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Inquiry Method: An Effective Strategy to Improve Science Understanding in Science Learning

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ABSTRACT

This study aims to comprehensively describe the effectiveness of the inquiry method in enhancing students' scientific understanding within the context of Natural Sciences (IPA) learning at the elementary school level. Employing a qualitative research design with a case study approach, the study focused on capturing in-depth insights into the implementation of inquiry-based learning in a real classroom setting. Data collection was carried out through systematic observation, in-depth interviews with teachers and students, and documentation of teaching and learning activities. The findings reveal that the implementation of the inquiry method significantly contributed to increasing students' active engagement during science lessons. It also fostered a deeper and more meaningful understanding of scientific concepts by encouraging students to explore, question, and construct knowledge through hands-on experiences and guided discovery. Moreover, the inquiry approach effectively developed essential science process skills, such as making detailed observations, classifying information, formulating hypotheses, and drawing evidence-based conclusions. Students demonstrated high levels of enthusiasm, curiosity, and motivation throughout the inquiry-based activities, which further supported their cognitive and affective engagement in learning. While some challenges were encountered—such as the need for adequate teacher preparation, time constraints, and the varying levels of student readiness—the inquiry method nonetheless emerged as a powerful pedagogical strategy. It provided a contextualized, student-centered learning environment that not only aligned with the nature of science but also improved the overall quality and relevance of science instruction. Therefore, this study affirms that the inquiry method holds strong potential as an effective approach to promoting scientific literacy and inquiry-mindedness among young learners in elementary education.

Keywords: inquiry, science understanding, science learning, process skills

INTRODUCTION

Natural Science (IPA) learning at elementary and secondary levels is generally still dominated by theoretical approaches and is oriented towards memorization (Long, 2022). Teachers tend to deliver material in a one-way manner through lectures, while students are more likely to act as passive recipients of information. This approach doesn't fully allow students to actively engage in scientific thinking processes such as observing, formulating questions, or conducting simple experiments (Tafonao et al., 2025). As a result, students' understanding of science concepts tends to be shallow and non-contextual, and it does not encourage the development of critical thinking and problem-solving skills. Learning that should foster curiosity and active engagement can

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actually lead to boredom due to the lack of meaningful learning experiences relevant to everyday life. This indicates the need for a more interactive and exploratory learning approach to revitalize students' enthusiasm for science learning (Sharp et al., 2020).

One of the fundamental problems in science learning in schools is the lack of an approach that stimulates students' curiosity, critical thinking, and exploration. Many learning activities still focus on providing textual, teacher-centered material, without providing sufficient space for students to ask questions, research, or test their own ideas (Tang, 2023). As a result, students' natural curiosity and exploration of the phenomena around them are not optimally developed. Learning tends to become a monotonous routine, lacking intellectual challenges that stimulate deep thinking. Science education should, in fact, encourage students to actively explore, test, and reflect on their findings so that they don't just memorize facts but truly understand and apply them. The absence of an exploratory and reflective approach in the learning process is a major obstacle to developing a generation that thinks scientifically, independently, and creatively.

Students' low conceptual understanding of abstract scientific phenomena is one of the main challenges in science learning in schools (Vosniadou, 2019). Concepts such as force, energy, changes in matter, and the water cycle are often taught theoretically without real-world experiences or adequate visualization, making them difficult for students to grasp, especially at the elementary and secondary levels. As a result, students tend to simply memorize definitions without being able to explain their meaning or relate them to everyday situations. This inability indicates that students' understanding is still shallow and meaningless (Johnson & Gallagher, 2021). Abstract phenomena that are not contextualized through experiments, simulations, or exploratory activities become obstacles to the internalization of scientific concepts. Furthermore, the lack of learning methods that involve direct experience prevents students from building a solid knowledge structure. Therefore, a more concrete, active, and contextual learning approach is needed so that students can build conceptual understanding gradually and deeply (Dewi & Primayana, 2019).

The need for active learning methods in science education is increasingly pressing, as curriculum demands and developments emphasize the importance of critical thinking, problem-solving, and scientific literacy. Science education cannot simply rely on verbal delivery of theory; it must emphasize an investigative and contextual approach. An investigative approach allows students to directly experience the scientific process through observation, experimentation, and reflection, enabling them to understand not only the "what" but also the "why" and "how" of a phenomenon (Owens et al., 2020).

Meanwhile, a contextual approach helps students connect science concepts to everyday life, making learning more relevant, engaging, and meaningful. In this regard, active learning methods such as inquiry methods, laboratory experiments, and problem-based projects are key to sparking students' curiosity and training them to think scientifically independently. Thus, active learning methods are not merely complementary but fundamental to developing a generation capable of understanding and applying scientific knowledge critically, creatively, and responsibly in real life (Mursalim et al., 2024).

For science learning to be effective and have a lasting impact, students need to be directly involved in the process of discovering concepts through meaningful learning experiences. This involvement goes beyond simply following teacher instructions, but also includes active participation in formulating questions, designing experiments, observing phenomena, analyzing data, and drawing conclusions from their own findings. Through this process, students not only understand the content but also experience how knowledge is constructed scientifically. Learning experiences that involve exploration and reflection enable students to internalize scientific concepts in a deeper and more personal way. Furthermore, direct involvement in the process of discovery also fosters the development of scientific attitudes such as curiosity, persistence, and openness to evidence. This is crucial for developing strong conceptual understanding and the critical thinking skills needed to address real-world problems. In other words, meaningful learning occurs when students become active participants in constructing their own knowledge, rather than simply passive recipients of information (Ariana, 2022).

The inquiry method is considered to meet these needs because it positions students as active subjects in discovering concepts, not simply recipients of information from the teacher. In this approach, students are encouraged to ask questions, observe, investigate, and draw conclusions based on the data and direct experiences they gain during the learning process. This aligns with the principles of active learning, which emphasizes students' cognitive, affective, and psychomotor involvement (Putri & Puspitorini, 2025). Through the inquiry method, students experience a challenging and contextual learning process, making it easier to understand abstract concepts in science. They also have the opportunity to develop critical thinking, problem-solving, and group collaboration skills. Thus, this method not only enhances conceptual understanding but also forms scientific attitudes and competencies essential for 21st-century education.

The advantage of the inquiry method in science learning lies in its ability to facilitate students' active involvement in an authentic scientific process. Students are not merely passive listeners, but are encouraged to ask relevant questions, design and conduct simple experiments, collect and analyze data, and ultimately draw conclusions based on the evidence found. This process not only strengthens a deep understanding of concepts but also develops critical and logical thinking skills. Furthermore, this method trains students to adopt a scientific attitude, such as being objective, thorough, and open to various possibilities. In the long term, the application of the inquiry method can increase students' interest in learning science and foster a strong curiosity about the phenomena around them (Puling et al., 2024).

The inquiry method significantly contributes to improving students' conceptual understanding, science process skills, and learning motivation. By engaging directly in the discovery process, students not only memorize concepts but also construct their own understanding through exploration, experimentation, and discussion. This strengthens conceptual understanding in a deep and lasting way. Furthermore, science process skills such as observing, classifying, interpreting data, and formulating hypotheses and conclusions can develop systematically. Equally important, this approach also stimulates students' learning motivation because they feel they have an active role in the learning process. Students become more enthusiastic, curious, and driven to continue exploring, resulting in a more dynamic and meaningful classroom atmosphere (Siahaan et al., 2020).

The inquiry method is highly aligned with the demands of the Independent Curriculum, which emphasizes project-based and discovery-based learning. This curriculum encourages student-centered learning, fosters independent learning, and develops critical and creative thinking skills. In this context, inquiry is a relevant approach because it encourages students to actively engage in the investigative process, from formulating questions, designing and conducting experiments, to drawing conclusions based on evidence. Learning is no longer a one-way process from teacher to student, but rather a dialogic and exploratory process, thus aligning with the spirit of the Independent Curriculum, which prioritizes contextual, authentic, and meaningful learning.

This research gap lies in the lack of in-depth exploration of how the process of qualitatively implementing inquiry methods impacts students' understanding of science concepts. Most previous research focuses more on aspects of learning outcomes or student motivation, without addressing the dynamics of inquiry implementation in science learning in detail. Furthermore, there are still few studies that contextually describe the challenges and strategies for implementing inquiry methods in the classroom based on direct observation. Research that integrates student and teacher perspectives as part of a reflection on the effectiveness of this method is also limited, leaving room for new contributions to a holistic understanding of the impact and practices of inquiry in science education.

The novelty of this research lies in the in-depth qualitative approach used to comprehensively describe the inquiry-based science learning process, not limited to the final learning outcomes. This research highlights the authentic experiences of teachers and students in applying the inquiry method in a real classroom context, thus presenting a factual and reflective picture of the dynamics that occur in the field. Furthermore, this research provides rich contextual insights into the strategies, obstacles, and real-world impacts of the application of inquiry learning on students' understanding of science concepts, which has not been widely revealed in previous studies.

The purpose of this study is to describe the application of the inquiry method in science learning and to analyze how this method can improve students' understanding of science concepts. This study also aims to identify the challenges faced by teachers and the strategies used in implementing the inquiry method in science classes. Furthermore, this research is expected to contribute to the development of more effective and contextual discovery-based active learning strategies in science.

METHOD

This study uses a descriptive qualitative approach to describe in depth the application of the inquiry method in science learning and its impact on students' understanding of science (Nirwan et al., 2024). The type of research used is a qualitative case study focused on one elementary or secondary school that has implemented inquiry-based science learning, with research subjects consisting of science teachers and students in certain classes. Data collection techniques were carried out through direct observation of the learning process, in-depth interviews with teachers and several selected students, and documentation in the form of lesson plans, teacher notes, student worksheets, and learning evaluation results. The research instruments used included semi-structured interview guidelines, learning activity observation sheets, field notes, and learning activity documentation. Data analysis was carried out using the Miles and Huberman model, which includes data reduction, data presentation in the form of narratives and thematic tables, and inductive conclusion drawing. To ensure the validity of the data, source triangulation techniques were used, member checking with informants, and peer debriefing with colleagues or other researchers. The research steps began with a preliminary study and location determination, gradual data collection during several learning meetings, simultaneous data analysis, and the preparation of the final research report.

RESULTS AND DISCUSSION

The results of the study indicate that the application of the inquiry method in science learning occurs in stages, starting from formulating questions, creating hypotheses, conducting experiments, and drawing conclusions. Throughout this process, students appeared active and enthusiastic, with increased participation, especially in questioning and discussion activities. Students also demonstrated a better understanding of science concepts such as changes in state of matter, force and motion, and the water cycle. Furthermore, this method also helps develop science process skills, including observation, classification, prediction, critical thinking, and systematic problem-solving.

However, implementing the inquiry method also faces several challenges, including time constraints, varying student readiness, and a lack of experimental tools and materials. Nevertheless, teachers feel that this method enhances the learning process, especially with support from the school and collaboration between teachers. Students also respond positively to this approach, as they find it easier to learn through self-discovery and understand the material through hands-on practice, rather than simply listening to teacher explanations.

Inquiry Method as a Contextual Learning Strategy

The inquiry method has proven to be an effective contextual learning strategy in building students' conceptual understanding. Research findings show that when students are actively involved in the learning process, from formulating questions, making observations, designing and conducting experiments, to drawing conclusions, they not only understand the material more deeply but are also able to relate science concepts to real-world situations (Firmansyah et al., 2025). This active engagement fosters curiosity and critical reflection, which are at the heart of meaningful learning. In this context, inquiry serves not only as a teaching method but as a holistic approach that fosters scientific thinking and contextual understanding of science, aligned with the needs of 21st-century learning.

The learning process becomes more meaningful because students do not just receive information passively, but are directly involved in the process of scientific discovery (Nurul Qolbi et al., 2025). Through exploratory activities such as observation, experiments, and discussions, students experience for themselves how a scientific concept is formed (Nurjihan & Bunawan, 2025). This active involvement builds connections between concrete experiences and theoretical understanding, making concepts easier to grasp and remember. Furthermore, direct involvement also fosters a sense of ownership over the knowledge gained, strengthens intrinsic motivation, and fosters scientific attitudes such as curiosity, persistence, and openness to evidence.

The inquiry method's alignment with constructivist theory lies in its fundamental principle, which emphasizes that knowledge is not transferred from teacher to student, but rather actively constructed by students through interactions with their environment and learning experiences. In inquiry-based learning, students are encouraged to ask questions, investigate, and reflect on the processes they experience, which aligns with the constructivist view that learning is an active and personal process. Activities such as formulating hypotheses, conducting experiments, and drawing conclusions provide space for students to construct their own meaning based on their concrete experiences. Thus, this method not only conveys knowledge but also shapes scientific thinking and enhances students' metacognitive abilities in understanding and evaluating their own learning process.

Students construct their own knowledge through direct interaction with the environment and real-world phenomena relevant to everyday life. In the context of inquiry-based science learning, this process is realized through observation, experimentation, and discussion activities that allow students to experience various scientific concepts firsthand. These experiences provide a concrete foundation for students to connect theory with practice, thus deepening their understanding and sustaining it. By engaging the senses, reason, and emotions in the learning process, students not only grasp concepts cognitively but also develop scientific attitudes such as curiosity, perseverance, and openness to new data. Learning becomes more personal and meaningful because students feel they have a role in the process of discovering knowledge.

The implementation of the inquiry method directly supports the achievement of the objectives of the Independent Curriculum, which emphasizes the importance of project-based learning, investigation, and meaningful exploration. Through this approach, students are not only required to master content but also to develop essential competencies such as critical thinking, problem-solving, collaboration, and communication. For teachers, the implementation of this method demands a more active role as learning facilitators, guiding students to explore, ask questions, and draw conclusions independently. This requires changes in teaching practices, including planning, time management, and the provision of varied learning resources. Overall, the inquiry method is a relevant and potential strategy to strengthen the implementation of the Independent Curriculum in a contextual and transformative manner.

For the inquiry method to be optimally implemented, teachers require ongoing support in the form of relevant and contextual professional training. Such training should not only focus on theory but also provide opportunities for teachers to practice and reflect on inquiry strategies in real classroom contexts. Furthermore, providing adequate resources such as teaching aids, experimental materials, learning media, and access to simple laboratories is crucial to support the inquiry process. Institutional support from schools, such as collaboration between teachers and flexible curriculum policies, is also a key factor in the successful implementation of inquiry learning in science classes. Without adequate support, the potential of inquiry as an active and contextual learning approach will not be fully maximized (Asikin, 2024).

The success of implementing the inquiry method is largely determined by the teacher's ability to be flexible and adaptive to diverse class dynamics.(Herung et al., 2025)This flexibility includes the ability to adapt the stages of inquiry to students' cognitive readiness levels, time availability, and the school's facilities and infrastructure. In certain situations, teachers may need to simplify the inquiry process without losing the essence of the scientific approach that engages students in critical and exploratory thinking. Teachers also need to be responsive to obstacles that arise during the learning process, such as student disinterest, conceptual misconceptions, or limited practical tools, by implementing alternative strategies that maintain the principles of inquiry. With a flexible and reflective approach, the inquiry method can be implemented effectively and have a positive impact on student understanding and learning engagement in various classroom contexts.

Adjusting the difficulty level of experiments and the question-provoking approach are crucial aspects of successfully implementing the inquiry method in the classroom. Teachers need to design experimental activities that are appropriate to students' cognitive abilities and developmental levels to avoid difficulties or loss of interest. Experiments that are too complex can lead to confusion, while those that are too simple may not be challenging enough. Therefore, it is important to strike a balance between task complexity and student abilities. Furthermore, the way teachers stimulate questions also plays a crucial role in fostering curiosity and encouraging exploration (Husna, 2025). Open-ended, challenging, and life-relevant questions will encourage students to think critically, investigate further, and actively construct their understanding. By adjusting the difficulty level of the experiment and designing appropriate question stimuli, the inquiry process can be more effective and meaningful for students (Monrat et al., 2022).

The inquiry method is not only effective in strengthening conceptual understanding, but also makes a significant contribution to improving students' overall scientific literacy (Wen et al., 2020). From a knowledge perspective, students gain a deeper understanding because they are directly involved in the process of exploration and discovery, rather than simply passively receiving information. From a process skills perspective, students are trained to systematically observe, classify, measure, formulate hypotheses, and draw conclusions all essential components of scientific practice. Meanwhile, from a scientific attitude perspective, students learn to be objective, thorough, open to data, and possess a sense of curiosity and questioning (Ardiansyah & Arda, 2020). Learning experiences through the inquiry method also help students understand how science works in real life, thereby fostering an appreciation for science as part of culture and everyday life. Thus, the application of this method can shape students who are not only cognitively intelligent but also possess comprehensive scientific competencies as part of 21st-century scientific literacy (Ogegbo & Ramnarain, 2022).

CONCLUSION

The inquiry method has been proven effective in improving students' understanding of science concepts because it actively engages them in a learning process that emphasizes exploration, observation, and independent discovery. The application of this method also encourages the development of science process skills, such as the ability to observe, ask questions, make predictions, design experiments, and draw evidence-based conclusions. Students responded positively to inquiry-based science learning, characterized by increased participation, curiosity, and interest in science material previously considered difficult. Although teachers faced several challenges in its implementation—particularly regarding limited time, facilities, and student readiness these challenges were overcome through adaptive strategies and institutional support. Thus, this study emphasizes the importance of implementing a constructivist approach in learning and recommends that the inquiry method be an integral part of science curriculum development and teacher training.

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