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The Effectiveness of the Environment-Oriented Practicum Guide Integrated with Catur Pramana in Developing Students' Science Process Skills

Ni Wayan Sri Darmayanti, Naif Mastoor Alsulami, Putu Beny Pradnyana, Nurul Isnaini Fitriyana, I Nengah Sueca, Muhamad Galang Isnawan

Research Article

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Author for correspondence:
Ni Wayan Sri Darmayanti
wyndarmayanti@gmail.com
ITP Markandeya Bali

Abstract

Background/purpose. One of the skills that students had to master in science learning was science process skills. However, there has not been much research examining these skills in elementary schools, especially those related to practicum guides integrated with local wisdom. Therefore, this study aimed to analyze the effectiveness of a science practicum guide for elementary schools integrated with Catur Pramana to improve students' science process skills. This guide was developed based on the surrounding environment and the concept of local wisdom in Bali, Indonesia.

Materials/methods. This study used a quasi-experimental approach with a one-group pre-test and post-test design involving 94 students as samples. Data were collected through practicum observation sheets and analyzed using gain scores to assess the improvement of students' science process skills.

Results. The analysis's results showed that the practicum guide was effective in improving science process skills, which were included in the moderate category. Furthermore, each indicator of science process skills showed an increase, with each gain score also included in the moderate category. Among the six indicators measured, the prediction indicator had the lowest score compared to the other indicators.

Conclusion. The elementary school science practicum guide integrated with Catur Pramana proved effective in improving students' science process skills. Therefore, this guide was seen as an effective solution to help students develop science process skills in elementary schools. This study also recommended the use of similar guides at higher school levels.

1. Introduction

According to the Merdeka Curriculum, it is emphasized that science learning involves concept discovery, where students engage directly in observation and experimentation to discover the taught concepts independently. As noted by Oviana (2018), learning in science is not merely about explaining concepts but also encompasses three dimensions: process, outcomes, and products. These dimensions can be achieved through learning that emphasizes scientific processes. As stated by Susanto (2013), the learning process for science in elementary schools should be directed toward inquiry-based learning rather than merely memorizing theories. This implies that practical activities are essential as part of the science learning process. Meanwhile, Kunandar (2007) emphasizes the importance of practicum activities in the learning process to enable students to develop process skills.

The primary goal of science is to develop scientific process skills. Aydogdu (2015) explains that through experimental or hands-on activities, students have the opportunity to formulate problems, propose hypotheses, collect and analyze data, and conclude their observations. These investigative activities help students develop their understanding of the world around them, which is the essence of scientific process skills. Consequently, students can apply these skills to solve real-life problems.

However, in practice, initial observations conducted by Mulyeni et al. (2019) in private elementary schools reveal that most second-grade students exhibit relatively low levels of basic scientific process skills. Teachers' lack of awareness in teaching experimental or practicum skills, such as formulating hypotheses, using tools and materials, establishing work steps, collecting data, analyzing data, and drawing conclusions, has resulted in suboptimal student performance in practical activities (Ekawati et al., 2018). The low level of students' scientific process skills is further supported by Rahayu and Angg (2017), whose research showed that elementary students in Sumedang had an average scientific process skills score of only 9.8. However, contrasting results were found in research by Angelia et al. (2022), which demonstrated that elementary students' scientific process skills improved significantly after applying innovative teaching models. Therefore, teachers are required to optimize elementary science learning through practical activities to enhance students' scientific process skills. However, teachers often lack proficiency in conducting practicums. This is evidenced by the findings of Sulistiyani et al. (2017), which revealed that teachers still struggle with laboratory management, planning and implementing authentic assessments, and executing practicums effectively. Science teachers must first master scientific process skills to ensure their students develop excellent scientific attitudes, as these reflect the true Nature of Science (NoS) (Setiawan & Sugiyanto, 2020). Furthermore, Haerullah and Suparman (2016) found complaints from school principals regarding science practicum processes, which tend to remain textual rather than hands-on. Conversely, research by Malik (2019) showed that practicum implementation received a high rating of 82.18%, categorized as excellent.

However, based on observations conducted in an elementary school in the Tampaksiring District, teachers rarely involve students in practicums, negatively impacting students' scientific process skills. This is due to the lack of specific guidelines for conducting practicums. During science lessons, teachers rely solely on practicum instructions found in student textbooks. An analysis of these instructions reveals several shortcomings, such as the absence of practicum titles, objectives, and theoretical foundations. However, the issue is that existing practicum guidebooks are often limited to specific topics, making the content monotonous and lacking variation, which may fail to motivate students. Novita (2020) also emphasizes the necessity of practicum guides as a foundation for conducting experiments to ensure successful implementation. Teachers can independently create simple science practicum guides using locally available tools and materials. In the Tampaksiring District, the lack of specific practicum guides is compounded by limited resources and materials, leading to infrequent practicum sessions. By developing guides tailored to the local environment,

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these challenges can be addressed, enabling more consistent and effective practicum implementation.

To address these challenges, it is necessary to develop a simple science practicum guide for elementary schools that is oriented toward the surrounding environment and integrated with the local wisdom of Catur Pramana to enhance students' scientific process skills. This approach is based on the premise that incorporating Balinese cultural elements into science learning has the potential to improve students' understanding of basic science competencies (Nofiana & Julianto, 2018). One example of Balinese local wisdom is Catur Pramana. which describes four methods the Balinese use to study science: observation (pratyaksa), reasoning (anumana), modeling (upamana), and testimony (sabda). Learning activities aligned with Catur Pramana strongly correlate with scientific process skills. The developed practicum guide utilizes objects from the local environment as substitute or complementary materials for practicum activities, integrating each component of Catur Pramana into every stage of the practicum. This approach not only enhances scientific skills but also fosters an appreciation for local wisdom and sustainable practices.

This research is conducted in response to existing field problems and because no prior studies have examined a practicum guide oriented towards the environment integrated with Catur Pramana local wisdom. Utilizing environmental media and Balinese local wisdom enables more contextual learning, where students can connect learning concepts with tangible objects or situations in their surroundings. Moreover, an environment-oriented practicum incorporating Catur Pramana's stages aims to foster scientific thinking and sharpen scientific process skills, including observation, inquiry design, data analysis, and conclusion drawing. This research is significant in improving the quality of science learning through a culture-based approach while also shaping students with strong scientific skills and awareness of their local wisdom.

Research by Wijaya (2020) has shown that Catur Pramana-based learning can be used to develop 4C competencies (critical thinking, creativity, communication, and collaboration) and scientific process skills. Similarly, Novita (2020) finds that the practicality level of developed practicum guides is highly practical, in line with Chan and Budiono (2019), whose study reveals that developed practicum guides are highly usable and well-received by students during learning processes. Additionally, research by Yuanita and Yuniarita (2018) demonstrates that the development of a science practicum guide based on scientific process skills can enhance elementary students' critical thinking skills. Research by Sugiarti et al. (2022) also shows that the development of science practicum guides can improve students' critical thinking abilities. Sodikun et al.. (2016) demonstrated an improvement in science process skills after implementing a guided inquiry module. The development of a simple science practicum guide for elementary schools, oriented towards the surrounding environment and integrated with Balinese local wisdom Catur Pramana, has been conducted and validated for its practicality and validity. However, further testing is needed to evaluate its effectiveness in improving students' scientific process skills. Therefore, this research aims to investigate the effectiveness of the developed science practicum guide in enhancing students' scientific process skills. The following are some research questions formulated to achieve the research objectives, including:

RQ1: How do students' science process skills improve after using the environment-oriented elementary science practicum guide integrated with the local wisdom of *Catur Pramana?*

RQ2: How does each of the indicators of students' science process skills improve after using the environment-oriented elementary science practicum guide integrated with the local wisdom of *Catur Pramana?*

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2. Literature Review

According to the Minister of Education and Culture, as cited in Wijaya et al. (2020), Merdeka Belajar refers to the freedom of educational units (schools, teachers, and students) to innovate and learn independently and creatively. Merdeka Belajar refers to the freedom of educational units (schools, teachers, and students) to innovate and learn independently and creatively. Implementing the Merdeka Curriculum, as part of the independent curriculum, requires teachers to work professionally and design or conduct effective and engaging learning experiences. This aims to ensure that all learning processes are carried out through a scientific approach. In Indonesia, one of the subjects in elementary schools where the learning process is conducted using a scientific approach is Natural Sciences (IPA). In the independent curriculum, Natural Sciences (IPA) are combined with Social Sciences (IPS) into a single subject called IPAS. IPA focuses on the scientific study of natural phenomena and comprises three inseparable competencies: product, process, and attitude.

The process skills approach is essentially a learning method that emphasizes students' active and creative involvement in acquiring learning outcomes (Conny, 1992). Science Process Skills (SPS) refer to students' abilities to apply scientific principles to acquire, understand, and develop knowledge. These skills are not only beneficial in classroom learning but also play an important role in solving various problems and facing situations in everyday life (Darmayanti & Setiawati, 2022). Science process skills serve as a foundation for developing critical thinking skills that are closely related to cognitive and psychomotor aspects. Therefore, these skills are crucial to teach in order to build knowledge and problem-solving abilities (Akani, 2015; Sridana et al., 2025). The skills acquired from the application of science are referred to as process skills (Juhji, 2016). Moreover, scientific process skills are one of the dimensions of scientific literacy (Messaoudi, 2024). To become scientifically literate, one must possess scientific process skills such as classifying, concluding, observing, controlling variables, formulating hypotheses, and conducting experiments in accordance with the scientific method (Ping et al., 2019). Scientific knowledge forms the content of science, and one of the ways to acquire this knowledge is through scientific process skills (Gürses et al., 2015).

Ratnasari et al. (2018) stated that scientific process skills are skills in learning science applied through the scientific method, enabling students to better understand the concepts being studied. According to Aktamiş et al. (2016), one of the essential skills to master in the 21st century is science process skills, which students can acquire through various scientific inquiry activities. According to Harlen (1992), the types of process skills include formulating problems, formulating hypotheses, determining tools and materials, establishing work steps, using tools and materials, collecting data, analyzing experimental data, drawing conclusions, and communicating findings. Basic process skills serve as the foundation that students must master before integrating them into more complex process skills (Maison et al., 2019). Scientific process skills taught to elementary school students must be simplified to align with their cognitive development stage. Basic scientific process skills for elementary school students include observing, classifying, measuring, communicating, predicting, and concluding (Rezba et al., 1995). Observational skills are abilities developed by utilizing all senses to recognize and identify the characteristics of objects or events. Communication skills refer to the ability to convey the results of observations or investigations clearly and systematically. Meanwhile, classification skills are developed through practice in grouping objects based on their characteristics. Measurement skills can be enhanced through various activities that involve the use of appropriate measurement units, such as length, area, volume, time, and weight. Additionally, inference skills involve the ability to draw preliminary conclusions based on available data. Prediction skills, on the other hand, refer to the ability to anticipate what will happen in the next observation specifically (Hisbullah & Selvi, 2018). From this explanation, it can be concluded that scientific process skills are essential in science learning and can be developed through practical activities. Practicum, therefore, should be implemented in science learning to develop and enhance students' scientific process skills.

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Science process skills enable students to explore their environment and gain a deeper understanding through active learning (Athuman, 2017). Through inquiry-based activities such as experiments, hands-on practice, and discussions, students actively participate in constructing their own understanding (Mulyeni et al., 2019). Practicum involves direct observation and experimentation to discover the concepts being taught (Djamarah, 2006). A practicum is a core activity in the science learning process that integrates teaching, learning, and hands-on practice to develop scientific process skills. Furthermore, Aydogdu (2015) explains that experimental or hands-on activities provide students with opportunities to formulate problems, propose hypotheses, collect and analyze data, and draw conclusions from their observations. Engaging in such investigative activities allows students to develop their own understanding of the world around them, which lies at the core of science process skills. Thus, the implementation of science process skills in learning not only makes the learning process more effective but also makes it more relevant and meaningful for students.

A practicum can be effectively conducted if accompanied by a practicum. Asmaningrum et al. (2018) stated that practicum guides contain topics, objectives, theoretical foundations, tools and materials, procedures, observation sheets, and evaluation questions tailored to the practicum's objectives. In essence, a practicum guide provides a framework for conducting experiments effectively, ensuring smooth practicum sessions. Through practical guidelines, the practicum activities carried out will be able to support the improvement of the quality of the learning process effectively (Syamsa, 2022). In line with the findings of Lepiyanto (2017), practicum activities have been proven to enhance students' scientific process skills. Based on this, practicum activities are essential in science learning to help students develop and improve their scientific process skills. Practicum in science learning is essential, as evidenced by research conducted by Kurniawati, Akbar, and Misri (2015), which states that practicums allow students to directly learn concepts by observing natural phenomena. Similarly, Lepiyanto (2017) emphasizes that practical activities can optimize students' scientific process skills. Science practicums can also foster students' learning motivation, helping them improve various scientific process skills and develop a scientific attitude. A practicum can be effectively conducted if accompanied by practicum guides (Darmaji et al., 2019). Engaging students in experiments is expected to enable them to explain natural phenomena scientifically, conduct scientific proofs, and make decisions based on scientific knowledge (Arrohman et al., 2022).

Local wisdom refers to concepts or ideas originating from the local environment that embody wise, creative, and positive values passed down from generation to generation (Kasiyan & Sulistyo, 2020; Wastap, 2017). One example of Balinese local wisdom is Catur Pramana. which describes four methods the Balinese use to study science: Sabda Pramana involves acquiring knowledge through credible testimonies, which includes listening, explaining, discussing, questioning, and reading literature. Pratyaksa Pramana focuses on gaining knowledge through direct observation of an object, with or without tools, involving activities such as observing, measuring, and conducting experiments (Kerti, 2018). Anumana Pramana involves acquiring knowledge through observable phenomena, including activities such as classifying, predicting, inferring, concluding, identifying variable relationships, processing data, analyzing investigations, formulating hypotheses, and determining variables operationally (Suja, 2017). Upamana Pramana emphasizes gaining knowledge by comparing objects being studied with other known objects, focusing on similarities and differences, such as comparing various opinions and literature.

3. Methodology

The type of research was a pre-experimental design. This type of pre-experimental research was often considered not very rigorous because there were still external variables that influenced the formation of the dependent variable. The method of pre-experimental design research was conducted on one group, namely the experimental group, which received treatment using an Environmental Oriented Simple Practicum Guide. The design used by the researcher was the one-

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group pretest-posttest design, where before being treated, they were first given an initial test (pretest), and after being treated, they were tested again with the same test questions as the final test (posttest) (Sugiyono, 2017). The approach used by the author in this research was a quantitative approach. This approach emphasized the analysis of numerical data processed using statistical methods. This research was a process to determine knowledge using numerical data as a means of information desired from the research results. The next test that was examined was the test of the effectiveness of the practicum guide developed to improve science process skills. The effectiveness test used one sample class as a limited trial class. The design of the effectiveness test of this practicum guide was to use the one-group pre-test and post-test design. This research was conducted at Tampaksiring Village Elementary School (SD) (a state elementary school in Tampaksiring village). Elementary schools in Tampaksiring District were selected for their suitability with the research objective of testing the effectiveness of the **Environment-Oriented Practicum Guide Integrated with Catur Pramana.** These schools have access to natural environments that support hands-on learning and students with appropriate characteristics for studying science process skills. The sample used for small group product testing (limited trial) was randomly taken from grade V students. The selection of fifth-grade elementary school students in this study is based on their cognitive readiness to understand science concepts, which is in line with Piaget's concrete operational stage. At this level, students begin to develop logical thinking and conduct simple experiments, making them more prepared to enhance scientific process skills such as observation, data analysis, and drawing conclusions. Additionally, the fifth-grade science curriculum aligns with these skills, allowing the integration of **Catur Pramana** local wisdom to be applied optimally. By fostering these skills early, students' understanding and application of the scientific method are expected to improve at higher levels. The sample used for product testing in the small group (limited trial) was selected using random sampling by randomly choosing students from the fifth grade. This means that every fifth-grade student had an equal chance of being selected for this trial. The sample used for product testing in the small group (limited trial) was selected using random sampling by randomly choosing students from the fifth grade. This means that every fifth-grade student had an equal chance of being selected for this trial. This technique is used when all elements in the population share uniform characteristics (homogeneous), ensuring that each selected sample accurately represents the entire population. Randomness is ensured through objective selection methods, such as: **Lottery Method** – students' names or numbers are written on pieces of paper, shuffled, and then drawn randomly.

The indicators of science process skills that were observed during the research process were observing, classifying, measuring, communicating, predicting, and concluding. Since this study aims to measure the improvement of scientific process skills in elementary schools, the basic process skill indicators appropriate for this level are used. The instrument used to measure these indicators was an observation sheet. Before being used, the instrument was validated using the Gregory test (Gregory, 2004), which involved expert assessments to ensure its accuracy and appropriateness. After the validation process, the scientific process skills instrument underwent several revisions to enhance its quality and precision in measuring students' scientific process skills. The instrument of science process skills was used at the beginning (**pre-test**) and at the end (post-test) of learning. Science process skills were scores obtained from the observation results of process skills indicators using the observation sheet instrument. At the beginning of the lesson (pre-test), this sheet is used to assess students' initial scientific process skills before they receive treatment using an environment-oriented science practicum guide integrated with **Catur Pramana**. Meanwhile, at the end of the lesson (**post-test**), the sheet is used again to evaluate the development of students' scientific process skills after completing the learning process. By comparing the results of the pre-test and post-test, the effectiveness of the practicum guide in enhancing students' scientific process skills can be determined. The observation sheet includes **seven indicators**, each comprising **five statements.** The highest score for each item on the indicator was 5, and the lowest was 1. The maximum score for

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science process skills was 35. To determine the magnitude of the increase in students' science process skills, a gain score test was used. The data from the calculation of science process skills scores before and after the students were then interpreted using Hake's standard gain. To see the magnitude of the increase in students' science process skills, a gain test was used with the following equation:

$$gain = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Where Spre was the initial score, Spost was the final score, and Smaks was the maximum score.

The data from the calculation of the science process skills score before and after were then interpreted using the standard gain as follows.

Table 1. Standard gain index value (Hake, 1999)

Standard Gain Value	Information
0,7 < g	High
0,7 ≥ g ≥ 0,3	Medium
g < 0,3	Low

4. Results

4.1. How do students' science process skills improve after using the environment-oriented elementary science practicum guide integrated with the local wisdom of Catur Pramana?

The data presented in Figures 1 and 2 were obtained by analyzing students' science process skills.

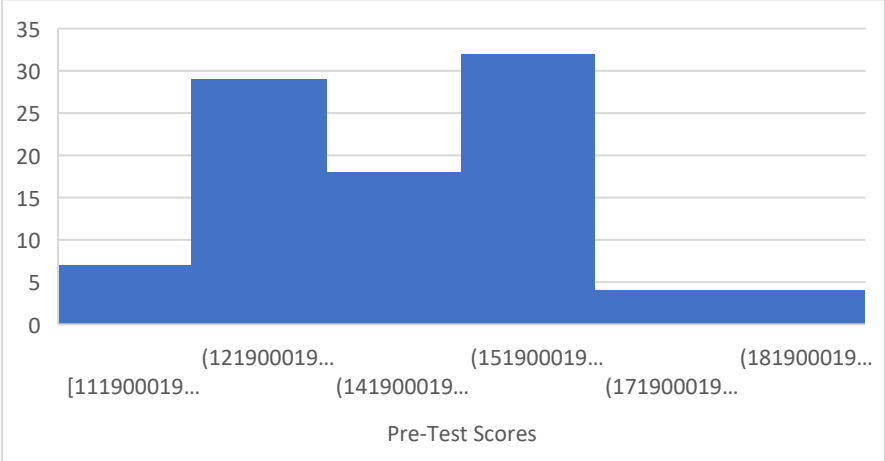

Figure 1. Pre-test scores of students' science process skills

Based on the graph of the pre-test scores for students' science process skills, it was shown that out of 94 students, 4 students achieved the highest pre-test scores, ranging from 20 to 21. Meanwhile, 8 students obtained the lowest scores, ranging from 12 to 13. The average pre-test score was 16.

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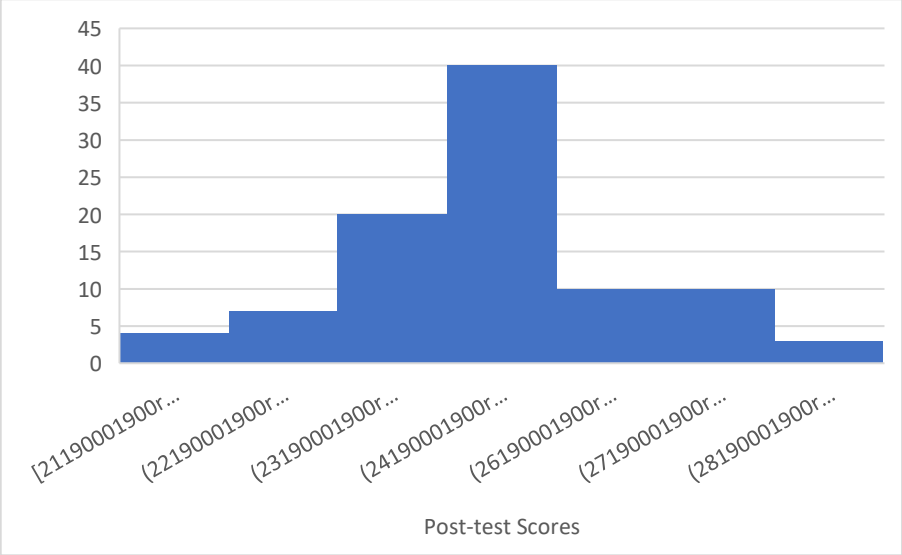

Figure 2. Post-test scores of students' science process skills

Figure 2 shows the post-test scores for students' science process skills. Out of 94 students, 3 achieved the highest post-test score of 30. Meanwhile, 4 students had the lowest scores, ranging from 22 to 23. The average post-test score was 26. Based on the pre-test and post-test results, the students' gain scores were as follows.

Table 2. Gain score results for students' science process skills

Gain Score Range	Gain Categories Score	Total Students	Percentage (%)
0,7 < g	High	0	0
0,7 ≥ *g* ≥ 0,3	Middle	55	59
g < 0,3	Low	39	41

Table 2 shows that out of 94 students, 55 have a gain score for science process skills in the medium category, while 39 students fall into the low category. The average gain score for students' science process skills is 0.30, which is categorized as medium.

4.2. How does each of the indicators of students' science process skills improve after using the environment-oriented elementary science practicum guide integrated with the local wisdom of Catur Pramana?

The gain scores for each indicator of students' science process skills could be seen in Table 3 below. Based on the gain score table for each indicator of science process skills, all indicator values fell into the medium category. Among the six indicators of science process skills, the lowest gain score was on the predicting indicator, with a gain score of 0.60, categorized as medium.

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Table 3. Gain scores for each indicator of science process skills

Indicators	Total Student Pre-test Scores	Total Student Post-test Scores	Gain	N-Gain Percent	Criteria
Observing	259	427	0,70	69,71	Medium
Classifying	246	424	0,70	70,08	Medium
Measuring	255	408	0,62	62,45	Medium
Communicating	250	416	0,66	66,4	Medium
Predicting	248	400	0,60	60,32	Medium
Concluding	257	405	0,61	62,45	Medium

5. Discussion

5.1. How do students' science process skills improve after using the environment-oriented elementary science practicum guide integrated with the local wisdom of Catur Pramana?

Based on the pre-test scores of students' science process skills, it is found that out of a total of 94 students, only 4 students achieved the highest scores in the range of 20–21. Conversely, there are 8 students with the lowest scores in the range of 12–13. The average pre-test score is 16, reflecting that students' science process skills are still low before implementing the learning intervention. This low pre-test score may be due to students' previous lack of experience in using a science process-based approach. This indicates that most students have not yet acquired basic science process skills such as observing, classifying, measuring, predicting, communicating, and concluding, which are essential elements of science process skills. The low scores highlight the need for more effective learning strategies to fundamentally build students' science process skills. In this context, multiple intelligences-based learning serves as a relevant solution (PANU, 2016). The Multiple Intelligences Theory, developed by Howard Gardner in 1983, states that human intelligence consists of various types rather than a single entity. Gardner identifies eight types of intelligence. This theory suggests that each individual possesses nine types of intelligence: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, naturalist, and existential intelligence (Syarifah, 2019). In the context of education, the application of this theory can be integrated with the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana. This approach not only enriches students' learning experiences but also facilitates the development of more holistic science process skills. By utilizing various types of intelligence, the learning practices designed in this guide help students better understand scientific concepts through an approach relevant to their local wisdom.

For example, students with linguistic intelligence engage in discussions and presentations, while those with bodily-kinesthetic intelligence participate in hands-on experiments. Students with naturalist intelligence learn about local ecosystems, and those with interpersonal intelligence collaborate in groups to complete projects (Fernández-Cézar et al., 2024). Thus, the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana serves as an effective tool to develop students' science process skills by leveraging the strengths of each type of intelligence possessed by individuals. Therefore, adopting this learning model is a strategic step to enhance students' generic science skills, which in turn contributes to better scores in the evaluation of science

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process skills. Hence, the development of the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana is necessary.

The pre-test results indicate the need for the development of the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana. The objective of this development is to create interactive learning experiences that involve simple experiments and observations of natural phenomena, which stimulate students' critical thinking skills. In this context, teachers play a crucial role in creating a dynamic learning environment and utilizing innovative strategies to enhance student engagement (Latifah et al., 2024). By implementing these various strategies, it is expected that there will be a significant improvement in students' science process skills, as well as an overall enhancement in their learning outcomes. After the learning intervention through the implementation of the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana, the post-test results show a significant improvement.

Based on the data analysis results, it can be concluded that the Environment-Oriented Science Practicum Guide is proven effective, as evidenced by an increase in students' science process skills scores at a classical level, with an average gain score of 0.30 (categorized as moderate). Out of 94 students, 59% experience an improvement in their process skills within the moderate category. The improvement of science process skills using the Environment-Oriented Science Practicum Guide integrated with Catur Pramana's local wisdom to achieve a high category cannot be achieved quickly. This is because science learning requires continuous and optimal guidance from teachers during practical activities, allowing students to be well-trained and enhance their science process skills. Currently, teachers are required to create learning experiences that do not focus solely on memorization (Andini et al., 2018). Teachers must be creative in adapting learning to the demands of the 21st century, one of which is mastering science process skills (Sari et al., 2023; Sujarittham et al., 2019). To enhance students' science process and critical thinking skills, a learning process that enables students to learn actively and discover new concepts is essential. One effective approach is through practicum-based learning (Darmaji et al., 2021). Science learning improves through practicum activities, which help overcome challenges such as understanding concepts, linking relationships between concepts, comprehending formulas, and applying formulas to solve problems (Wenno et al., 2016).

Practicum activities in the learning process allow teachers to assess students' skills, including science process skills (Maison et al., 2019). Through these activities, students perform steps such as observation, hypothesis formulation, measurement, and other tasks that serve as indicators of scientific process skills. According to research conducted by Bundu et al. (2022) and Lepiyanto (2017), practicum activities improve students' science process skills. In addition, Safaah et al. (2017) state in their journal that practicum activities provide opportunities for all students to acquire science process skills. The learning process should be arranged to ensure that all students have the opportunity to participate in practicum activities, thus enhancing their science process skills. Successful implementation of practicum activities relies on the availability of specialized guidelines. An environment-oriented practicum guide provides significant benefits for students' learning experiences. As highlighted by Rios and Brewer (2014), "frequent outdoor learning experiences, implemented by a trained teacher in a familiar setting, like a schoolyard, can result in greater engagement and science achievement for students."

The results of this study are consistent with previous research conducted by Sodikun et al. (2016), which demonstrated an improvement in science process skills after implementing a guided inquiry module. This is evident from the average score of students' science process skills after learning, which reached 84.66. A similar result was also found in research using the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana, which showed an improvement in science process skills with an average gain score of 0.3 in the moderate category. This indicates that both

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approaches are effective in enhancing students' science process skills, although they employ different methods and measurement indicators. Furthermore, research by Rosalina and Miriam (2024) indicates that teaching modules using the Predict-Observe-Explain (POE) learning model are effective in enhancing students' science process skills. This study indicates that the instructional module using the POE learning model is effective in enhancing students' science process skills, with an N-gain score of 0.41, categorized as moderate. Meanwhile, research utilizing the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana also demonstrates an improvement in science process skills, with an average gain score of 0.30, also classified as moderate. Although there is a slight difference in the improvement scores, the local wisdom-based approach still makes a positive contribution to strengthening science process skills, particularly through environmental exploration and the integration of cultural values into learning. Additionally, the findings are supported by research from Darmayanti et al. (2019), which confirms the effectiveness of the science practicum guidebook based on the results of a limited trial, showing that the improvement in science process skills at a classical level falls into the moderate category. Using a scientific approach-based practicum guide with an environmental orientation, the research shows an improvement in students' science process skills, with an average gain score of 0.4, categorized as moderate. Meanwhile, the study implementing the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana also resulted in an increase in science process skills, with an average gain score of 0.30, falling within the same category. Although there is a difference in gain scores, both approaches have proven effective in enhancing students' science process skills through environment-based practices. Sufiyanto and Hefni (2021) also demonstrate that using media from recycled materials found in the surrounding environment, such as plastic bottles and clear plastic, in practicum activities effectively improves the science process skills of fifth-grade students. Similarly, the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana, which utilizes practicum materials from the surrounding environment, has been proven to enhance students' science process skills through contextual and experience-based practicum activities.

These relevant research findings indicate that learning approaches emphasizing active student engagement—whether through exploring the surrounding environment as practicum materials or conducting scientific experiments—provide more meaningful learning experiences. At the elementary school level, this study demonstrates that the use of an environment-oriented science practicum guide not only enhances students' understanding of scientific concepts but also develops their science process skills, such as observation, prediction, and data analysis.

Through environmental exploration, students are directly engaged in activities relevant to their daily lives, helping them understand scientific concepts in a more tangible and applicable way. This approach enhances student engagement and motivation to learn (Dewi et al., 2019;Khanifah, L. N., Mustaji., 2019; Rahmawati et al., 2024). Active involvement also facilitates the development of a positive attitude toward science, which is crucial for shaping a generation that not only understands scientific concepts but can also apply them in social and environmental contexts. Exploring the surrounding environment as practicum material and a learning resource through the science practicum guide integrated with Catur Pramana's local wisdom encourages students to ask questions, conduct observations, and draw conclusions based on firsthand experiences (Dewi et al., 2019;Yusuf et al., 2023).

The elementary school science practicum guide, which integrates environmental orientation with Catur Pramana, proves effective in developing students' science process skills. The implementation of this guide encourages students to ask questions based on phenomena they observe in their surroundings, engaging directly with the elements of Catur Pramana: Pratyaksa (direct observation): Activities in this category include observing, measuring, and conducting experiments. Anumana (reasoning): Activities include classifying, predicting, inferring, concluding,

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relating variables, processing data, analyzing investigations, formulating hypotheses, and determining operational variables. Sabda (testimony): Activities involve listening, explaining, discussing, asking questions, and reading literature. Upamana (comparison): Activities include comparing various opinions and literature sources. By incorporating these elements, students not only develop critical thinking skills but also learn to draw conclusions based on empirical data. This approach aligns with the needs of students at this developmental stage, as they tend to learn more effectively through hands-on experiences and concrete exploration. Utilizing the surrounding environment as practicum materials and integrating it with the Catur Pramana local wisdom in the science practicum guide provides students with opportunities to learn directly from real-world experiences. This, in turn, enables them to better understand and appreciate the relevance of science in everyday life. Environmental exploration not only enriches students' learning experiences but also encourages them to think critically and creatively in solving real-world problems around them.

Learning that involves exploring the surrounding environment as practicum material and a learning resource through the science practicum guide integrated with Catur Pramana's local wisdom to enhance science process skills is often conducted in groups, which enhances social interactions among students. This approach not only strengthens conceptual understanding but also teaches essential collaborative skills for solving problems collectively (Kurniasih, 2024;Yusuf et al., 2023). Incorporating environmental exploration as a learning resource through science practicum activities integrated with Catur Pramana's local wisdom positively impacts not only the development of students' science process skills but also their collaborative abilities. Conducted in groups, this learning approach encourages intensive social interactions, where students share ideas, discuss findings, and collaborate to solve problems collectively. This process reinforces scientific concept comprehension through constructive discussions while fostering values such as cooperation, responsibility, and effective communication. Thus, the elementary school science practicum guide, which integrates environmental orientation with Catur Pramana, equips students not only with academic skills but also with essential social competencies to face real-life challenges. This aligns with the principles of contextual learning that support the integration of scientific knowledge with local cultural values.

The basic concept component emphasizes operational concretes, which serve as the foundational elements for understanding and applying theoretical knowledge in practical scenarios. Meanwhile, the skill component focuses on developing scientific process skills, which are crucial for scientific inquiry, experimentation, and analysis. By integrating these components into an environment-based guide, educators create a comprehensive learning framework that caters to diverse learning styles and fosters a holistic understanding of environmental concepts and issues. In the elementary science practicum guide oriented towards the surrounding environment, the integration of local wisdom Catur Pramana encourages students to conduct experiments that emphasize concrete operational aspects, which are fundamental building blocks for understanding and applying theoretical knowledge in practical situations (Agnafia et al., 2022). In addition, the components of the guide focus on developing science process skills, which are crucial for scientific inquiry, experimentation, and analysis (Rahayu et al., 2022) . By integrating these components into the environment-based guide, educators create a comprehensive learning framework that caters to diverse learning styles and fosters a holistic understanding of environmental concepts and issues. Thus, the research findings further strengthen the evidence that an environment-oriented practicum guide integrated with local wisdom enhances students' science process skills. This approach is relevant for implementation at various educational levels and serves as an essential foundation for designing innovative and context-based learning. Learning that actively involves students—such as through practicums, experiments, and utilizing the surrounding environment—helps students develop their science process skills. These studies highlight the importance of using approaches that actively engage students in learning, such as through practicums and experiments. Consequently,

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students develop their science process skills, which are not only crucial in science education but also transferable to various other disciplines.

5.2. How do students' science process skills improve after using the environment-oriented elementary science practicum guide integrated with the local wisdom of Catur Pramana?

Based on the pre-test scores of students' science process skills, it is found that out of a total of 94 students, only 4 students achieve the highest scores in the range of 20–21. Conversely, there are 8 students with the lowest scores in the range of 12–13. The average pre-test score is 16, reflecting that students' science process skills are still low before the learning intervention is implemented. This low pre-test score may be due to students' lack of experience in using a science process-based approach previously. This indicates that most students have not yet acquired basic science process skills such as observing, classifying, measuring, predicting, communicating, and concluding, which are essential elements of science process skills. The low scores highlight the need for more effective learning strategies to fundamentally build students' science process skills. In this context, multiple intelligences-based learning serves as a relevant solution (PANU, 2016).The Multiple Intelligences Theory, developed by Howard Gardner in 1983, states that human intelligence consists of various types, rather than a single entity. Gardner identifies eight types of intelligence. This theory suggests that each individual possesses nine types of intelligence: linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, naturalist, and existential intelligence (Syarifah, 2019). In the context of education, the application of this theory can be integrated with the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana. This approach not only enriches students' learning experiences but also facilitates the development of more holistic science process skills. By utilizing various types of intelligence, the learning practices designed in this guide help students better understand scientific concepts through an approach relevant to their local wisdom.

For example, students with linguistic intelligence engage in discussions and presentations, while those with bodily-kinesthetic intelligence participate in hands-on experiments. Students with naturalist intelligence learn about local ecosystems, and those with interpersonal intelligence collaborate in groups to complete projects (Fernández-Cézar et al., 2024). Thus, the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana serves as an effective tool to develop students' science process skills by leveraging the strengths of each type of intelligence possessed by individuals. Therefore, adopting this learning model is a strategic step to enhance students' generic science skills, which in turn contributes to better scores in the evaluation of science process skills. Hence, the development of the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana is necessary.

The pre-test results indicate the need for the development of the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana. The objective of this development is to create interactive learning experiences that involve simple experiments and observations of natural phenomena, which stimulate students' critical thinking skills. In this context, teachers play a crucial role in creating a dynamic learning environment and utilizing innovative strategies to enhance student engagement (Latifah et al., 2024). By implementing these various strategies, it is expected that there will be a significant improvement in students' science process skills, as well as an overall enhancement in their learning outcomes. After the learning intervention through the implementation of the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana, the post-test results show a significant improvement.

Based on the data analysis results, it can be concluded that the Environment-Oriented Science Practicum Guide is proven effective, as evidenced by an increase in students' science process skills

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scores at a classical level, with an average gain score of 0.30 (categorized as moderate). Out of 94 students, 59% experience an improvement in their process skills within the moderate category. The improvement of science process skills using the Environment-Oriented Science Practicum Guide integrated with Catur Pramana's local wisdom to achieve a high category cannot be achieved quickly. This is because science learning requires continuous and optimal guidance from teachers during practical activities, allowing students to be well-trained and enhance their science process skills. Currently, teachers are required to create learning experiences that do not focus solely on memorization (Andini et al., 2018). Teachers must be creative in adapting learning to the demands of the 21st century, one of which is mastering science process skills (Sari et al., 2023; Sujarittham et al., 2019). To enhance students' science process and critical thinking skills, a learning process that enables students to learn actively and discover new concepts is essential. One effective approach is through practicum-based learning (Darmaji et al., 2021). Science learning improves through practicum activities, which help overcome challenges such as understanding concepts, linking relationships between concepts, comprehending formulas, and applying formulas to solve problems (Wenno et al., 2016).

Practicum activities in the learning process allow teachers to assess students' skills, including science process skills (Maison et al., 2019). Through these activities, students perform steps such as observation, hypothesis formulation, measurement, and other tasks that serve as indicators of scientific process skills. According to research conducted by Bundu et al. (2022) and Lepiyanto (2017), practicum activities improve students' science process skills. In addition, Safaah et al. (2017) state in their journal that practicum activities provide opportunities for all students to acquire science process skills. The learning process should be arranged to ensure that all students have the opportunity to participate in practicum activities, thus enhancing their science process skills. Successful implementation of practicum activities relies on the availability of specialized guidelines. An environment-oriented practicum guide provides significant benefits for students' learning experiences. As highlighted by Rios and Brewer (2014), "frequent outdoor learning experiences, implemented by a trained teacher in a familiar setting, like a schoolyard, can result in greater engagement and science achievement for students."

The results of this study are consistent with previous research conducted by Sodikun et al. (2016), which demonstrated an improvement in science process skills after implementing a guided inquiry module. This is evident from the average score of students' science process skills after learning, which reached 84.66. A similar result was also found in research using the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana, which showed an improvement in science process skills with an average gain score of 0.3 in the moderate category. This indicates that both approaches are effective in enhancing students' science process skills, although they employ different methods and measurement indicators. Furthermore, research by Rosalina and Miriam (2024) indicates that teaching modules using the Predict-Observe-Explain (POE) learning model are effective in enhancing students' science process skills. This study indicates that the instructional module using the POE learning model is effective in enhancing students' science process skills, with an N-gain score of 0.41, categorized as moderate. Meanwhile, research utilizing the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana also demonstrates an improvement in science process skills, with an average gain score of 0.30, also classified as moderate. Although there is a slight difference in the improvement scores, the local wisdom-based approach still makes a positive contribution to strengthening science process skills, particularly through environmental exploration and the integration of cultural values into learning. Additionally, the findings are supported by research from (Darmayanti et al. (2019), which confirms the effectiveness of the science practicum guidebook based on the results of a limited trial, showing that the improvement in science process skills at a classical level falls into the moderate category. The research using a

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scientific approach-based practicum guide with an environmental orientation shows an improvement in students' science process skills, with an average gain score of 0.4, categorized as moderate. Meanwhile, the study implementing the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana also resulted in an increase in science process skills, with an average gain score of 0.30, falling within the same category. Although there is a difference in gain scores, both approaches have proven effective in enhancing students' science process skills through environment-based practices. Sufiyanto and Hefni (2021) also demonstrates that using media from recycled materials found in the surrounding environment, such as plastic bottles and clear plastic, in practicum activities effectively improves the science process skills of fifth-grade students. Similarly, the Environment-Oriented Science Practicum Guide Based on Local Wisdom of Catur Pramana, which utilizes practicum materials from the surrounding environment, has been proven to enhance students' science process skills through contextual and experience-based practicum activities.

These relevant research findings indicate that learning approaches emphasizing active student engagement—whether through exploring the surrounding environment as practicum materials or conducting scientific experiments—provide more meaningful learning experiences. At the elementary school level, this study demonstrates that the use of an environment-oriented science practicum guide not only enhances students' understanding of scientific concepts but also develops their science process skills, such as observation, prediction, and data analysis.

Through environmental exploration, students are directly engaged in activities relevant to their daily lives, helping them understand scientific concepts in a more tangible and applicable way. This approach enhances student engagement and motivation to learn (Dewi et al., 2019;Khanifah, L. N., Mustaji., 2019; Rahmawati et al., 2024). Active involvement also facilitates the development of a positive attitude toward science, which is crucial for shaping a generation that not only understands scientific concepts but can also apply them in social and environmental contexts. Exploring the surrounding environment as practicum material and a learning resource through the science practicum guide integrated with Catur Pramana's local wisdom encourages students to ask questions, conduct observations, and draw conclusions based on firsthand experiences (Dewi et al., 2019;Yusuf et al., 2023).

The elementary school science practicum guide, which integrates environmental orientation with Catur Pramana, proves effective in developing students' science process skills. The implementation of this guide encourages students to ask questions based on phenomena they observe in their surroundings, engaging directly with the elements of Catur Pramana: Pratyaksa (direct observation): Activities in this category include observing, measuring, and conducting experiments. Anumana (reasoning): Activities include classifying, predicting, inferring, concluding, relating variables, processing data, analyzing investigations, formulating hypotheses, and determining operational variables. Sabda (testimony): Activities involve listening, explaining, discussing, asking questions, and reading literature. Upamana (comparison): Activities include comparing various opinions and literature sources. By incorporating these elements, students not only develop critical thinking skills but also learn to draw conclusions based on empirical data. This approach aligns with the needs of students at this developmental stage, as they tend to learn more effectively through hands-on experiences and concrete exploration. Utilizing the surrounding environment as practicum materials and integrating it with the Catur Pramana local wisdom in the science practicum guide provides students with opportunities to learn directly from real-world experiences. This, in turn, enables them to better understand and appreciate the relevance of science in everyday life. Environmental exploration not only enriches students' learning experiences but also encourages them to think critically and creatively in solving real-world problems around them.

Learning that involves exploring the surrounding environment as practicum material and a learning resource through the science practicum guide integrated with Catur Pramana's local wisdom

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to enhance science process skills is often conducted in groups, which enhances social interactions among students. This approach not only strengthens conceptual understanding but also teaches essential collaborative skills for solving problems collectively (Kurniasih, 2024;Yusuf et al., 2023). Incorporating environmental exploration as a learning resource through science practicum activities integrated with Catur Pramana's local wisdom positively impacts not only the development of students' science process skills but also their collaborative abilities. Conducted in groups, this learning approach encourages intensive social interactions, where students share ideas, discuss findings, and collaborate to solve problems collectively. This process reinforces scientific concept comprehension through constructive discussions while fostering values such as cooperation, responsibility, and effective communication. Thus, the elementary school science practicum guide, which integrates environmental orientation with Catur Pramana, equips students not only with academic skills but also with essential social competencies to face real-life challenges. This aligns with the principles of contextual learning that support the integration of scientific knowledge with local cultural values.

The basic concept component emphasizes operational concretes, which serve as the foundational elements for understanding and applying theoretical knowledge in practical scenarios. Meanwhile, the skill component focuses on developing scientific process skills, which are crucial for scientific inquiry, experimentation, and analysis. By integrating these components into an environment-based guide, educators create a comprehensive learning framework that caters to diverse learning styles and fosters a holistic understanding of environmental concepts and issues. In the elementary science practicum guide oriented towards the surrounding environment, the integration of local wisdom Catur Pramana encourages students to conduct experiments that emphasize concrete operational aspects, which are fundamental building blocks for understanding and applying theoretical knowledge in practical situations (Agnafia et al., 2022). In addition, the components of the guide focus on developing science process skills, which are crucial for scientific inquiry, experimentation, and analysis (Rahayu et al., 2022) . By integrating these components into the environment-based guide, educators create a comprehensive learning framework that caters to diverse learning styles and fosters a holistic understanding of environmental concepts and issues. Thus, the research findings further strengthen the evidence that an environment-oriented practicum guide integrated with local wisdom enhances students' science process skills. This approach is relevant for implementation at various educational levels and serves as an essential foundation for designing innovative and context-based learning. Learning that actively involves students—such as through practicums, experiments, and utilizing the surrounding environment—helps students develop their science process skills. These studies highlight the importance of using approaches that actively engage students in learning, such as through practicums and experiments. Consequently, students develop their science process skills, which are not only crucial in science education but also transferable to various other disciplines.

6. Conclusion

The environmentally-oriented science practicum guide integrated with the local wisdom of Catur Pramana proves effective in enhancing students' science process skills, with an average gain score of 0.30, which falls into the moderate category. Each indicator of science process skills shows improvement within the moderate category. Among the six measured indicators, the prediction indicator has the lowest gain score compared to the others, although it still falls within the moderate category. This guide makes a significant contribution to the development of students' science process skills by providing contextual, interactive, and locally-based learning experiences. Through this approach, students become more actively engaged in observing, classifying, measuring, communicating, predicting, and drawing conclusions, thereby enhancing their conceptual understanding and scientific thinking skills. Furthermore, the guide encourages students to be more

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explorative and reflective in solving science-based problems in real life, ultimately strengthening their critical thinking and problem-solving abilities.

The environmentally oriented science practicum guide integrated with the local wisdom of Catur Pramana serves as an innovative learning resource to improve the quality of science education. Its implementation supports teachers in creating more engaging, relevant, and student-centered learning processes while also fostering a scientific culture within the school environment. In addition, the guide helps schools realize environment- and local culture-based education, aligning with the vision of sustainable education and fostering students' character to be more environmentally and culturally aware.

7. Suggestion

Based on the research findings, it is recommended that the environmentally oriented science practicum guide integrated with the local wisdom of Catur Pramana be continuously developed and refined, especially in indicators with the lowest gain scores, such as prediction, to enhance its effectiveness across all aspects of students' science process skills. The implementation of this guide can be expanded to other schools with similar local wisdom potential and integrated into an environment- and culture-based curriculum. Ongoing teacher training is also necessary to ensure the optimal implementation of this guide in the learning process. Furthermore, integrating digital technology, such as the use of interactive applications and online learning platforms, can enhance the appeal and accessibility of learning. Regular evaluations should also be conducted to ensure the guide's long-term effectiveness and identify areas that need further improvement.

Declarations

Author Contributions. NWS Darmayanti : Conceptualization, design, analysis, writing, securing funding. Naif Mastoor Alsulami: Editing/reviewing, securing funding, supervision. PB Pradnyana: Critical revision of the manuscript, securing funding, technical or material support. NI Fitriyana: Analysis, writing, securing funding. I N Sueca: Analysis, writing, securing funding. MG Isnawan: Critical revision of the manuscript. All authors have read and approved the published version of the article.

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About the Contributor(s)

Ni Wayan Sri Darmayanti, M.Pd. is a lecturer in Elementary School Teacher Education at the Faculty of Teacher Training and Education, Markandeya Bali Institute of Technology and Education. She earned her bachelor's degree from Ganesha University of Education in 2011 and her master's degree from the same university in 2013. She is a researcher in various fields of science education, particularly those related to elementary school teaching materials and science process skills.
Email: wyndarmayanti@gmail.com
ORCID: https://orcid.org/0009-0001-7640-3901

Naif Mastoor Alsulami, Ph.D., is an associate professor and lecturer at the Curriculum and Instruction Department, Faculty of Education, University of Jeddah, Saudi Arabia. He was appointed a lecturer at Jeddah Teachers College in 2005. He obtained his Bachelor of Education (Mathematics) in 2004 (Saudi Arabia), his Master of Science (Mathematics Education) in 2009, and his Doctor of Philosophy in 2014

from Curtin University in Australia. His research interests include transformative research, transformative education, professional development, and teacher education.
Email: nsulami@uj.edu.sa
ORCID: https://orcid.org/0000-0002-7404-8141

Putu Beny Pradnyana, M.Pd. is a lecturer in Elementary School Teacher Education at the Faculty of Teacher Training and Education, Markandeya Bali Institute of Technology and Education. He earned his bachelor's degree from Ganesha University of Education in 2011 and his master's degree from the same university in 2013. He is a researcher in various fields of science education, particularly those related to educational technology and instructional media for elementary school science subjects.
Email: putubenypradnyana380@gmail.com
ORCID: https://orcid.org/0000-0002-8345-1282

Nurul Isnaini Fitriyana, M.P., is a lecturer in Elementary School Teacher Education at the Faculty of Teacher Training and Education, Markandeya Bali Institute of Technology and Education. She earned her bachelor's degree from the University of Jember in 2001 and her master's degree from Brawijaya University in 2011. She is a researcher in various fields of literacy education in elementary schools.
Email: isnainifitriyana@markandeyabali.ac.id
ORCID: https://orcid.org/0000-0002-2679-5193

I Nengah Sueca, M.Pd. is a lecturer in Indonesian Language and Literature Education at the Faculty of Teacher Training and Education, Markandeya Bali Institute of Technology and Education. He earned his bachelor's degree from the Ganesha University in 2013 and his master's degree from Ganesha University in 2015. He is a researcher in various fields of literacy education and character development in elementary schools.
Email: su3ca.nngah@gmail.com
ORCID: https://orcid.org/0009-0001-1318-8765

Muhamad Galang Isnawan, Dr., is a lecturer at the Faculty of Teacher Training and Education at Universitas Nahdlatul Wathan Mataram, Indonesia. He was appointed as a lecturer in 2014 and continued his postgraduate studies in mathematics education at Universitas Pendidikan Indonesia. He was the best graduate at the master's and doctoral levels. He is passionate about improving the quality of teaching and student learning and their development in schools and in higher education settings. Dr. Muhamad Galang Isnawan's research interests lie in learning or lecture design that integrates ICT in order to optimize student competence in the 21st century, didactical design research, representational ability, fractions, and lesson study.
Email: galangisna19@gmail.com
ORCID: https://orcid.org/0000-0002-3799-3435