Culture Adventure Games: Exploring Natural Science through Local Wisdom

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Article Info	Abstract
	The purpose of this study is to develop a natural science learning game oriented towards local Papuan culture for grade IV elementary school students that is feasible and effective. This research uses a qualitative approach with R&D (Research and Development) research methods with the Lee & Owen development model. The results of the formative evaluation showed an average feasibility test of material experts, learning design experts, and media experts of 3.94 with good conclusions, one-to-one evaluations with students obtaining an average of 3.05 with good conclusions, small group evaluations obtaining an average of 3.43 with very good conclusions, and field trial evaluations obtained an average score of 3.61 with a very good conclusion, so it was concluded that the science learning game oriented towards local Papuan culture for grade IV elementary school students was very good. Test the effectiveness of science learning game development oriented to local Papuan culture, tested through a t-test. The results show a Sig. (2-tailed) value of 0.000 < 0.05, so there is a significant difference between science learning outcomes in pretest and posttest data, and it can be concluded that science learning games oriented towards local Papuan culture are effective in improving the learning outcomes of grade IV elementary school students.

One of the subjects given to elementary school students in Indonesia is natural science. Natural science is defined literally as the study of natural phenomena (Tillery et al., 2007). Positing that science is an approach to contemplating and understanding the world that surrounds us. While (Glencoe, 2008). It suggests that science is a method or procedure used to see the world around us to find potential answers to questions we have. The following opinion is expressed by (Trianto, 2007) that natural science is a methodical investigation of nature. In line with the above opinion, (Kumala, 2016) suggests that natural science is a science that examines all events that occur in nature, including living things

and inanimate objects. Based on some of the above opinions, it can be concluded that natural science is a branch of knowledge that aims to explore, analyze, and understand all events that occur in nature in order to provide potential answers to questions that arise.

Learning science in elementary school is very important because students' initial knowledge greatly influences their interest and tendency to learn science at a higher level (Widiana, 2016). Science learning should encourage the development of students' skills and their capacity to build their concepts. As a means for students to understand

science more contextually and apply it in everyday life, science learning is also expected to be the main foundation of education (Irsan, 2021). Science learning in elementary schools places a strong emphasis on using hands-on experience through the development of scientific processes and mindsets. Scientific ideas and concepts are used in everyday life to help students understand what they have learned and help them apply it to other areas of their daily lives (Donna Safira et al., 2021). In particular, the objectives of science learning in elementary schools according to (Darmodjo & Kaligis, 1993) are: 1) increasing students' understanding of the surrounding nature; 2) develop students' science process skills; 3) develop a scientific attitude and problem-solving abilities, as well as a belief in the greatness of the Creator; 4) impart basic knowledge to students so that they can proceed to higher education.

In an effort to maximize the objectives of science learning in elementary school students, of course, it must be supported by the use of all resources such as learning media so that learning objectives can be achieved effectively and efficiently. One of the interesting learning media that can motivate students to be actively involved in the learning process is educational games. Educational games can be defined as a game system specifically designed to develop an understanding of concepts about certain learning materials by involving active and fun communication or reciprocal relationships between students and the game itself. The nature of games that are interesting and can be fun is the impetus for developing games that can be used in learning activities. The use of games certainly has a very important role (Vanbecelaere et al., 2019). Duh, Koceska, and Koceski (2017) said that digital game-based learning is a way to connect the learning process with new learning technologies. Science learning using technology, such as visual technology, will be more successful than traditional learning (Utami et al., 2021). As for the advantages of using the game, according to Alessi and Trollip (2001) That is, games can develop learning motivation in students, encourage students to learn, and create a fun learning atmosphere. While Henry (2010) Stating the positive impact of using learning games for children including (1) children can get to know technology; (2) train children in following rules; (3) develop problem-solving and logic skills; (4) develop motor and spatial abilities; (5) can create familiarity between children and parents, (6) provide knowledge to students about technology and its features, (7) become a means of healing for certain patients; and (8) entertaining and fun.

The explanation above shows that the use of media

such as educational games is very important to support the achievement of learning objectives effectively and efficiently, but based on the results of preliminary research conducted in 3 schools in Abepura District, Jayapura City shows that science learning outcomes of grade IV elementary school students are still low. At SDN Inpres Hedam Abepura, the average science learning outcomes in the 2019/2020 school year were 47, the 2020/2021 school year was 54, and the 2021/2022 school year was 50, from the stipulated KKM, which was 60. Furthermore, at SDN 1 Abepura, student learning outcomes for the 2019/2020 school year were 55, the 2020/2021 school year was 60, and the 2021/2022 school year was 58, from the designated KKM, which was 65 classically. As for SD Negeri 3 Abepura, student learning outcomes for the 2019/2020 school year are 50, student learning outcomes for the 2020/2021 school year are 46, and the 2021/2022 school year are 48, from the KKM set at 60 classically.

The low results of science learning are caused by the limited use of media, where the media used in schools still uses images printed by teachers themselves with limited/small sizes. Teacher exploration of The use of interesting media and can stimulate student activity in learning. Learning is also still limited, and learning content has not been oriented to material that is close to the student's environment, which causes a lack of student interest and interaction with learning, so student learning outcomes are still low. This shows that it is necessary to develop interesting learning media, and can motivate students in learning. The results of other preliminary research show that since the COVID-19 pandemic, students in Abepura District, Jayapura City, have begun to have an interest in technological developments through the use of *Smartphones*.

Students have a tendency to play games on *Smartphones*. That's even though their abilities are still limited to games that are still simple. This is the basis for the development of science learning games. Furthermore, researchers integrate local culture into the development of science learning games. Remember the importance of preserving local culture or the value of local wisdom. One of the efforts to continue to preserve these local cultural elements is to transmit them to the next generation (students) through education. The integration of local culture into science learning has a positive impact on student development. This is in accordance with opinion Vygotsky (Roblyer, 2016), that the development of a student can be supported by social and cultural activities. By organizing students' social interaction experiences in their cultural settings, students' mentality will mature. Thus, researchers conducted this study with the aim of developing a feasible and

effective Papuan culture-oriented science learning game.

This research is different from previous studies because this research focuses on developing science learning games oriented to local Papuan culture for grade IV elementary school students. Science learning games oriented towards local Papuan culture are a value of innovation in this research, because there have been many previous studies that have developed educational games, but no one has integrated elements of local Papuan culture into the educational games developed. Local cultural elements integrated in this research are local knowledge *systems,* living equipment systems, and technology, and art. The local knowledge system is related to aspects of Papua's natural resources, both in the form of sea, forest, river/lake, and mining products. These natural resources are in the form of endemic plants and animals in Papua.

Furthermore, the living equipment system and technology of the Papuan people are related to productive tools or livelihoods such as arrows, noken, typical foods such as papeda, traditional clothing such as koteka and tassel skirts, as well as Papuan traditional shelters/houses called honai. While the art system integrated in science learning includes tifa musical instruments, tassel skirts, and cassowary crowns. The integration of local culture is an innovative value for the implementation and development of educational technology, to facilitate learning and improve performance. This research provides added value because it has facilitated the availability of interesting learning media, oriented to elements of local Papuan culture; easy to use because it is tailored to the abilities and characteristics of students; facilitate the availability of learning resources; and improving student learning outcomes in science subjects, especially in KD 3.7, namely describing the relationship between natural resources and the environment, technology, and society effectively and efficiently.

1. Method

1.1 Research Design

This research uses a qualitative approach with R&D (*Research and Development*) research methods. The development model used is the Lee & Owen model, which consists of several steps, namely: 1) Assessment / Analysis, consisting of needs analysis and initial and final capability analysis; 2) Design; 3) *Development; 4)* Implementation; *and* 5*)* Evaluation. The use of the Lee & Owen model in the development of educational games because it has detailed and

appropriate steps used in developing learning (multimedia) media. The research was conducted in Abepura District, Jayapura City with the subject of the study being grade IV elementary school students.

1.2 Sampling

Participants will be selected from Grade IV Elementary Schools in Papua City, ensuring diverse representation of various age groups of grade 4 elementary school children and gender. Aiming to obtain a sample of 29 participants to ensure statistical significance.

1.3 Data Collection

Data collection techniques in this study are: 1) At the needs analysis stage, conducted through interviews and observations; 2) At the product feasibility stage, it is carried out through expert validation using evaluation sheets and responses; 3) In the one-to-one and small group trial phase, data collection is carried out through observation and response; and 4) In the field trial stage, data collection is carried out through pre-test and post-test as well as student responses.

1.4 Data Analysis

Data analysis is carried out quantitatively by describing the development steps carried out and the data obtained through interviews, observations, and other materials systematically. Game feasibility analysis was conducted on the average results of expert validity tests, one-on-one trials with students, small group trials, and field trials. To test the effectiveness of science learning games oriented to local Papuan culture, a t-test was carried out using the SPSS application version 20.

2. Results and Discussion

2.1 Finding Need Analysis

This stage is divided into 2, namely needs analysis and initial and final capability analysis. The results of the needs analysis provide an overview of the science learning process that has been carried out, including: 1) the use of media is still limited, where the media used in schools still uses images printed by the teacher himself with a limited/small size; 2) teacher exploration of the use of interesting media and can stimulate student activeness in learning learning is also still limited; and 3) the learning content has not been oriented to material that is close to the student's environment. In addition, it was also found that since the COVID-19 pandemic, students in Abepura District, Jayapura City have begun to have an interest in technological developments through the use of *smartphones.* Students have a tendency to play games

through these *smartphones*, even though their abilities are still limited to simple games. The results of interviews with teachers and principals provide input to develop science learning games while considering the importance of preserving local culture or the value of local wisdom, so the researcher concluded that the need is the development of science learning games oriented to local Papuan culture for elementary school students.

After knowing the development needs, the researchers then conducted an initial and final ability analysis with the following results: 1) the results of student analysis showed that the science learning outcomes of grade IV elementary school students were still low, because the media used by teachers was less attractive. In addition, students are also less motivated in learning and their involvement in learning is very limited because teachers dominate learning through the lecture method; 2) the results of technology analysis show that all parents of students already have smartphone devices that students can use in learning; 3) the results of the situation analysis show that the situation and conditions of the school can support the implementation of safe and enjoyable learning for students; 4) the results of the task analysis show that the competencies that students want to achieve through the development of science learning games are related to basic competencies 3.7, namely describing the relationship between natural resources and the environment, technology, and society; 5) The results of the analysis of important events show that students already have preliminary knowledge about natural resources in the surrounding environment. This describes the initial competencies possessed by students and competencies that must develop; 6) the results of the goal analysis produce the formulation of goals as the basis for the competencies to be achieved by students; 7) the results of the problem analysis produce the conclusion that to solve learning problems, interesting learning media are needed; 8) the results of media analysis show that the media that must be developed is a science learning game oriented towards local Papuan culture; and 9) the results of the cost analysis show that making science learning games is still affordable for researchers, so that development can be carried out.

2.2 Design

Science learning games oriented to local culture are designed by referring to the curriculum used by the school. After knowing the school curriculum, researchers analyze the syllabus and lesson implementation plans available to determine basic competencies and learning topics. The basic competencies developed through this development

research are basic competencies 3.7, namely describing the relationship between natural resources and the environment, technology, and society. The material included in the game is oriented to 3 elements of Papuan local culture, namely local knowledge *systems,* living equipment and technology systems, and art. The local knowledge system is related to aspects of Papua's natural resources, both in the form of sea, forest, river/lake, and mining products. These natural resources are in the form of endemic plants and animals in Papua. Furthermore, the living equipment system and technology of the Papuan people are related to productive tools or livelihoods such as arrows, noken, typical foods such as papeda, traditional clothing such as koteka and tassel skirts, as well as Papuan traditional shelters/houses called honai. While the art system integrated in science learning includes tifa musical instruments, tassel skirts, and cassowary crowns. At this stage, researchers make *storyboard* games by dividing learning materials into 4 game menus, namely guessing SDA, playing puzzles, playing booms, and playing boxes.

2.3 Development

In this stage, an outline of the content of learning media/games is developed. The material developed in the storyboard game is oriented to 3 elements of local Papuan culture so that it is close to students' daily lives. In this stage, the game is developed using the Unity 3D application to be played using a smartphone device. The results of the development of science learning games oriented to local Papuan culture for elementary school students as in Figure 1.

Figure 1. Game main Display

Figure 1 shows the main view of the game that has been developed. The background of the game is in the form of hills and trees that grow around it and there is

Figure 2 Nenu Display

The game consists of 4 game menus, namely Guess SDA, Play Puzzle, Play Boom, and Play Box. To see the display of the game menu "Guess the SDA" can be seen in Figure 3.

Figure 3. "Guess SDA" Game Menu Display

Students can choose one of the answers according to the question that arises. This is done until the "Guess the SDA" game menu is finished. Furthermore, the display of the game menu "Playing Puzzle" can be seen in Figure 4.
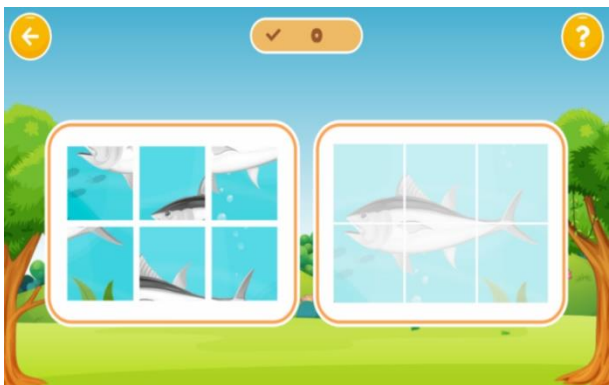
Figure 4. "Playing Puzzle" Game Menu Display

In this puzzle game, students are asked to play the game by rearranging the puzzle pieces into a whole shape, as in the picture on the right. The next game menu is "Play Boom". The menu display of this game can be seen in Figure 5.
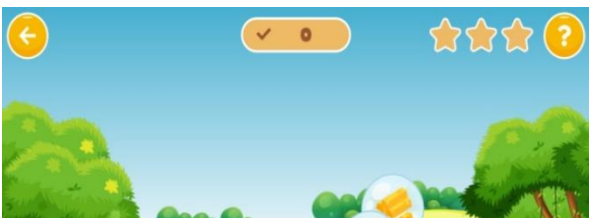
Figure 5. "Playing Boom" Game Menu Display

In this boom game, students are asked to suppress all natural resources and natural damage that appears over time and accelerates, and try not to press the boom. Next is the "Play Box" game menu. The appearance of this game menu can be seen in Figure 6.
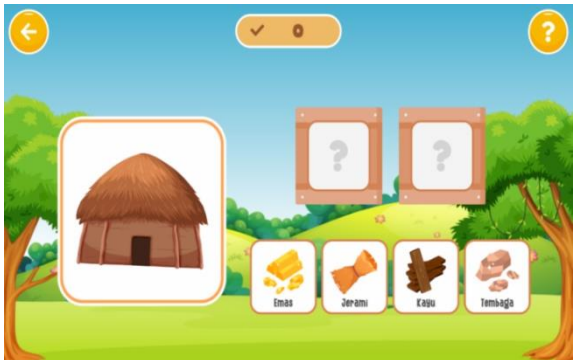
Figure 6. Game Menu Display "Play Box"

In this game, students will be asked to enter the elements forming objects displayed in the game.

3.4 Implementation

Before implementing the development results, researchers first conduct *expert judgment* to material experts, instructional design, and media, so that the learning game is declared suitable for use in learning.

The results of expert assessments of learning games developed can be seen in Table 1.

Table 1: Average Results of Expert Evaluation

Expert	Assessment Results
Material	4.10
Learning Design	3.79
Media	3.92
Average	3.94

Based on the data in Table 1, the average value of expert evaluation was 3.94, with good conclusions. Thus, science learning games oriented towards local Papuan culture are worth using. In addition to expert evaluations, researchers also conducted one-to-one evaluations with 3 students, small group evaluations, and field trials. The provision of categories in the three evaluation results refers to the basis of Widyoko's (2019) evaluation, which is modified according to the needs of researchers. The basis for the evaluation is in Table 2.

Table 2: Score Average Assessment Criteria

Average Score	Classification
>3.4	Exeecllent
>2.6-3.4	Good
>1.8-2.6	Less
<1.8	Very Lacking

The results of the one-to-one evaluation with 3 students can be seen in Table 3.

Table 3: One-to-one Evaluation Results

Participants	Score
Particitpant-01	3.53
Particitpant-02	2.63
Particitpant-03	3
Average	3.05

Based on the results of one-on-one evaluations with 3 students in Table 3, an average one-to-one *evaluation result of* 3.05 was obtained, so it was concluded that science learning games oriented to local Papuan culture were in the good category.

Furthermore, a small group *evaluation was carried out* with 8 students, the results of which can be seen in Table 4.

Table 4: Small Group Evaluation Results

Participants	Score
Particitpant-01	2.84
Particitpant-02	3.63
Particitpant-03	3.58
Particitpant-04	3.31
Particitpant-05	3.42
Particitpant-06	3.37
Particitpant-07	3.63
Particitpant-08	3.68
Average	3.43

Based on the results of the data processing carried out, the average evaluation results of the small group were 3.43, so it was concluded that the science learning game oriented to local Papuan culture was in the very good category.

The next stage, carried out after the evaluation of the small group, is a field trial. This trial was carried out on 15 students by applying science learning games oriented to local Papuan culture. Before this field trial, students were first given a *pre-test* to find out the results of students' science learning before using science learning games oriented to local Papuan culture. Furthermore, after learning is complete, students are given post-tests and questionnaires as a form of evaluation of the learning game they have just used. The results of the field trial evaluation as in Table 5.

Table 4: Small Group Evaluation Results

Participants	Score
Particitpant-01	3.68
Particitpant-02	3.68
Particitpant-03	3.68
Particitpant-04	3.68
Particitpant-05	3.63
Particitpant-06	3.63
Particitpant-07	3.74
Particitpant-08	3.69
Particitpant-09	3.58
Particitpant-10	3.63
Particitpant-11	3.47
Particitpant-12	3.79
Particitpant-13	3.21
Particitpant-14	3.37
Particitpant-15	3.69
Average	3.61

Based on the results of the data processing carried out, an average *field trial evaluation result of* 3.61 was obtained, so it was concluded that the application of the game-based science learning model oriented to local Papuan culture and product assessment was in the very good category.

3.5 Evaluation

In the last stage of developing this Papuan local culture-oriented science learning game, an evaluation or revision was carried out on the results of expert evaluation, one-to-one evaluation, small group evaluation, and field trial evaluation, so as to produce

the final product. The effectiveness of the local culture-oriented science learning game was tested using a t-test against pretest and posttest results. The results of the t-test can be seen in Table 6.

Table 6: Results of the t-test

		Mean	Std. Dev.	df	Sig. (2-tailed)
Pair1	Pre and Post-test	-33.00	7.745	14	0.000

The results of the t-test contained in table 6, show that the value of Sig. (2-tailed) or the probability value of the p-value of *the* Paired T test is 0.000 < 0.05 (with a confidence level of 95%), so there is a significant difference between science learning outcomes in *pretest* and *posttest data*. For the mean value of -33.00000, it is negative, which means that there is a tendency to increase the posttest score after treatment. As for the average increase of 33, it can be concluded that science learning games oriented towards local Papuan culture are effective in improving science learning outcomes for grade IV elementary school students.

Research on the development of science learning games oriented towards local Papuan culture for elementary school students was carried out using the development model from Lee & Owen. The steps of such a model consist of: 1) Assessment / Analysis consisting of needs analysis and Initial and Final Capability Analysis; 2) Design *(Design)*; 3) Development *(Development)*; 4) Implementation *(implementation)*; and 5) Evaluation *(evaluation).* Researchers using Lee and Owen's model to develop science learning games oriented towards local Papuan culture by considering the suitability of the model with the product to be developed. This is in line with (Akbar, 2016) which states that the Lee & Owen model is specifically used to develop educational products in multimedia form. In developing this science learning game oriented to local Papuan culture, of course, pay attention to factors that can have an impact on the science learning climate. These factors include: 1) internal teacher enthusiasm, overall student development efforts; 2) The social aspect of teaching; 3) relationship with authority; and 4) the existence and adherence to the rules (Grecmanová et al., 2020).

This science learning game oriented towards local Papuan culture was developed based on needs analysis based on various theories and by paying attention to methodological aspects. The development of learning games in this study was supported by (Rusmono et al., 2020) which suggests that digital media is effective in improving learning outcomes. The opinion is corroborated (Carson et al., 2018) Through the results of his research that digital media is effective in improving student learning outcomes and skills.

To test the feasibility of the product, expert evaluations are carried out with experts in material, learning design, and media; one-on-one evaluations with students*; small group* evaluations; and *field trials*. The overall evaluation results state that science learning games oriented towards local Papuan culture are worth using.

Furthermore, to test the effectiveness of the resulting game, a t-test is performed. The t-test results show that the value of Sig. (2-tailed) is 0.000 < 0.05, then there is a significant difference between the results of learning science in the data *Pretest* and *posttest*. Thus, it can be concluded that science learning games oriented towards local Papuan culture are effectively used in learning. This finding is in accordance with the results of research conducted by (Cotič et al., 2020) which suggests that MNSL model *(The Mobile Natural Science Learning)*, effective for educating students and achieving good learning outcomes. The MNSL model has a positive effect on student achievement in science learning. The same findings are put forward by (Partovi &; Razavi, 2019) that computer educational games have an impact on the motivation of academic achievement of elementary school students. In addition to science learning outcomes, the use of game-based learning oriented to local Papuan culture also motivates students in learning. Next (Sung & Hwang, 2013) found that collaborative game-based learning approaches can improve student achievement, learning attitudes and motivation, and self-efficacy. The above findings show that the use of game-based learning models in learning not only improves the cognitive aspects of students, but can also improve affective aspects and skills. This is in accordance with the findings (Pratama &; Setyaningrum, 2018) which suggests that students who participate in game-based learning have a positive effect on their cognitive and affective aspects. (Hwang et al., 2013) Gives reinforcement that computer games not only improve students' learning attitudes, but also improve their learning achievement. The use of games in science learning is also an effort to habituate students in using technology. This is in accordance with the findings (Rakimahwati &; Ardi, 2019) that interactive games can improve students' digital literacy skills. Moreover (Huang et al., 2020) positing that collaborative learning approaches are related to *Mobile Learning* more effective than personalized learning. The presence of learning media such as educational games can also guide students in independent learning (Bada & Olusegun, 2015).

Science learning games oriented to local Papuan culture that have been developed, certainly have strengths and weaknesses. Its strengths are: 1) the learning games developed facilitate student engagement/activeness in learning; 2) the learning games used are interesting and interactive; 3) the material contained in the learning game is oriented to elements of local Papuan culture so that it is close to the student's environment; 4) the game's navigation buttons are adjusted to the abilities of grade IV elementary school students in Abepura District making it easier to explore the game; 5) can use a smartphone device with standard specifications to

run the game; and 6) learning games can be run properly. *offline.* The above advantages are in accordance with the findings (Chen et al., 2019) That said, quiz-based interactive game play becomes an innovative and fun resource for students to learn. Students are highly interactive and have the convenience of learning to use *Smartphones* they. In another section, (Fitriyana et al., 2020) suggests that *Blended Learning* And the use of Android-based games can increase success in learning and self-efficacy of students. For students who have high anxiety, Digital game-based learning is also very beneficial for changes in their learning performance (Yang et al., 2018).

The results of this research have the following implications: 1) the results of research and development provide benefits for the development of science. The presence of science learning games oriented towards local Papuan culture is a new reference for teachers to be able to develop the learning process carried out for grade IV elementary school students; 2) the feasibility of science learning games oriented to local Papuan culture has a positive impact to be applied in science learning for grade IV elementary school students, because this game can provide real and fun experiences for students; 3) the effectiveness of local Papuan culture-oriented science learning games for elementary school students is the foundation for every teacher to be able to solve science learning problems in their respective schools through efforts to improve science learning outcomes, especially for grade IV elementary school students.

3. CONCLUSION

Based on the results of research and discussion, it can be concluded that: 1) research and development was carried out using the Lee & Owen model, which produced a science learning game oriented to local Papuan culture for grade IV elementary school students; 2) the science learning game oriented to local Papuan culture developed is declared suitable for use in learning; and 3) science learning games oriented towards local Papuan culture are effective in improving the learning outcomes of grade IV elementary school students. This research shows that the use of games as a learning tool is effective in teaching natural science with an approach based on local wisdom. Games can motivate students to learn and increase their understanding of the natural surroundings.

This research underscores the importance of incorporating elements of local wisdom and culture in natural science learning. This can help students develop respect for their traditions and environment. Cultural adventure games can increase student engagement in learning. Students tend to be more active and participate with enthusiasm in game-centered learning. This research shows that a local wisdom-based approach can help students understand natural science holistically. They not only learn facts, but also incorporate cultural and environmental

aspects into their understanding. The results showed a positive impact on students' understanding and knowledge of natural sciences. Game-based learning and local wisdom can improve the quality of education in the field of natural sciences.

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