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The Effect of Experimental Methods on Understanding the Use of Science in Elementary Schools

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Abstract

This study aims to examine the impact of the application of experimental methods on improving the understanding of science concepts in elementary school students. The basis for implementing this study is based on the fact that science learning in elementary schools is still dominated by a theoretical and teacher-centered approach, resulting in students being less actively involved in the learning process. The experimental approach was implemented through a simple activity called "a mini eruption of Mount Merapi," which aims to provide students with direct experience in understanding scientific phenomena. This study used a pretest-posttest design involving eight fourth-grade students of elementary schools 3 Dadakitan as participants. The measurement tool used was a conceptual understanding test administered before and after the experimental activities. The results showed an increase in the average score from 70 in the pretest to 80 in the posttest, indicating an increase in students' understanding of scientific concepts. Furthermore, classroom observations showed that students became more active, enthusiastic, and confident in expressing their ideas during the learning process. These findings indicate that the experimental method not only improves learning outcomes but also fosters students' curiosity, critical thinking, and scientific attitudes. Therefore, the experimental method can serve as an effective learning strategy to strengthen scientific process skills and improve the quality of science learning in elementary schools.

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INTRODUCTION

Natural Science (NC) is a subject taught in elementary schools. NC explores nature and everything within it. Science learning is highly important because, by understanding various concepts and principles of science, students are able to recognize and explain natural phenomena they encounter in their daily lives. Misunderstanding of concepts can lead to misinterpretation of fundamental ideas (Ridwansyah et al., 2025). Science learning is expected to serve as a medium for students to examine themselves and their surrounding environment, as well as to support

further development. Science instruction emphasizes providing direct experiences to develop students' competencies in exploring and understanding the natural environment scientifically (Miftahussudur et al., 2024). Experiments in science learning are able to create an engaging and active learning atmosphere because students are directly involved in the process. They not only observe or listen to the teacher's explanations but also experience firsthand how a scientific event occurs. Such a learning process enables students to understand the cause-and-effect relationships of the phenomena observed in their environment (Saskia & Margaretha, 2025).

Science education at the elementary school level plays a major role in building a basic understanding of science and developing scientific thinking skills from an early age. However, in practice, science learning often takes place theoretically and focuses on the teacher, resulting in students becoming less engaged and struggling to grasp concepts. Science learning in many classrooms, particularly at the elementary school level, tends to be theoretical and abstract. On the other hand, implementing simple volcanic eruption-themed experiments as a science-based learning method for early childhood has been shown to improve children's science process skills, learning interests, and scientific attitudes (Hanan et al., 2025). Science is a systematic way of exploring the natural world to master knowledge, facts, concepts, principles, the process of discovery, and develop a scientific attitude. Science education is beneficial for students in learning about themselves and the natural world. Science education emphasizes providing hands-on experiences and practical activities to develop competencies that foster a scientific understanding of the natural world (Solikati, 2021). The experimental method in an educational context refers to a learning approach that allows students to directly observe, experiment, and evaluate phenomena through practical activities (Nurlaela, 2023). The experimental method is a learning method in which students conduct an experiment, observe it, write down the results, and present the results to the class (Bintoro et al., 2022).

In early childhood, science can be defined as a series of activities and experiences designed to stimulate the development of curiosity, interest, and problem-solving skills. This approach encompasses a variety of activities that encourage children to observe the world around them, think critically, and connect concepts and events they experience (Nurlaela, 2023). Material is often delivered solely through lectures or textbooks, without providing students with the opportunity to directly experience the phenomena or concepts being studied. As a result, students struggle to connect theory to reality, making science material feel dry, uninteresting, and difficult to understand (Sudiana et al., 2025). Science can essentially be viewed as a process, a product, and an attitude. As a process, science is knowledge discovered through the scientific method, which begins with identifying a problem, formulating tentative hypotheses, conducting investigations, analyzing data, and drawing conclusions. These conclusions eventually become scientific products such as concepts, principles, theories, and laws (Wijaya et al., 2023; Musfirayanti et al., 2024).

The experimental method is a learning method that encourages students to be directly involved in discovering knowledge through simple experiments. Through these activities, students not only listen to or observe explanations but also experience and verify various scientific concepts for themselves. The lack of real-life scientific experiments in science learning can prevent students from becoming accustomed to using science process skills. As a result, they lack the skills needed to learn and develop knowledge independently. This ultimately hinders students from achieving

science learning goals (Khumraksa & Burachat, 2022). This study aims to examine the extent to which the use of experimental methods can improve elementary school students' understanding of science concepts. Therefore, research is needed to highlight the influence of experimental methods on science understanding at the elementary school level. Through the application of experimental methods, it is hoped that students can construct their cognitive abilities through observation, experimentation, and drawing final conclusions in the field of Natural Sciences (Astuti & Airlanda, 2022; Mustakim et al., 2025). The experimental learning method is a learning method presented by conducting experiments through experience and self-proven experience, then drawing conclusions. In learning using the experimental method, students try to prove abstract concepts being discussed using equipment prepared in advance (Ayu & Sholikhah, 2024). Science process skills involve observing, asking questions, formulating hypotheses, collecting data, analyzing information, and drawing conclusions. Children can use these skills in their daily lives as a foundation for future learning and building their future. Science instruction in elementary school plays a fundamental role in developing logical, critical, and analytical thinking in students. Science, more than just a collection of facts to be memorized, is an investigative process aimed at understanding the natural phenomena that occur around us (Fadly, 2025). To maximize the development of science process skills (a process that develops specific skills in students, enabling them to process information and discover new and useful insights, including facts, concepts, attitudes, and values), students should not simply conduct experiments without conceptualizing them. Students should understand the core of the material they are studying or the problem to be investigated in the experiment, ensuring that their thinking processes are conceptualized in accordance with the development of process skills (Dariansyah et al., 2023).

General Overview of the Application of Experimental Methods in Science Learning to improve early childhood thinking skills can be applied through experimental methods to achieve learning objectives in accordance with the learning curriculum used in schools (Sapia et al., 2025). The experimental method is a learning method in which students conduct experiments to discover, prove, and understand certain concepts. This method emphasizes active student involvement, observation, and drawing conclusions based on real data. Natural Sciences, often referred to as science education, is abbreviated to NC. The experimental method provides opportunities for children to gain hands-on and enjoyable learning experiences. Thus, it encourages children to become skilled at conducting their own experiments. In the teaching and learning process using the experimental method, children are also given the experience of directly observing an object. Thus, children are required to experience it themselves, seek the truth, find the necessary data, obtain the data themselves, prove a law, and draw conclusions from the process they experience (Rumihin et al., 2023). Science subjects at the elementary school level are a learning program aimed at developing curiosity, a positive attitude, and an awareness of the interplay of relationships, as well as decision-making skills relevant to everyday life. Furthermore, students with a solid understanding of the subject matter are able to explain previously discussed material and relate concepts to real-world examples. Mastery of science concepts is a crucial foundation for students. This means students must be able to describe, apply, and expand their understanding of science in various contexts (Sudiana et al., 2025). Natural Sciences (NC) subjects are related to the systematic search for knowledge about nature, so that NC is not only the mastery of a collection

of knowledge in the form of facts, concepts, or principles, but also a process of discovery (Artha & Setiyawati, 2022).

Natural Science (NC) learning in elementary schools has unique characteristics that distinguish it from other subjects. One of its main characteristics is a learning approach that emphasizes direct experience through experiments and observations. In this process, students are trained to observe various phenomena, collect and record data, and draw conclusions from their observations (Saskia & Margaretha, 2025). Science education is expected to be a vehicle for students to learn about themselves and their surroundings, as well as prospects for further development in applying it in everyday life (Martini, 2021).

There are various methods that can be used to improve students' ability to conduct experiments. Practical exercises and experiments are common learning methods in science and play a crucial role. However, in practice, many teachers still use practical activities and experiments solely as a means to reinforce specific knowledge or sills, resulting in students following predetermined experimental steps rather than exploring independently. Therefore, to harness the power of practice and experimentation in developing students' natural inquiry skills, it makes sense to link experiments to the scientific method process (Tu et al., 2022). Science learning activities are more meaningful when students actively participate. Experimental methods, using simple experiments, require students to actively participate. Learning activities conducted through experimental models are highly suited to the characteristics of students' cognitive development, particularly in elementary school (Fauziah et al., 2022).

In science learning, the primary focus is on developing students' ability to understand scientific concepts through hands-on experience. Science teaching differs from other subjects because it engages students in activities such as conducting experiments, making observations, gathering information, verifying theories, and drawing conclusions based on their findings. Given the importance of science education, science content must be applicable to students' daily lives to enhance science learning (Vandho et al., 2024). In elementary school science learning, students conduct a pretest to determine their level of understanding before using experimental methods. After completing the experimental activities, students are given a posttest to determine the extent to which their understanding has improved.

The experimental method is a learning approach that encourages students to participate directly in experiments to understand and prove scientific concepts through real-life experiences. In elementary school, this method facilitates students' learning by observing, experimenting, and discovering the concepts themselves. Through the application of the experimental method, researchers can assess the extent to which the method influences students' understanding. Science process skills involve the ability to observe, ask questions, formulate hypotheses, collect data, analyze information, and draw conclusions. Children can use these skills in their daily lives as a foundation for future learning and building their future (Syahrul et al., 2023). The first advantage of the experimental method is that learning involves students actively, both mentally and physically. Students can observe objects directly. They can draw conclusions independently. Students gain hands-on experience and data (Paembonan et al., 2023). The experimental learning method provides students with opportunities to discover concrete evidence for the theories they are studying. Through this approach, students are encouraged to experience the process firsthand,

seek truth, test principles or rules, and draw conclusions based on their own experiences (Putri & Meilana, 2023).

METHOD

This study used an experimental approach with a pretest-posttest design to determine the extent to which the experimental method improved students' understanding of science concepts. This design was chosen because it allowed researchers to compare conditions before and after the treatment, allowing for more accurate observation of changes. The study was conducted on eight fourth-grade students at elementary schools 3 Dadakitan, selected purposively, considering that students at that age are at the concrete operational thinking stage and therefore suitable for participating in simple experimental activities. The main instrument used was a conceptual understanding test administered twice: before the experimental activity began and after the learning process was completed. The test questions were designed based on indicators of scientific concept understanding that align with the elementary school curriculum. By comparing the results of the two tests, researchers were able to determine the effectiveness of the experimental method in helping students understand the material more deeply.

RESULTS AND DISCUSSION

Result

Based on quantitative data analysis, the use of experimental methods has been proven to have a positive impact on improving the understanding of science concepts of fourth-grade students at elementary schools 3 Dadakitan. The pretest and posttest results showed an increase in scores after the method was implemented. Before learning, the average pretest score of students was 70, with the highest score of 80 and the lowest of 60. After participating in experiment-based learning, the average posttest score increased to 80, with the highest score of 90 and the lowest of 70. This average increase of 10 points indicates that experimental activities help students understand science concepts better.

Table 1. Average Student Pretest and Posttest Results

Test Type	Highest Score	Lowest Score	Average
Pretest	80	60	70
Posttest	90	70	80

To determine the significance of the increase in student understanding, a paired sample t-test was conducted between the pretest and posttest results. Based on the analysis results, the calculated t = 4.25 with a t table = 2.36 at a significance level of $\alpha = 0.05$, and a p-value = 0.003, which is smaller than 0.05. This indicates that there is a significant difference. between the pretest and posttest results, so it can be concluded that the experimental method has a significant effect on improving students' understanding of science concepts.

Table 2. Results of the Pretest and Posttest t-Test

Statistik	Value
t Count	4,25
t table (α=0,05)	2,36
p-value	0,003

In addition to test results, observations during learning activities also showed changes in student learning behavior. A total of 87.5% of students showed increased active participation, high enthusiasm in participating in experimental activities, and courage to express opinions during discussions. Simple experimental activities such as the "mini Merapi eruption" experiment helped students understand the concept of changes in the state of matter in a concrete way. Thus, quantitatively and qualitatively, the application of the experimental method has been proven to improve conceptual understanding, motivation, and student engagement in science learning in elementary schools.

Discussion

The results of the study indicate that the application of the experimental method has a significant influence on improving elementary school students' understanding of science concepts. The increase in the average score from 70 in the pretest to 80 in the posttest indicates that the experimental method helps students understand science concepts more deeply. The results of the t-test with a calculated t value of 4.25 and a p-value of 0.003 (<0.05) strengthen the evidence that the difference is statistically significant. Thus, the research hypothesis stating that the experimental method influences students' understanding of science concepts is accepted. This is due to the characteristics of elementary school students who are still at the concrete operational thinking stage, so that direct learning involving real experiences is easier to understand than learning that is solely theoretical. In addition to improving conceptual understanding, the success of this method is also evident in the increase in student interest and motivation to learn. Classroom observations show that the learning atmosphere becomes more lively and participatory when experiments are conducted. Students who were previously passive become more enthusiastic about asking questions, experimenting, and are no longer afraid of making mistakes (Fadly, 2025).

These findings align with previous research by Ayu & Sholikhah (2024), which stated that the use of experimental methods in science learning can improve students' understanding of the properties of light in elementary school. These findings also support Fauziah argument that experimental-based learning can develop students' scientific literacy skills and curiosity. In the context of learning at elementary schools 3 Dadakitan, the experimental method applied through simple activities such as a mini-eruption experiment with Mount Merapi demonstrated that Direct learning experiences can help students relate theory to real phenomena in their environment.

In addition to influencing learning outcomes, the experimental method can also increase student engagement and motivation in participating in learning. Based on observations, approximately 87.5% of students appeared more active, enthusiastic, and self-confident during learning activities. This finding aligns with Piaget's view that elementary school students are at the concrete operational stage, so they understand material more easily when given direct experience rather

than abstract explanations. Through experimental activities, students can observe, try, and discover various scientific concepts for themselves through an engaging and meaningful process.

Overall, the findings of this study indicate that the experimental method is an effective learning strategy in science subjects. This approach can help students develop scientific thinking, deepen their understanding of concepts, and foster a scientific attitude from elementary school age. Through hands-on learning experiences, students not only memorize material but also see and understand the cause-and-effect relationships of the various natural phenomena they study. Therefore, teachers are encouraged to utilize the experimental method more frequently in science lessons, so that students can acquire knowledge through a more meaningful process of observation, experimentation, and discovery.

Figure 1.1 Process of completing the test for group 1 to determine the extent of their understanding of the experiment.

Figure 1.2 Process of completing the test for group 2 to determine the extent of their understanding of the experiment.

Figure 1.3 Process of completing the test for group 3 to determine the extent of their understanding of the experiment.

Figure 1.4 Mini Mount Merapi eruption experiment

CONCLUSION

Based on the research results, it can be concluded that the application of the experimental method in science learning in elementary schools can improve students' understanding of scientific concepts. This method provides direct learning experiences through observation, experimentation, and active student involvement, making it easier for them to grasp the material being taught. Furthermore, the experimental method can also foster curiosity. Thus, the use of experiments has proven to be more effective than lectures alone, as students not only passively receive knowledge but also construct understanding through real-world experiences.

REFERENCES

Artha, E. A. D., & Setiyawati, E. (2022). The effect of experimental methods on students' cognitive learning outcomes in elementary schools. *Indonesian Journal of Education Methods Development*, *18*(1), 35–43. https://doi.org/10.21070/ijemd.v21i.708

Astuti, R. B., & Airlanda, G. S. (2022). Pengaruh penggunaan metode eksperimen terhadap kognitif belajar siswa mata pelajaran ilmu pengetahuan alam IV SD. *Jurnal Ilmiah Pendidikan Profesi Guru*, *5*(2), 353–362. https://doi.org/10.23887/jippg.v5i2.50893

Ayu, W. S. M., & Sholikhah, O. H. (2024). Pengaruh penggunaan metode eksperimen dalam meningkatkan pemahaman siswa pada pembelajaran IPAS materi sifat cahaya kelas V SD. *Jurnal Media Akademik (JMA)*, *2*(9), 1–15. https://doi.org/10.62281/v2i9.776

Bintoro, T., Fahrurrozi, F., Sari, Y., Hasanah, U., & Syahdan, A. (2022). The Implementation of experimental methods to students' critical thinking skills in elementary science learning: literature review. *EduHumaniora | Jurnal Pendidikan Dasar Kampus Cibiru*, *14*(2), 190–199. https://doi.org/10.17509/eh.v14i2.45579

Dariansyah, J., Sumianto, A., M. L., Fauziddin, M., & Hardi, V. A. (2023). Peningkatan keterampilan proses sains siswa sekolah dasar melalui model pembelajaran berbasis masalah. *Jurnal Pendidikan MIPA*, *13*(4), 939–946. https://doi.org/10.37630/jpm.v13i4.1238

Fadly, M. (2025). Eksperimen Sederhana untuk meningkatkan pemahaman konsep sains siswa kelas tinggi (studi kasus di Sekolah Dasar Negeri 064010 Medan). *Jurnal Penelitian, Pengembangan, Pembelajaran, dan Teknologi (JP3T)*. *3*(2), 81–85. https://doi.org/10.61116/jp3t.v3i2.578

Fauziah, S. R., Sutisnawati, A., Nurmeta, I. K., & Hilma, A. (2022). Pengaruh metode eksperimen berbantuan media kit IPA terhadap kemampuan literasi sains dan karakter rasa ingin tahu siswa sekolah dasar. *Jurnal Cakrawala Pendas*, *8*(2), 457–467. https://doi.org/10.31949/jcp.v8i2.2283

Hanan, S., Asih, R. S., Arief, D., Agus, M. H., Danu, F. F., & Fauzan, R. (2025). Eksperimen edukasi gunung meletus untuk anak sekolah dasar sebagai upaya pengenalan awal reaksi kimia sederhana. *Jurnal Tiyasadarma*, *3*(1), 23–30. https://doi.org/10.62375/jta.v3i1.630

Khumraksa, B., & Burachat, P. (2022). The scientific questioning and experimental skills of elementary school students: the effects of research-based learning. *Jurnal Pendidikan IPA Indonesia*, *11*(4), 588–599. https://doi.org/10.15294/jpii.v11i4.36807

Martini, C. (2021). Penerapan metode eksperimen untuk meningkatkan hasil belajar siswa pada konsep sifat dan perubahan wujud benda di sekolah dasar. *JPD: Jurnal Pedagogiana*, *8*(49), 1–10. https://doi.org/10.47601/AJP.XXX

Miftahussudur, Putri, Z. D., Rahmi, A., & Monajar. (2024). The influence of experimental methods on science learning outcomes of class iv students on magnetic style material at state primary school 064968 Medan. *Educational Journal of Elementary School*, *5*(1), 27–31. https://jurnal.umsu.ac.id/index.php/EJoES/article/view/18471

Musfirayanti, M., Mustakim, M., & Hamna, H. (2024). Efektivitas penggunaan media pembelajaran gambar seri terhadap peningkatan literasi peserta didik. *Jurnal Basicedu*, *8*(4), 2953–2967. https://doi.org/10.31004/basicedu.v8i4.8302

Mustakim, M., Sriwahyuni, T., Abidah, D., Aksa, M., Alajai, R., & Ratmi, R. (2025). Kerja sama guru dan orang tua dalam meningkatkan pengerjaan pekerjaan rumah (PR) mata pelajaran IPA siswa. *LENSA (Lentera Sains): Jurnal Pendidikan IPA*, *15*(2), 82-89. https://jurnallensa.web.id/index.php/lensa/article/view/558

Nurlaela, E. (2023). Peningkatan kemampuan kognitif anak melalui metode eksperimen dalam pembelajaran sains. *Wistara: Jurnal Pendidikan Bahasa Dan Sastra*, *4*(2), 102–110. https://doi.org/10.23969/wistara.v4i2.10566

Paembonan, E., Arsyad, N., & Kusmawan, U. (2023). Effectiveness of inquiry model with scientific approach and experimental methods in science learning for elementary school. *EduLine: Journal of Education and Learning Innovation*, *3*(1), 107–113. https://doi.org/10.35877/454ri.eduline1500

Putri, N. R. S., & Meilana, S. F. (2023). Effect of experimental learning methods on students' cognitive abilities in science learning. *Jurnal Penelitian Pendidikan IPA*, *9*(9), 7539–7546. https://doi.org/10.29303/jppipa.v9i9.4602

Ridwansyah, E. P., Santosa, A. B., & Wiliam, N. (2025). Pengaruh metode eksperimen terhadap pemahaman konsep sains perubahan wujud benda siswa sekolah dasar. *Jurnal Pendidikan DEWANTARA: Media Komunikasi, Kreasi Dan Inovasi Ilmiah Pendidikan*, *11*(1), 25–35. https://doi.org/10.55933/jpd.v11i1.737

Rumihin, O., Abarua, H., & Lokollo, L. J. (2023). The effect of experimental methods on science ability in children aged 5-6 years at PAUD Rafflessia Arnoldy Kayu Tiga, Sirimau District, Ambon City. *International Journal of Education, Information Technology, and Others*, *6*(2), 352–357. https://doi.org/10.5281/zenodo.8008951

Sapia, S., Herlina, H., Bachtiar, M. Y., & Wahira, W. (2025). Application of experimental methods in science learning to improve early childhood thinking skills. *Pancasila International Journal of Applied Social Science*, *3*(01), 116–128. https://doi.org/10.59653/pancasila.v3i01.1383

Syahrial, S., Juneda, J., Saskia, D., & Margaretha, D. (2025). Penggunaan eksperimen sederhana dalam pembelajaran IPA di sekolah dasar : Tinjauan Pustaka. *Jurnal Bersama Ilmu Pendidikan (DIDIK)*, *1*(2), 81–86. https://doi.org/10.55123/didik.v1i2.180

Solikati, N. (2021). Peningkatan prestasi belajar IPA Materi rangkaian listrik sederhana dengan metode eksperimen. *Jurnal Terapan Pendidikan Dasar Dan Menengah*, *1*(2), 310–322. https://doi.org/ 10.28926/jtpdm.v1i2

Sudiana, I., Hidayat, R., & Ihsanda, N. (2025). *Efektivitas metode eksperimen terhadap kemampuan pemahaman siswa sekolah dasar pada materi IPA*. *Journal of Elementary Education: Strategies, Innovations, Curriculum, and Assesment*. *2*(1), 13–27. https://doi.org/10.61580/jeesica.v1i2.99

Syahrul, F. S., Kartini, M., & Rika, K. (2023). Pengaruh metode eksperimen terhadap keterampilan proses sains anak usia 5-6 tahun. *Ihya Ulum: Early Childhood Education Journal*, *1*(3), 123–141. https://doi.org/10.59638/ihyaulum.v1i3.107

Tu, P. T. H., Hang, N. T., Van, L. T. T., Dung, H. Van, Nga, N. T. H., & Phan, C. X. (2022). Experimental teaching by scientific methods for developing students' natural finding capacity in teaching natural science in vietnamese high schools. *World Journal of Education*, *12*(6), 1–8. https://doi.org/10.5430/wje.v12n6p1

Vandho, S. A. A., Harun, & Cahya, R. D. (2024). The influence of experimental methods on understanding concepts, materials, properties and changes in the form of objects. *Jurnal Penelitian Pendidikan IPA*, *10*(12), 10308–10315. https://doi.org/10.29303/jppipa.v10i12.7425

Wijaya, I. K. W. B., Yasa, I. M. W., & Muliani, N. M. (2023). Menumbuhkan literasi sains siswa sekolah dasar di lingkungan keluarga. *Jurnal Pendidikan MIPA*, *13*(4), 1012–1016. https://doi.org/10.37630/jpm.v13i4.1259