools has a positive influence (Praminingsih et al., 2022; Susanto & Indarini, 2022).

Making students the center of learning has logical consequences, where students are positioned as active subjects, especially in constructing knowledge about their learning, investigating, answering questions, discovering new knowledge scientifically, and building scientific literacy and problem-solving abilities (Restiani et al., 2024). The results of a study conducted on upper-grade elementary school students in Hong Kong provide evidence that inquiry has a positive effect in developing knowledge domains and investigative skills, especially in terms of asking and explaining. For this reason, IBL can increase students' understanding of science concepts, contribute to the achievement and development of scientific process skills, and help develop students' attitudes towards science (Adadan & Ataman, 2021). Apart from that, the results of other studies say that IBL influences critical thinking skills and the science performance of students regardless of their socio-economic background.

Even though IBL is considered the right way to learn science, IBL still has problems that almost all countries experience. The problem that often arises is that the majority of teachers choose not to use IBL in science learning. Teachers find it challenging to implement IBL because they feel they need various supports to differentiate inquiry or non-inquiry practices. In addition, teachers feel they lack the experience to guide students in designing a series of investigative activities. Teachers tend to focus on information and concepts, make minimal connections with various other types of knowledge, and do not yet fully explore the nature of science as a goal. There is a strong tendency for teachers not to consider ideas that come from students. Furthermore, teachers prefer to help students go through the stages of activities rather than guiding them to think.

The Problem of The Study

The core problem hindering effective Inquiry-Based Learning (IBL) implementation in Indonesian elementary science education is teachers' insufficient knowledge of IBL. This deficit directly impacts their ability to create student-centered learning environments and their understanding of essential IBL pedagogical practices. Consequently, this study addresses two critical questions: What is the nature of elementary school teachers' knowledge regarding IBL in science learning? How do elementary school teachers implement IBL practices within their science classrooms?

Research's State of the Art

Tracking the results of studies that discuss teachers' knowledge of IBL is the best way to see how far the study has progressed. Previous studies are useful as a basis for writing this article. However, we still pay serious attention to any relevant studies that can be used to support this research.

To prove why teachers' knowledge of IBL is important, we examined the results of many academic studies from various countries. Look at the results of the studies conducted. which suggests that for successful inquiry-based science learning to be effective, teachers must know how to practice a positive attitude towards IBL. Teacher knowledge about inquiry is a fundamental thing that teachers must have because it has positive significance for classroom learning (Afifah et al., 2023).

On the other hand, we also tracked the results of studies involving many elementary school teachers. They focused on how prospective elementary school teachers viewed inquiry-based science learning. These results indicate that understanding elementary school teacher candidates is key to building teachers' self-confidence and confidence in teaching inquiry-based science. On the other hand, (Soonjan & Kaewkhong, 2022) saw how 38 elementary school science teachers in Thailand's understanding of IBL had a strong relationship with self-evaluation. Their findings show that teachers need to gain knowledge, and there is a fundamental misunderstanding about how to teach IBL (Anam et al., 2023).

Teachers' knowledge and beliefs about inquiry, and science teaching practices in the classroom. Of 34 primary and secondary school teachers surveyed in Lebanon, they reported that most had limited knowledge about the nature of science and beliefs and attitudes that did not support inquiry learning. Through a quantitative approach with a sample of 728 elementary school science teachers, they showed that teacher knowledge, attitudes, and beliefs are the three main predictors of implementing IBL in science teaching in elementary schools. 149 elementary school teachers and secondary school teachers in America said that the majority of teachers did not report implementing inquiry based on well-structured inquiry knowledge, teachers often believed that have done the inquiry but did not (Daccache & Ibrahim, 2023; Temsah & Safa, 2021). So, what about the results of studies conducted in Indonesia?

In the Indonesian context, studies focusing on the knowledge and implementation of IBL among elementary school teachers must be revised and appear relatively rare. Generally, studies conducted in Indonesia refer to developing the IBL model and only concentrate on one region in Indonesia. Research conducted (Syahrial et al., 2021). Involving a sample of prospective elementary school teachers found that applying IBL in ethno-constructivist modules effectively encouraged critical thinking and developed positive attitudes. Using a quantitative descriptive method (Rahayu et al., 2022) focuses on the skills possessed by elementary school teachers, which shows that teachers' inquiry skills need to be improved.

Novelty, Research Gap, & Objective

While existing research contributes to understanding how Inquiry-Based Learning (IBL) functions in Indonesian elementary schools, a significant gap remains concerning the specific mechanisms for constructing teacher knowledge that effectively guides IBL implementation in science education. Although the importance of teacher knowledge for IBL is recognized, research lacks a detailed, staged framework demonstrating how this knowledge construction process can positively impact classroom science learning. This gap presents a clear opportunity for further investigation.

Given IBL's alignment with scientific philosophy and its potential to enhance learning outcomes, its effective implementation is crucial. Teacher knowledge of IBL is fundamental to this process, serving as the essential foundation for developing the practical skills required for classroom application. However, research specifically examining the knowledge and implementation of IBL among in-service elementary school teachers across diverse regions of Indonesia (e.g., Western, Central, Eastern) remains notably scarce (Koto & Susanta, 2021; Nirwan et al., 2024). Therefore, this research aims to address these gaps by investigating the process of constructing teacher knowledge for IBL and developing a practical framework for its implementation in Indonesian elementary science classrooms.

METHOD

Type and Design

This research is qualitative research using a phenomenological approach. One of the reasons why phenomenological methodology is used in this research refers to the argument that, as a research methodology for investigating the lived experiences of science teachers, phenomenology not only provides a means to access subjective knowledge and pure perception but is also quite rigorous. Moreover, systematically represent the life-world experiences of research participants accurately.

Starting from Koopman and Creswell's arguments above, the experience of elementary school teachers in Indonesia will tell the story of how science has been taught so far. Apart from that, phenomenology is considered appropriate in the broad geographical context of Indonesia, where each elementary school teacher in

Indonesia has different characteristics. Therefore, in this research, we look at the phenomenon of implementing IBL in science learning that teachers in elementary school positions in Indonesia have carried out. To see how this phenomenon occurred, we then grouped the research areas, which included the Western Indonesia region, the Central Indonesia region, and the Eastern Indonesia region. By grouping these areas, we can then determine the research problem, determine research respondents, collect data, analyze data, and draw conclusions.

Data and Data Sources

To ensure robust and valid findings, this study employed purposeful sampling to recruit 74 Indonesian elementary school teachers, strategically representing diverse demographics and the three major geographic regions (Western, Central, and Eastern Indonesia). Data were collected through triangulated methods, including open-ended questionnaires, in-depth interviews, and literature review to capture nuanced perspectives and enhance credibility. Demographic characteristics (detailed in Table 1) included:

Table 1. Demographics of Research Respondents

Indicators	Criteria	Number	%
Gender	Male	24	32,4
	Female	50	67,6
Education	Undergraduate Education	67	90,5
	Masters	7	9,5
Academic Background	Primary Education	66	89,2
	Biology Education	4	5,4
	Language Education	2	2,7
	Biology	1	1,4
	Mathematic Education	1	1,4
Teaching experience	1-10	40	54,1
	11-20	26	35,1
	21-30	5	6,8
	31-40	3	4,0

Data Collection Technique

Data collection through questionnaires, interviews, observations, and literature studies is the step we rely on in this research. In-depth interviews in the form of open questions aimed at exploring teachers' knowledge of IBL and how teachers implement IBL in science learning content in elementary schools. Teacher knowledge will describe how the teacher understands IBL. Through a questionnaire, we explored teachers' knowledge about IBL through open questions by asking teachers to explain the nature of IBL and how IBL is used in elementary schools. Apart from that, we also collected data regarding how intensely teachers implemented IBL learning, as seen from the learning activities that had been carried out.

Data Analysis

This process involved systematically examining the data to identify key themes and conceptual categories related to teachers' knowledge, prevalent misconceptions, and the practical application of IBL in science classrooms. The analysis specifically revealed patterns in teachers' conceptual grasp of IBL principles and distinct variations in implementation practices, particularly highlighting regional disparities across Western, Central, and Eastern Indonesia. This approach allowed us to determine how elementary school teachers conceptualize and enact IBL within their instructional settings.

RESULTS

After conducting a series of data analyses, we believe that elementary school teachers in Indonesia do not understand IBL practices in science learning. We assess that there are fundamental errors in how elementary school teachers in Indonesia understand IBL practices. One of the misunderstandings of elementary school teachers regarding IBL practices in science learning is that they only observe the surrounding environment and demonstrate learning activities, which then end with group discussions and not critical investigation and reasoning. Building on this, we codified the research findings with two critical points, which can be seen below.

Misconceptions of elementary school teachers' knowledge of IBL

After collecting the questionnaire data, we think elementary school teachers already know IBL. This indication can be seen from the answers of teachers who can explain the essence of IBL well, starting from the process of observing natural phenomena as a source of learning, asking questions about the natural phenomena being observed, collecting data and facts, gathering answers to a conclusion to provide the meaning of what is obtained from the phenomena observed, and then ending with a reflection. In general, teachers have the same understanding that IBL in science learning places students as subjects in the learning process.

However, when we compared the questionnaire results with the data obtained through interviews, the results showed a different situation. We found that there were gaps in the data. Through interview data, it was confirmed that out of 74 teachers, five did not understand IBL. We can see that from the five teachers' answers, they only answered that they understood IBL without being able to describe their understanding in more detail about IBL.

At this stage, we assess that understanding is not directly proportional to the IBL practices that the teacher will carry out. The teachers only understand IBL in theory, but its implementation needs to be improved. It did not stop there; when we asked questions about the importance of IBL applied in elementary schools, especially in science content, all the teachers gave critical answers, which can be seen in the teachers' answers as follows;

> "..Because students can develop process skills and scientific attitudes; students can become independent problem solvers; student-centered learning is more active, directly involved in formulating questions; conducting investigations; finding answers yourself, carrying out investigations, training students' creativity, better-understanding concepts, understanding environmental events; student activities to search and find; understand an event based on facts obtained from experiments; engage students in critical and logical thinking; science learning requires practice or proof; Science learning must be conveyed with concrete examples.."

Looking at the arguments presented by the teacher above, the teacher is aware that science learning requires learning practices that can support the completion of the learning. The teachers realized that IBL was an appropriate learning practice for this. Even though the teachers said so, we found a discrepancy in how teachers had the knowledge to interpret the importance of IBL practices in science learning. Based on the data, the importance of IBL practice is not a vital core contained in the learning scheme prepared for science learning.

The same thing happened when we asked more specifically about the IBL practices implemented by teachers in the classroom. Almost all teachers answered that IBL practice consists of problem orientation, observing, gathering information, trying, and making conclusions. Of course, this is yet to be optimal as a procedure for IBL practice. Based on this, we are increasingly convinced that the elementary school teachers we sampled in several regions in Indonesia experienced misconceptions due to their inability to understand the conceptual framework of ILB practice in science learning. Because of this misconception, science learning in elementary schools does not attract elementary school students' interest.

Weak implementation of IBL

The misconceptions experienced by elementary school teachers in IBL practice are linear with the lack of implementation of IBL in science learning in the classroom. This argument was strengthened when we triangulated questionnaire data, interview data, and observation results. If the questionnaire data states that teachers tend to have good knowledge about IBL, the investigation through interviews was not wholly carried out well. Of the 74 teachers as respondents, 30 carried out IBL-based learning even though they were still in the minimum category. The interview results show that the relationship between teacher knowledge of IBL is not directly proportional to implementation in the classroom.

Regarding how often teachers practice IBL on science material in the classroom, we obtained data that one teacher (1.4%) answered that they never used IBL, 37 teachers (50%) answered rarely, and 36 teachers (48.6%) answered often. After conducting interviews and observing activities, we found that elementary school teachers were more likely to dominate learning with IBL practices. We saw this dominance when the teacher started learning activities, carried out investigations, and the teacher demonstrated the learning object. At the same time, the students only watched and presented the results orally in class.

Table 2. IBL Framework

Dimensions of Inquiry	Definition
Orientation	Stimulates curiosity about the topic being discussed by providing a problem statement.
Questioning	Proposing a hypothesis about a natural phenomenon or topic being investigated
Investigating	Planning, designing, or carrying out an investigation
Interpreting Data	Analyzing, evaluating, interpreting, making meaning from data, and synthesizing knowledge
Explaining Evidence	Explaining phenomena from the results of investigations
Argumentation	Uses evidence from an investigation to propose a conclusion
Communicate	Present the results of investigations in writing and orally to colleagues and teachers
Reflection	The process of describing, criticizing, evaluating, and discussing the entire cycle of inquiry

Referring to the data above, this is not good news when we compare the implementation of IBL by elementary school teachers in the classroom with the IBL. Starting from this guide, we analyzed elementary school teachers' implementation of

IBL practices. The following describes the IBL mechanism used as a guide for analysis in this research.

When we used the guide above to cross-check the IBL practices carried out by elementary school teachers in science learning, we found that science learning with IBL implementation was worrying. This indication is strengthened by a series of data collected through triangulation of interview results, questionnaires, observations, and supporting literature documents. In the orientation dimension, for example, 11 teachers (34.4%) answered rarely, 20 teachers (62.5%) answered often, and one teacher (3.1%) did not give an answer.

In the questioning dimension, the results of the data recording that we obtained were that 72 (97.3%) teachers answered that they directed students to formulate hypotheses. Two teachers (2.7%) said they never directed students to formulate hypotheses. However, interview data with teachers does not show that they direct students to formulate hypotheses. We can say this: when we ask the teacher to provide an argument for why the teacher needs to direct students to propose a hypothesis in IBL, the teacher provides an answer.

> "..Because you can find out the level of difficulty, know the level of the child's thinking power, know the student's understanding, encourage students to prepare for all possibilities, think critically, and measure the student's ability to respond to the material being discussed.."

The interview excerpt above shows how elementary school teachers also experience difficulties in formulating hypotheses regarding IBL practices in science learning. Suppose we refer to the scheme we use. In that case, the hypothesis process in IBL training presents various questions that encourage students to have temporary answers that can be used to find honest answers. Therefore, teachers still need to understand the dimensions of asking or hypothesizing.

In planning and designing investigations, the data shows that around 75% of teachers answered that teachers are the primary movers in planning and investigating the natural phenomena that will be investigated. According to the results of existing studies, in the planning and investigation process, the teacher is only the initiator. In the rest, the students do the planning and investigation. This section reveals that only around 25% of teachers can understand that inquiry learning places students as the subjects of the learning process.

Researching phenomena is a series of activities that must be carried out in the inquiry learning process. Some teachers gave various answers to the process of inquiry activities, such as:

> "..observe; discuss; seek information from various sources; observing the surrounding environment; viewing video shows; visiting neighboring groups to explain the material to each other; question and answer, presentation, and performance; distribute teaching materials.."

In this section, the data shows that teachers often take over what their students should do. Students only watch what the teacher does and then listen to what the teacher explains. That is why a series of inquiry activities that compare findings with initial hypotheses will experience difficulties. The data also shows that teachers experience inconsistencies in the previously planned inquiry design, where teacher dominance in the learning process is relatively high. However, in this section, several elementary school teachers are categorized as capable of implementing this IBL series.

In interpreting data, they were analyzing, evaluating, interpreting, making meaning from data, and synthesizing knowledge. Seventy-four teachers (100%) answered that they implemented it. Nevertheless, the results of the interview data that we collected show how teachers misrepresent how to analyze, evaluate, interpret, make meaning from data, and synthesize knowledge in IBL practice.

In terms of the dimension of explaining evidence that explains the phenomenon from the investigation results, three teachers (4.1%) answered no, and 71 teachers (95.9%) answered that they provided opportunities for students to explain the investigation results. Furthermore, teachers were asked the question, "How to allow students to explain the results of the investigation?" 67 teachers only answered "Yes," and seven teachers answered:

> "...ask students to compare the conclusions of the investigation with predictions made prior to the investigation; compare answer papers between predictions and results; see the results as predictions or results that have been experimented with directly; conclude together; question and answer method.."

Based on the teacher's answers, we can conclude that implementing the dimension explaining evidence is not good. Seven teachers gave almost the same argument, comparing the results with the predictions. Furthermore, three teachers answered that they did not allow students to explain the investigation results, indicating that this dimension was neglected and the teachers' conception still needed to be improved.

The next dimension is the argumentation dimension, namely the process of concluding research data. The data shows that 12 teachers (16.2%) answered rarely, 30 teachers (40.5%) answered often, and 32 (43.2%) answered that they always asked students to conclude from the results of the investigation. However, something is interesting about this dimension, where students conclude inquiry activities, but the conclusions are not based on the data from the investigation. Students conclude simply by repeating what the teacher has explained.

Another thing is the communication dimension, namely, presenting the results of investigations into natural phenomena stored orally and in writing. We see that the responses given by teachers are differentiated. Most teachers argue that the communication process is where students must make presentations. On the other hand, some teachers can define well what is meant by the communication process in inquiry, which is a step in encouraging students to make written reports about the results of the information found and then present them orally. In this case, the teacher said they provided opportunities for their students to explain their findings. However, the explanation students give depends on what the teacher has said. In this case, students do not have the independence that is the goal of IBL learning.

The last dimension in the IBL dimension is the reflection dimension. Reflection is describing, considering, and discussing the entire cycle of inquiry. The analysis of questionnaires and interviews shows that the reflection dimension is usually carried out at the end of learning during the final learning activities. Apart from that, we also found that teachers still dominated reflection activities. In fact, in IBL, reflection practice should be carried out by students who receive guidance from the teacher.

Analysis of the data reveals systemic challenges in implementing Inquiry-Based Learning (IBL) across its various dimensions. Teacher dominance emerges as the primary pattern, where educator direction consistently overrides student agency. This manifests in practices where students merely compare results superficially or skip evidence interpretation, replicate teacher conclusions instead of forming independent understanding, and experience reflection as a fully guided routine. Furthermore, the execution of IBL activities remains superficial: procedural activities like stating conclusions or presentations occur, but without depth. Argumentation becomes ritualistic, communication is limited to oral forms, and the explanations and conclusions produced lack critical analysis and independence. Consequently, student autonomy is severely constrained across all key IBL dimensions—from explaining phenomena, drawing conclusions, and communicating, to reflecting—due to heavy reliance on teacher input. This condition fundamentally contradicts the core objectives of IBL. Essentially, the observed IBL implementation is superficial, teacher-dominated, and lacking both authentic inquiry skills and critical student autonomy.

DISCUSSIONS

Based on existing research findings, we would like to discuss why IBL practices in science learning by elementary school teachers in Indonesia are not very convincing. The lack of teacher knowledge impacts two essential things, namely the occurrence of misconceptions about IBL practice, which results in weak IBL practice carried out by teachers. However, we appreciate several elementary school teachers who have practiced IBL in science learning.

In this section, we propose several essential things to answer how teachers know and how elementary school teachers apply IBL practices to science learning in the classroom. We have several relevant arguments to discuss to see this phenomenon. First, teachers' knowledge of basic IBL concepts is very minimal. Of course, this will be a challenge to how IBL can be implemented in elementary school classes appropriately. We agree with the results of the research conducted by Nicol (2021). The challenge facing inquiry-based science learning is confusion about what is meant by inquiry. A further indication of the lack of knowledge of elementary school teachers about IBL is due to the lack of understanding of elementary school teachers in the field of science. In Indonesia, there is a phenomenon where to become an elementary school teacher, the teacher must be able to master five fields of study as a class teacher. Teachers who teach in more than one discipline have a different understanding of inquiry, which will influence classroom practice. Of course, this impacts less-than-optimal IBL practice in science learning (Karno et al., 2024; Usman et al., 2024).

Second, based on interviews and observations, we suspect that a teacher's motivation, attitudes, and beliefs are the reasons why IBL is not very interesting to do. The obstacles faced by teachers in implementing IBL in the classroom are teachers' beliefs, values, and understanding. Teachers' knowledge, attitudes, and beliefs are the three main predictors of implementing IBL in science learning in elementary schools.

Third, in implementing IBL, teachers tend to apply IBL activities, which are limited to observation activities and discussions of the results of observations, and end by presenting the results of the discussion in front of the class. Teachers ignore other inquiry activities that are also important, such as questioning activities, where students are directed to ask a question that can be answered through the investigation process. Teachers must ask open questions, which direct students to ask their own questions and carry out investigations to answer them. It is explained by research results. Teachers must involve students in scientifically oriented questions, asking students to develop explanations and present them.

Other dimensions of IBL that are often overlooked by teachers are the dimensions of interpreting data, explaining evidence, making meaning from investigative data, and synthesizing new knowledge. This dimension is essential in IBL. According to the synthesis results. The four dimensions, namely questioning, interpreting data, explaining evidence, and communicating, are essential features of inquiry and are related to inquiry practices.

The neglect of several IBL dimensions in classroom practice is due to teacher limitations or errors in understanding IBL holistically. If teachers fully understand IBL holistically, it does not prevent teachers from using it effectively, which, in the end, can facilitate students' understanding of science concepts.

Fourth, IBL in elementary schools is not very promising to be able to abandon the old knowledge paradigm of teachers, where they position themselves as sources of knowledge. For this reason, elementary school teachers are more interested and happy to use the banking system learning style as presented by Freire. Students take notes, memorize, and repeat the teacher's explanation without understanding the actual meaning of the concepts the teacher gives. Even though the teacher believes that he has implemented IBL in the classroom, learning is still dominated by the teacher's explanation. In line with the study's results, teachers believe that they have implemented IBL, but in reality, the teaching practice they carry out is traditional learning. Teachers must analyze students' abilities to plan appropriate lessons (Putri et al., 2024). Teachers should consistently understand students' learning needs and closely supervise all their activities (Jupriyanto et al., 2023).

Fifth, in the Indonesian context, unequal educational infrastructure and infrastructure between regions create gaps in teacher knowledge. Based on the data obtained, teachers in the Java region are more accustomed to implementing IBL. This is because teachers in the Java region are closer to better educational resources and facilities than teachers in the Sumatra and Sulawesi regions.

Sixth, the obstacles faced by teachers in implementing IBL, the majority of teachers said was due to limited time. However, time constraints should not be a reason not to implement IBL; inquiry learning cannot be utilized optimally due to limited time. However, teachers can use inquiry by focusing on specific aspects and looking at opportunities when they can take advantage of them.

CONCLUSION

This study concludes that the implementation of Inquiry-Based Learning (IBL) in Indonesian elementary science education falls significantly short of expectations, primarily due to critical gaps in teachers' conceptual understanding and practical knowledge of the IBL dimensional framework. This core finding theoretically contributes to IBL research by empirically demonstrating how specific teacher misconceptions directly hinder the intended student-centered processes—critical thinking, independent investigation, and evidence-based conclusion—essential for positioning students as learning subjects. Consequently, these knowledge deficits prevent science learning from meeting successful criteria. Therefore, targeted professional development programs, systemically integrated and addressing these precise IBL knowledge gaps, are imperative to enable effective teacher practice and achieve meaningful science learning outcomes.

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Conflict of Interest Statement**:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.