



Teachers' Creativity in Science Education Through Play-Based Learning to Foster Students' Naturalist Intelligence

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Abstract: This study was motivated by the low level of student engagement and the suboptimal development of naturalistic intelligence in science education in elementary schools, which is still dominated by conventional methods. This study aims to describe the creativity of teachers in implementing game-based learning methods as an effort to foster students' naturalistic intelligence at SDN Kamunti. This study used a qualitative approach with a descriptive research design. Data sources included teachers, principals, and students, as well as relevant learning documents. Data collection techniques were carried out through observation, in-depth interviews, and documentation, while data analysis techniques involved the stages of data reduction, data presentation, and drawing conclusions. The results showed that teachers creatively developed learning through game-based activities, such as environmental exploration, mini-experiments, outdoor exploration games, the use of recycled materials, and role-playing based on local projects. Observational data showed that students actively observed, classified, and interacted directly with natural objects. Interview results revealed that teachers deliberately designed lessons so that students could learn through games and direct experiences. Field notes confirmed the findings that students showed high enthusiasm, collaborated in groups, and were able to explain their observations in their own words. Thus, the implementation of play-based learning has been proven effective in creating meaningful learning experiences, increasing student engagement, and optimally fostering naturalistic intelligence.

Keywords: Teacher Creativity, Science Learning, Game-Based Learning Method, Naturalist Intelligence

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Introduction

The development of education in the 21st century demands a learning system that focuses not only on mastering cognitive content but also on the holistic development of students' multiple intelligences (Ilham et al., 2022) . Modern educational discourse increasingly emphasizes the importance of teacher creativity as a key player in designing meaningful, contextual, and student-centered learning experiences (Syarifuddin et al., 2025) . In the national context, policies such as the implementation of the Independent Curriculum encourage teachers to teach Natural and Social Sciences (IPAS) in an integrated manner, using an approach that facilitates exploration of the surrounding environment as a learning resource (Ramadhan et al., 2024) . This shows that education is no longer understood merely as the transfer of

knowledge, but as a process of cultivating ecological awareness and naturalistic intelligence relevant to the challenges of the global environmental crisis (Gani, 2022) .

Current trends indicate that the integration of games into science education is beginning to gain widespread attention as awareness of the importance of fun and meaningful learning grows (Patika & Surmilasari, 2023) . Reports from various national educational institutions in recent years indicate an increased use of game-based approaches in elementary schools, particularly following the pandemic, which has triggered a transformation in teaching methods (Pradani, 2022) . Data from various educational surveys indicate that elementary school students engaged in activity- and game-based learning have higher participation rates and demonstrate improved exploration skills (Solikati, 2021) . However, in practice, gaps remain in the implementation of these methods (Khairatun & Ramadhan, Syahru, 2026) . Many teachers still rely on lectures and written assignments, resulting in students' learning experiences being abstract and disconnected from the realities of their environment (Ramadhan & Faradilah, Aulia, 2026) .

This situation results in low emotional engagement of students with the science curriculum and limited development of naturalistic intelligence (Moran et al., 2025) . If this situation is allowed to continue, students risk losing the opportunity to develop ecological awareness which, in the long term, can affect their attitudes towards environmental conservation (K. Chen et al., 2025) . Teachers, as the main facilitators of learning, face significant administrative pressure, which limits their opportunities for creativity, while students, as the main participants in the learning process, experience teaching that is not challenging and contextually irrelevant (Britton et al., 2025) . This phenomenon highlights the urgent need to evaluate and strengthen teacher creativity in designing learning experiences that are relevant to the developmental characteristics of elementary school-aged children (Rosa, Nila & Ramadhan, 2026) . One method that teachers can use in teaching science in elementary schools is play-based learning. (Liang et al., 2025). Teacher creativity in implementing play-based learning methods has the potential to be an effective strategy to foster students' sensitivity to nature, increase their learning motivation, and strengthen their observation and investigation skills (Rädel-ablass et al., 2025).

The main issue lies in the gap between the ideal curriculum requirements – which emphasize active learning – and the reality of teaching practices, which remain conventional (Ilham et al., 2024). Science learning should provide opportunities for exploration, interaction with nature, and structured play experiences. In reality, many learning activities do not utilize the surrounding environment as a natural laboratory (Hermansyah et al., 2025). When teachers have not fully integrated play-based learning methods, students tend to be passive recipients of information (Hakkarainen, 2020). The impact is seen not only in students' low interest in learning but also in their limited ability to observe natural phenomena, classify objects, and establish cause-and-effect

relationships (Miller, 2018). This gap results in missed opportunities to develop naturalistic intelligence, which should naturally develop through direct interaction with the environment. If this situation continues, elementary school students risk failing to build the foundation of ecological awareness, which is crucial in this era of environmental crisis (Tri Wulandari & Adam Mudinillah, 2022).

Several previous studies have examined the effectiveness of game-based methods in elementary school science education and the development of multiple intelligences. A study by Raden Vina Iskandya Putri¹ showed that game-based learning significantly improves elementary school students' observation skills (Raden Vina Iskandya Putri¹, 2023). A study by Tulljanah & Amini found that integrating nature exploration activities into science education can increase students' learning motivation and environmental awareness (Tulljanah & Amini, 2021). Meanwhile, a study by Chen confirmed that game-based learning contributes to the development of naturalistic intelligence through direct sensory experiences (C. Chen et al., 2025). Although this topic has been widely studied by previous researchers, most studies have focused primarily on cognitive learning outcomes and have not thoroughly explored the dimension of teacher creativity as a key factor in the implementation of this method. The uniqueness of this study lies in its attempt to connect teacher creativity, play-based learning methods, and naturalistic intelligence within a contextual analysis framework that considers the school's geographical conditions. This research contributes to broadening the perspective that the success of play-based learning is not only determined by the method, but also by the teacher's ability to utilize the potential of the local environment as a learning resource.

This research becomes even more important when viewed in the context of educational institutions in mountainous areas, such as Kamunti Elementary School in Donggo, Bima District, Bima Regency. This school has unique geographical characteristics, as it is located in a highland area surrounded by natural landscapes with relatively well-maintained biodiversity. The local socio-cultural environment still maintains a strong connection with nature, so the school has significant potential to develop context-based and environment-centered learning. Initial observations conducted by the researcher indicate that in daily practice at Kamunti Elementary School, teachers have begun to utilize open spaces as learning environments; however, the implementation of play-based learning methods has not been systematically structured. Students show a high interest in outdoor exploration activities, but these activities have not been fully designed as pedagogical strategies oriented towards the development of naturalist intelligence. Initial observations also indicate that some teachers still face limitations in designing educational games integrated with Natural Science learning objectives. This school has a community culture and outdoor activity program that has the potential to be developed into a nature learning laboratory. These

conditions make Kamunti Elementary School a representative location to research how teacher creativity can be optimized through a play-based approach.

The selection of SDN Kamunti as a research location was not only based on geographic considerations, but also because the school possesses innovative potential relevant to the research objectives. Access to a natural environment provides numerous opportunities for teachers to design learning experiences based on direct experience. The school has a teacher community that is open to developing new methods and shows interest in creative approaches. Initial findings indicate a gap between the rich environmental potential and learning practices that are still limited to routine classroom activities. This situation presents a research opportunity to formulate a contextual and practical model of teacher creativity. By studying this school, the research is expected to generate pedagogical recommendations relevant not only to SDN Kamunti but also to other schools with similar geographic characteristics. The urgency of this research lies in its contribution to enriching theory on game-based learning to strengthen teachers' creative pedagogical practices, as well as providing policy input for the development of context-based and environment-centered curricula.

Methodology

This study used a qualitative research design with a descriptive approach, aiming to gain an in-depth understanding of teacher creativity in science education through game-based learning methods to foster students' naturalist intelligence at Kamunti Elementary School (Sugiono, 2021). This research design focused on exploring natural phenomena within the school environment without manipulating variables. This study was conducted at Kamunti Elementary School, located in Mpili Village, Donggo. This research was conducted in Bima District, Bima Regency, and lasted for two months. The research subjects consisted of six participants: one principal, two teachers, and three students. Participants were selected using purposive sampling based on certain criteria: teachers who actively teach science, principals who understand learning policies, and students who are directly involved in play-based learning activities. Observations of learning activities were conducted directly inside and outside the classroom, with each session lasting 1–2 hours to capture the dynamics of interactions, teacher creativity, and student responses (Luthfiyah, 2017). In addition, in-depth interviews lasting 30–60 minutes were conducted to explore each respondent's perspective on the implementation of the method. Through this design, researchers attempt to obtain a comprehensive picture of the learning practices that occur and the factors that influence the development of students' naturalistic intelligence (Sidiq & Choiri, 2018).

The data sources for this study consisted of primary and secondary data. Primary data were collected directly from the principal, teachers, and students

through observation and interviews, while secondary data were obtained from school documents such as lesson plans, teaching and learning activity records, and archives related to the Science and Education program (Helaluddin, 2015) . Data collection was conducted using three main methods: observation, interviews, and documentation. Observations were conducted in a participatory manner to directly observe the implementation of play-based learning and teachers' creativity in managing the learning process. Interviews were conducted using a semi- structured approach so that researchers could collect information flexibly but focused. Documentation was used to strengthen the data obtained from observations and interviews (Moleong, 2017) . The data analysis technique used an interactive analysis model that includes data reduction, data presentation, and drawing conclusions. Data reduction was carried out by simplifying and grouping key information, which was then presented in a descriptive narrative form to ensure ease of understanding. Researchers drew conclusions gradually based on patterns found during the study. Data validity is ensured through triangulation of sources and techniques to ensure that the research results truly reflect the conditions observed in the field (Ramdhan, 2017) .

Results and Discussion

Findings

In implementing science learning at Kamunti Elementary School, teachers strive to provide meaningful, contextual, and enjoyable learning experiences through creative approaches. Teacher creativity is evident in designing activities that integrate science concepts with educational games, enabling students to learn actively and exploratively. Through game-based learning methods, teachers not only deliver content but also facilitate students' direct interaction with the surrounding environment as a learning resource. This effort aims to foster students' naturalist intelligence – that is, the ability to recognize, understand, and care for nature. Based on observations, in-depth interviews, and document analysis, various forms of teacher creativity were identified in implementing this learning approach effectively and innovatively, including the following:

1. Creating Innovative Nature-Based Teaching Materials

Research findings indicate that teachers at Kamunti Elementary School actively create innovative nature-based learning materials by utilizing the potential of the school environment as the primary learning resource in teaching science. Teachers do not rely solely on textbooks but also design student worksheets (LKPD) that guide students to directly observe, classify, and describe natural objects. During ecosystem introduction activities, teachers prepare exploration guides that instruct students to identify plant species in the schoolyard, record their characteristics, and group them based on leaf shape and stem texture. Based on observations, teachers are seen bringing real-world examples such as dry leaves, soil, and rocks to enrich students'

understanding. Field notes show that teachers distribute observation sheets and ask students to sit in groups under trees to directly observe the objects while discussing them. This is also consistent with what one teacher stated in an interview.

" I deliberately create learning materials based on their surroundings so that children don't just imagine things, but can see and touch them directly. This way, they understand the material more quickly because they can learn from what's around them. I also notice that children are more enthusiastic and active during lessons, especially when they are taken outside the classroom. They can ask questions, experiment, and discover things for themselves. I think this kind of learning is more meaningful because children actually experience things directly, rather than just listening to explanations from the teacher. "

Interview results showed that this approach enabled teachers to design learning materials that were contextual, practical, and encouraged students' active engagement in the learning process. Teachers' creativity in creating nature-based learning materials was also evident in their ability to integrate game elements into each learning activity. Teachers designed game cards made from recycled paper featuring images of local plants and animals, then used them in a matching and classification game. This activity not only developed students' cognitive skills but also strengthened their naturalist intelligence through direct interaction with environmental concepts. Based on observations, students appeared enthusiastic to participate in the games and actively engaged in group discussions. Field notes indicated that students competed with each other to match cards to real objects they found around the school. Furthermore, teachers developed a simple planting medium using recycled plastic bottles as part of the practical learning materials. This activity allowed students to directly plant and care for plants, allowing them not only to understand the concept but also to experience the process firsthand.

Teachers consistently evaluated and refined the learning materials they used based on student responses and engagement throughout the learning process. Teachers recorded each student's progress in a dedicated notebook, particularly regarding their ability to observe, categorize, and demonstrate environmental awareness. Observations showed that teachers provided direct feedback when students made errors in identifying natural objects. Field notes showed that teachers approached each group, provided guidance, and asked students to rephrase their observations. This demonstrates that the teaching materials created by teachers were not static but dynamically developed to meet students' needs. Thus, teachers' creativity in creating innovative, nature-based teaching materials has significantly contributed to fostering students' naturalist intelligence through hands-on, enjoyable, and meaningful learning experiences.

2. Integrated Science Learning Activities that Incorporate Local Wisdom of Ngaha Aina Ngoho

Teachers at Kamunti Elementary School concretely integrate the local wisdom of the Ngaha community. Aina Ngoho integrates science learning activities through a structured and contextual play-based learning approach. The teacher designs environmental exploration activities by assigning students to observe the condition of the school garden and the surrounding area, then identifying appropriate and destructive ways of utilizing nature. In practice, the teacher guides students to record their findings on a prepared observation sheet, including the types of plants cared for and areas showing signs of damage. Based on the observations, the teacher provides operational instructions such as grouping, comparison, and explanations of the relationship between human behavior and environmental conditions. Field notes show the teacher leading student discussions under a tree while showing examples of leaves damaged by careless picking. This approach demonstrates that the teacher not only conveys concepts theoretically but also guides students to understand and apply these values through direct experience in their environment.

Teachers developed educational games based on Ngaha. Aina Ngoho values encourage students to think critically and act wisely toward the environment. One activity included a "nature guardian" simulation, where students were asked to play the role of individuals responsible for maintaining environmental balance. In this game, teachers presented scenarios such as excessive tree felling or littering, and then asked students to determine appropriate actions. Observations of the learning activities showed that students engaged in discussions and expressed their opinions, drawing insights from their daily experiences. An interview with the principal of Kamunti Elementary School revealed that students reminded each other not to damage plants and suggested replanting as a solution, as highlighted in the interview excerpt below.

" We are indeed encouraging implementation Ngaha ." Aina Ngoho implant values in the learning process so that students develop this awareness from an early age. We want students not only to understand the subject matter, but also to adopt attitudes and behavior that reflect concern " We are committed to environmental stewardship. Therefore, we consistently guide teachers to integrate these values into every learning activity, both inside and outside the classroom. We have also observed that when these values are consistently implemented, students become more responsible and begin to see the importance of preserving their environment. The hope is that these values will be practiced not only at school but also in their daily lives at home and in the community. "

Based on the explanation above, the teacher systematically reinforces Ngaha. Aina Ngoho values are integrated through reflection and activity-based evaluation.

After learning activities, the teacher asks students to share their experiences and explain actions that reflect an environmentally conscious attitude. Observations show that the teacher asks in-depth questions to encourage students to think reflectively. Field notes indicate that most students are able to explain the importance of maintaining the balance of nature and demonstrate a caring attitude towards their surroundings. The teacher also documents the development of students' attitudes in a daily journal as part of the learning evaluation. Thus, the integration of Ngaha local wisdom values is realized. Aina The integration of Ngoho into science learning is not merely symbolic, but is implemented through directed, repetitive, and real-world experience-based activities, thereby fostering students' naturalistic intelligence in a deeper and more sustainable way.

3. Conducting Mini Experiments Based on Educational Games

The results of the study indicate that teachers at Kamunti Elementary School actively designed and conducted mini-experiments based on educational games as part of their science education. Teachers developed simple experimental procedures that students could carry out directly using materials available in their environment, such as soil, water, leaves, and rocks. During the implementation, teachers divided students into small groups and provided operational instructions, such as observing changes, recording results, and drawing conclusions. One of the activities conducted was a water filtration experiment using sand and rocks, which was presented as a game. During this simple experimental activity, students were seen pouring water, arranging filter layers, and comparing results between groups. Field notes noted that teachers moved around the room, guiding students to observe the differences in water color before and after filtration. This activity demonstrated that teachers were able to present scientific concepts as concrete, fun, and easily understood activities for students through direct experience.

The teacher's creativity was evident in her ability to develop various mini-experiments that combined elements of competitive and collaborative play. The teacher designed activities such as a "plant growth guessing game," in which students were asked to plant seeds in different growing media and observe their growth over a period of time. Students were then asked to compare the results and present their findings to the class. Observations showed that students recorded the height of the plants, watered the plants regularly, and discussed factors that influenced growth. Field notes showed that students discussed among themselves which group of plants grew the fastest and related this to soil and water conditions. In addition, the teacher used a natural object classification game, in which students were asked to group objects based on certain properties, such as hard and soft or wet and dry, thereby concretely developing students' analytical skills.



Figure 1. Mini Experiment on Plants

The teacher consistently reinforced concepts through reflection after the experiment was completed. The teacher asked students to explain the process they followed, identify any errors, and summarize the results of the experiment in their own words. Direct observations revealed that the teacher asked thought-provoking questions such as, “Why does filtered water become clearer?” This was done to encourage students to think critically. During this process, most students were able to explain the results of the experiment by referring to their recent experiences. The teacher also recorded the development of students' skills in the assessment book, particularly regarding observation, collaboration, and conceptual understanding. Thus, the systematic and purposeful implementation of mini-experiments based on educational games has provided authentic learning experiences, increased student engagement, and significantly contributed to the development of students' naturalist intelligence at SDN Kamunti.

4. Implementation of Outdoor Exploration Games (Nature Exploration)

The results of the study show that the teachers at SDN Kamunti in a way systematic apply Game Outdoor exploration as a concrete expression of creativity in play-based science education. Teachers design exploration routes within the school environment—such as the garden, playground, and the area near the school fence—by setting up observation stations that students must visit in groups. At each station, teachers provide specific instructions, such as identifying plant species, observing soil texture, and recording interactions between living organisms in the surrounding area. During the activity, teachers distribute exploration sheets containing specific tasks, such as grouping three types of leaves based on their shape and describing moist and dry soil conditions. Based on their observations, students move from one point to another while carrying writing utensils and discussing in groups. This is also reflected in the results of interviews with science teachers at Kamunti Elementary School , as shown below .

" We organize nature exploration activities so that students can learn actively and observe objects directly, rather than just listening to explanations. Through these activities, students become more engaged because they are not just sitting in class – they are actively involved in the learning process. They can observe, touch, and discover new things around them. I have noticed that students understand the material more easily when they experience it themselves. Furthermore, these activities encourage teamwork among students in groups and foster a strong sense of curiosity. Learning becomes more fun, less boring, and students seem more enthusiastic to participate in each stage of the activities we design. "

These activities demonstrate the teacher's ability to organize outdoor learning in a systematic and focused manner. The teacher's creativity is evident in how they transform nature exploration activities into challenging and fun games. The teacher establishes game rules, such as time limits, point systems, and additional challenges at each station, motivating students to complete tasks quickly and accurately. One game used was a treasure hunt on a nature trail, where students had to find specific objects such as dry leaves, small stones, or insects and then describe their characteristics. Observations showed that students jogged around, searching for objects, and discussing among themselves to ensure their answers were correct. This approach demonstrated a lively learning environment, with students collaborating and presenting their findings to the teacher. The teacher also provided immediate feedback by correcting students' observations and offering contextual explanations, allowing students to refine their understanding directly in the field.



Figure 2. Nature Exploration Activities

Teachers conducted reflection and conceptual reinforcement after the nature exploration activities to ensure that students' learning experiences were meaningful. Teachers gathered students and asked each group to present their findings and explain the relationship between the objects observed and the science curriculum. Field notes indicated that most students were able to explain their exploration findings by referring to their recent direct experiences. Teachers then documented students'

progress in the areas of observation, classification, and environmental awareness. Thus, the implementation of the Outdoor Exploration Game, which was systematic, interactive, and based on real-world experiences, has significantly contributed to fostering students' naturalist intelligence through active, enjoyable, and meaningful activities.

5. Using Recycled Materials as Innovative Teaching Aids

Teachers at Kamunti Elementary School in a way systematic utilise Recycled materials serve as innovative teaching aids in play-based science education. Teachers actively collect, sort, and prepare various materials, including plastic bottles, cans, cardboard, and other used containers, for use in learning activities. During the learning process, teachers guide students in transforming these recycled materials into educational props, such as making plant pots from plastic bottles and mini ecosystems from cardboard. Teachers provide clear operational instructions, including cutting, assembling, filling with planting media, and observing changes in the plants. Based on observations, students enthusiastically follow each step of the process and collaborate within their groups. Field notes show that teachers demonstrate how to cut bottles and ask students to take turns imitating the steps. This activity demonstrates that teachers not only teach science concepts but also instill values creativity and environmental awareness through hands-on practice.

The teacher's creativity was evident in her ability to integrate activities using recycled materials into challenging and fun educational games. The teacher designed a potting mix contest, where each group of students was asked to create the most creative plant pots from recycled materials, then plant and care for them. The teacher established clear evaluation criteria: neatness, functionality, and successful plant growth. This activity was highly beneficial because, in addition to fostering creativity, it also taught students to care about waste. The teacher also guided students to observe the growth of the plants they had planted, record changes, and compare results across groups. Thus, this activity was not only creative but also directly developed students' observational and analytical skills.

The teacher reinforced the concepts through activity-based reflection and evaluation after the activity was completed. The teacher asked students to present their work and explain the process of making and the benefits of using recycled materials. The teacher noted that most students were able to explain the relationship between growing media and plant growth based on their experiences. The teacher also documented students' progress in creativity, collaboration, and environmental awareness in the assessment book. Thus, the use of recycled materials as an innovative learning medium has provided a real-life learning experience, increased student engagement, and effectively fostered naturalist intelligence through meaningful and sustainable activities.

6. Project-Based Role Play Activities

Teachers at Kamunti Elementary School systematically developed project-based role-play activities in their Integrated Science, Technology, and Environmental Studies (IPAS) lessons using play-based learning methods. Teachers designed learning scenarios that addressed environmental issues in the surrounding village, such as waste management, school garden maintenance, and the wise use of natural resources. In practice, students were divided into groups and assigned specific roles, including farmers, environmental guards, nature observers, and environmental condition reporters. Teachers provided clear operational instructions, such as explaining the duties of each role, simulating actions, and recording observations. Students acted out their roles using simple props, such as paper hats, notebooks, and natural objects found around the school. Field notes showed that teachers guided students in simulating environmental cleanliness by picking up trash and sorting it by type. This is evident in the following interview excerpt.

“ I want children to learn by experiencing their role in protecting nature firsthand, not just by listening to theory. By being directly involved, they can understand that protecting the environment isn't just a concept, but a concrete action they can take every day. I've noticed that when they're given specific roles – such as being a cleaning supervisor or a nature observer – they take their responsibilities more seriously. They also remember what they've learned more easily because they're experiencing it firsthand. Furthermore, these activities make students more active, collaborative, and supportive of each other in protecting the environment. I believe this approach is more effective because the learning becomes lively, meaningful, and truly felt by the students. ”

This activity demonstrates the teacher's ability to creatively and purposefully connect learning to students' real-life contexts. The teacher's creativity is evident in their ability to transform role-playing into a locally based collaborative project focused on solving environmental problems. The teacher challenged students to complete a "clean environment" mission, where each group had to identify environmental issues around the school and propose simple solutions through the roles they played. Observations revealed that students discussed strategies such as how to reduce plastic waste or keep the schoolyard clean. This was also evident in field notes, which showed that students enthusiastically carried out their respective roles while interacting directly with their surroundings. This activity is excellent because it instills a sense of environmental responsibility in students from an early age. The teacher also gave students the opportunity to present their project results to the class, explaining the roles they played and their impact on the environment. This allows students not only to play but also to learn critical thinking and responsibility towards nature.

Teachers conducted learning reflections to strengthen students' understanding of the values of naturalist intelligence gained from local project-based role-play activities. Teachers guided students to describe their experiences during the role-play and relate them to their daily lives. Observations showed that teachers asked reflective questions, such as "What would you do if you saw a dirty environment in your home?" This was done to encourage students to think more deeply. Field notes showed that most students were able to explain the importance of environmental conservation based on their role-play experiences. Teachers also documented students' progress in terms of care, cooperation, and responsibility in the assessment book. Therefore, local project-based role-play activities, which were carried out systematically, contextually, and fun, have provided meaningful learning experiences and effectively fostered students' naturalist intelligence at SDN Kamunti.

Discussion

The research findings described above show that teachers' creativity in implementing science teaching through game-based learning at SDN Kamunti is in line with constructivism theory, which emphasizes that knowledge is built through direct experience. (Abdurrahman, 2024). Activities such as environmental exploration, mini-experiments, and educational games reflect the view that students learn actively through interactions with real objects. This is also consistent with cognitive development theory, which states that elementary school-aged children are in the concrete operational stage and therefore require real-world experiences to understand abstract concepts. (Handini & et al., 2023). Research findings also indicate that teachers not only deliver content but also design learning experiences that enable students to observe, classify, and draw conclusions independently. Compared with previous literature, this practice shares the same emphasis on student-centered learning activities. However, the difference lies in the use of the local environment as the primary source for more contextual learning (Sulaiman, 2024). Contribution of SDN Kamunti lies in optimization The surrounding environment acts as a natural laboratory. The success of this approach stems from the direct involvement of students, which makes learning more meaningful and easier to understand.

Integrating the local wisdom of "ngaha" aina The integration of the concept of "ngoho" into science learning shows a connection with culturally responsive teaching (Kusdarini & Irawan, 2021). This theory emphasizes the importance of connecting learning with local cultural values, norms, and practices to make it more relevant to students. Teachers at SDN Kamunti successfully implemented these values through role-playing activities, environmental exploration, and reflection, so that students not only understand scientific concepts but also internalize moral values. Compared to previous research, many studies emphasize the importance of cultural integration, but have not specifically combined it with play-based learning methods. (Ardila et al.,

2024) . This is where the uniqueness of this finding lies: the synergy between educational games and local values that shape students' character. The context of SDN Kamunti makes a significant contribution because local culture remains strong and is an integral part of students' daily lives. The success of this approach stems from the fact that students feel connected to the material they are learning, making it easier for them to understand and apply it (Rohman, 2024) . Furthermore, learning becomes more meaningful because it focuses not only on cognitive aspects but also on affective and psychomotor aspects in an integrated manner.

Findings related to the use of educational game-based mini-experiments can also be linked to the inquiry-based science learning theory (Trianto, 2019) . This theory emphasizes that students must engage in the inquiry process to develop scientific understanding. Teachers at Kamunti Elementary School have implemented this principle through simple experiments designed as games, encouraging students to ask questions, experiment, and find their own answers. Compared with previous research, this approach shares similarities in the use of experiments as a learning tool (Solikati, 2021) . The main difference lies in the way the experiments are presented as competitive games, which increases student motivation. The school environment, which uses simple materials from the surrounding environment, is another distinct advantage, as it demonstrates that science learning does not have to rely on modern laboratory facilities. The success of this method stems from students' active involvement in the learning process, which allows them to gain a deep understanding of the concepts (Sukma et al., 2024) .

The implementation of Outdoor Exploration Games demonstrates a connection with contextual teaching and learning theory, which emphasizes the relationship between academic content and real-life situations (Simatupang, 2019) . In this activity, students learn directly in their surroundings, so the concepts they learn become more relevant and easier to understand. Compared to previous research, outdoor learning activities have indeed been widely implemented, but generally have not been systematically organized into structured games as has been done at SDN Kamunti. This shows an innovative approach to integrating games with environmental exploration (Raden Vina Iskandya Putri1, 2023) . The contribution of the local context is crucial, because the school environment is rich in learning resources that allow these activities to be carried out effectively. The success of this method stems from the fact that students learn through direct experiences that involve their senses, physical movements, and social interactions.

The use of recycled materials and project-based role-playing activities demonstrates a connection with creative and collaborative learning theories. These theories emphasize that learning should encourage students to be creative, collaborate, and solve real-world problems (Trianto, 2019) . Teachers at Kamunti Elementary School have successfully implemented this principle through activities that actively

engage students in creating products and solving environmental problems. Compared with previous literature, this practice shares similarities in the use of projects as a learning method. However, the difference lies in the integration of projects, games, and local contexts, which makes learning more holistic (Abdurrahman, 2024) . The success of play-based learning methods in this context is due to the combination of teacher creativity, student engagement, and the relevance of the material to everyday life (Sagita & Ikashaum, 2023) . Thus, learning not only fosters conceptual understanding but also develops students' environmental awareness and naturalist intelligence in a sustainable manner.

Conclusion

Based on the explanation above, this study shows that the implementation of science learning through play-based learning at SDN Kamunti is effective because it is supported by teacher creativity in designing contextual, active, and enjoyable learning experiences. Teacher creativity is a key factor in creating active, contextual, and enjoyable learning. Teacher creativity is evident in how they transform nature exploration activities into challenging and enjoyable learning resources. Teachers not only act as content deliverers but also as facilitators who integrate the natural environment, the local wisdom of the Ngaha Aina Ngoho community, and various game-based activities such as exploration, mini-experiments, outdoor exploration games, the use of recycled materials, and project-based role-playing. The results of this study indicate that students are more enthusiastic about participating in learning because they are directly involved in the learning process. Students not only receive theoretical material but also gain real-world experience through interaction with their surroundings. This has an impact on improving students' abilities to observe, classify, analyze, and understand natural phenomena.

Based on the research discussion, *the play-based learning method* has a positive impact on the development of students' critical thinking skills, creativity, cooperation, and environmental awareness. Game-based learning is able to create a more interactive learning atmosphere and reduce student boredom during the learning process. In addition, the integrity of the local wisdom of Ngaha Aina Ngoho helps students understand the importance of protecting the environment through learning experiences close to everyday life. The findings and discussion of this study also show that this approach is able to increase student engagement, strengthen conceptual understanding of science and science, and significantly foster naturalist intelligence through direct and reflective experiences. Theoretically, these findings confirm that the game-based learning method combined with a contextual, inquiry-based, and locally rooted approach produces more optimal results compared to conventional learning.

The main contribution of this study lies in strengthening the science and natural sciences learning model, which systematically integrates educational games with environmental resources and local values. Furthermore, this study enriches research on the implementation of play-based learning in elementary schools, particularly in areas where environmental and cultural resources are still preserved. The practical implication of this study is that teachers can utilize the surrounding environment as a primary learning resource without relying on complex facilities. Teachers are also encouraged to continue developing creativity in designing meaningful play activities and integrating local values into learning. For schools, these findings serve as a basis for supporting innovative learning policies rooted in the environment and culture. Schools are also expected to be able to support innovative learning policies based on the environment and local culture to improve the quality of science and natural sciences learning and to shape the character of students who are creative, independent, and concerned about environmental sustainability. Thus, the implementation of play-based learning not only improves the quality of science and natural sciences learning but also fosters student character – making them environmentally conscious, creative, and capable of independent learning in everyday life.

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