



Development of a Game-Based Science Learning Model Oriented to Papuan Local Culture for Grade IV Elementary School Students

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Abstract

The aim of this research is to develop a game-based science learning model oriented to local Papuan culture for fourth grade elementary school students that is feasible and effective. This game-based learning model is oriented towards 3 elements of local Papuan culture, namely elements of local knowledge related to aspects of Papua's natural resources; elements of living equipment and technology related to productive tools related to Papuan livelihoods, including arrows, noken, typical Papuan food; and elements of Papuan art which include Papuan musical instruments and artistic clothing. This research uses a qualitative approach with the R&D (Research and Development) research method which collaborates 3 development models, namely the Borg & Gall first step model, the Dick & Carey model, and the Lee & Owen model. Data analysis was carried out through formative evaluation and effectiveness testing with the t test. The results of formative evaluations by material experts, learning design experts, and media experts are in the good category, face-to-face evaluations with students are in the good category, small group evaluations are in the very good category, and field trial evaluations are in the very good category. So it is concluded that the game-based science learning model oriented towards local Papuan culture for fourth grade elementary school students is very good. The effectiveness of the development of a game-based science learning model oriented towards local Papuan culture for fourth grade elementary school students was tested using the t test. The research results show that there is a significant difference between science learning outcomes in pretest and posttest data, so it can be concluded that the game-based science learning model oriented towards local Papuan culture is effective in improving the learning outcomes of fourth grade elementary school students.

Keywords:

local culture; game; natural sciences; learning model

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INTRODUCTION

One of the absolute requirements to develop human resources who have intellectual abilities, skills and have high competitiveness to answer all global challenges is education. To be able to support this development, strategies are needed that can increase student motivation and interactivity. Ideal learning implementation should no longer be teacher oriented but student oriented. Student-oriented learning is needed so that students are mentally involved in learning which ultimately leads to the achievement of learning objectives



effectively and efficiently. In addition to the application of appropriate learning strategies, human resource development efforts are also inseparable from all supporting resources including the results of very rapid technological developments. One of the results of technological developments in question is learning media such as educational games. (Hertati, Asrowi, & Ardianto, 2022) who put forward a concrete example of the use of technology in learning is the use of Android-based educational game media. (Solihatin et al., 2021) provide further explanation that comprehensive supporting elements in creating effective learning include media, teaching materials, evaluation tools, and other supporting tools. The use of media and learning resources in the teaching and learning process will produce a pattern of student interaction with learning resources (Ikawati, Purmadi, Anwar, & Zulfakar, 2018).

In practice, the presence of learning technology certainly cannot be separated from the existence of technological progress itself, so that the skills and creativity of learning technology developers are needed to be able to produce a product that has advantages. For this reason, teachers are required to have the competence to use all the tools both available at school and tools that are the result of the demands of the times. Teachers must have the ability to use and develop media, materials, and even learning models that are not yet available in their respective institutions. Therefore, to be able to support the above abilities, an adequate understanding of the use and development of learning media is needed. In addition, what must be considered is an understanding of learning strategies as stated by (Arum, Ibrahim, & Solihatin, 2020) that the utilization of appropriate learning strategies is very important to pay attention to. The learning strategy used must be able to foster attractiveness for students, so as to get high interest and attention from these students. In addition, educators who understand the importance of student involvement in learning, will be able to evaluate and modify learning models in an effort to maximize the learning process (Arum, Ibrahim, Solihatin, & Siang, 2020).

Referring to the initial findings obtained from 3 schools in Abepura District, it was found that the science learning outcomes of grade IV elementary school students were still low. At SDN Inpres Abepura, the average science learning outcomes in the 2019/2020 school year were 47, the 2020/2021 school year were 54 and the 2021/2022 school year were 50 from the set minimum completeness criteria of 60. Furthermore, at SDN 1 Abepura, student learning outcomes in the 2019/2020 school year were 55, the 2020/2021 school year were 60 and the 2021/2022 school year were 58 from the set minimum completeness criteria of 65 classically. As for SD Negeri 3 Abepura, student learning outcomes in the 2019/2020 school year amounted to 50, student learning outcomes in the 2020/2021 school year amounted to 46 and the 2021/2022 school year amounted to 48 of the set minimum completeness criteria of 60 classically. This fact is due to the fact that learning is still teacher centered, dominated by teacher explanations and students become listeners on their respective benches. Students become passive and their interaction with learning is limited. In addition, from the results of this preliminary study it can also be seen that the use of learning media is still limited.

The media used in schools still use pictures printed by the teacher himself with a small size; and there is still a lack of teacher exploration of the use of media that is interesting and can stimulate student activeness in learning, so that students are easily bored in participating in learning; learning content has not been oriented to material that is close to the student's environment, and teacher knowledge about media development is still limited. This is the basis for developing a game-based science learning model oriented to Papuan local culture to change the teacher centered learning paradigm to student centered.

This paradigm shift is in accordance with the opinion (Ndia, Solihatin, & Syahrial, 2020) which states that The basis for implementing the development of creative learning models is a shift in perspective on learning. The use of educational games is in accordance with Edgar Dale's cone of experience which illustrates that a person can remember 10% of what he reads, 20% of what he hears, 30% of what he sees, 50% of what he hears and sees, 70% of what is said and written, and 90% of what is done directly. The development of this game-based science learning model oriented to Papuan local culture attracts students' contribution and involvement in learning activities so as to achieve good learning outcomes.

The system of living equipment and technology relates to all matters relating to techniques or ways of producing, using, and maintaining existing living equipment such as productive tools, containers, weapons, food, shelter, clothing, fire tools, and transportation (Abidin & Saebani, 2014). Furthermore, the livelihood system is related to the efforts of people in their social environment to be able to maintain their lives, such as hunting and others. The material that will be included in this educational game is oriented to elements of Papuan local culture related to the knowledge system, living equipment system and technology, and art.

Local culture has an influence on the implementation of learning. (Suardana, 2014) suggests that students' prior knowledge is strongly influenced by local culture. A similar opinion was expressed by Vygotsky (Roblyer, 2016), who suggested that a student's development can be supported by social and cultural activities. This means that without social situations, student development will not be able to go well. Social situations can help students to think, communicate, and solve problems. By organizing students' social interaction experiences in their cultural setting, the child's mentality will be more mature.

According to (Mayasari, 2017) culture-oriented learning can strengthen identity, character, and mastery of concepts related to the culture. (Rohaeti, 2011) suggests that efforts to develop students' life skills so that they can adapt to the surrounding environment can be done by integrating cultural values into learning. The development of students' desire and drive to learn as a result of socio-cultural integration into the classroom can improve their learning outcomes in addition to helping them become more adaptable (Supriyadi, Haeruddin, & Nurjannah, 2016). This shows the importance of integrating local cultural elements in the learning that is implemented.

Teachers' ability to integrate culture into learning according to (Arends, 2008) is one component in dealing with cultural diversity. (Suardana & Retug, 2013) added that culture-oriented learning will increase students' curiosity. In

addition, culture-oriented learning can also increase students' involvement in learning through direct exploration to find answers and draw conclusions on these answers. In relation to science learning, integrating local cultural elements in learning can develop students' understanding, in addition to being a tool to preserve local culture (Kencanawaty & Irawan, 2017). The above explanation provides an understanding that local culture can have a positive influence on learning practices in schools.

Research on science learning has been conducted by previous researchers. Many of these studies focused on the development of teaching materials such as modules or e-modules, interactive videos, educational games, and instruments. In addition, in relation to educational games, most previous studies focused more on working memory development, English word recognition, motion recognition, digital literacy, math and science skills, reading and spelling, prevalence of interactive game use, and evaluation of digital learning games that recommended strengthening the content in the learning game. In terms of research subjects, most previous studies were directed at early childhood although there were also those that directed their research at elementary school students.

This research is different from the previous research that has been described because this research focuses on developing a game-based science learning model oriented to Papuan local culture for grade IV elementary school students. Game-based science learning model oriented to Papuan local culture is a novelty in this study, because there has been no research that develops game-based science learning models specifically oriented to Papuan local culture for grade IV elementary school students.

METHODS

This research uses an R&D (Research and Development) research design that combines 3 development models, namely: the initial stage model from Borg & Gall, the Dick & Carey model, and the Lee & Owen model for developing educational games. This research focuses on designing, developing and evaluating a game-based science learning model that focuses on local Papuan culture. The sample in this study consisted of 15 students taken using total sampling technique. The research instruments used in this research were: 1) at the needs analysis stage, using interview guidelines and observation sheets; 2) at the product feasibility stage using evaluation and response sheets; 3) at the one-on-one and small group testing stage, using observation and response sheets to assess the feasibility of the product being developed; and 4) at the field trial stage, observation sheets and student response sheets. Data analysis was carried out by describing the development steps taken and describing the data obtained through interviews, observations, and other material systematically, including steps for expert validity testing, one-on-one trials with students, small group trials, and testing. try the field. To test the effectiveness of developing a game-based science learning model oriented towards local Papuan culture, a t test was carried out using the SPSS version 20 application.

RESULTS & DISCUSSION

To find out the condition of science learning that has been running in elementary schools in Abepura District, researchers first conducted observations, interviews, and documentation in October-December 2022 and January 2023. The results of preliminary research show that science learning organized by teachers has not been effective, where student learning outcomes have not reached the established minimum completion criteria. This is because the applied science learning is still teacher centered where the teacher dominates by explaining the material in front of the class and students become listeners on their respective benches.

As a result, students become passive and their interaction with learning is limited. Referring to interviews with 3 grade IV elementary school teachers in Abepura District, data obtained that in learning science, teachers have not explored the use of media that is attractive to students. The media used by the teacher is still limited to images made (printed) by themselves with a limited size (small). The learning strategy applied by teachers is still conventional where teachers still dominate learning activities.

In addition, the teacher's knowledge about using and developing interesting media for students is still limited. Therefore, the teacher provided input so that the researcher can develop a learning model that is not boring, fun, motivating, and can activate students in the learning process. Furthermore, the results of interviews with school principals provide information on the determination and making of learning tools in science learning, fully left to the teacher while still considering the effectiveness and efficiency of learning. Although the media and strategies used by teachers have not been effective in improving student learning outcomes, according to the principal, learning can run smoothly.

In relation to the learning facilities owned by the school, teachers have not utilized them optimally. Based on some of these facts, the principal said that a learning model that can make students become active in learning is needed in order to support the achievement of the learning objectives set. The results of the preliminary research became the basis for researchers in formulating the need for innovative, fun, and student-centered learning development, so that a game-based science learning model oriented to Papuan local culture for grade IV elementary school students was developed.

To assess whether or not learning products are suitable for use in science learning, validation is carried out through formative evaluation with 3 experts (material, instructional design, and media), one to one evaluation with students, small group evaluation, and field trial. After conducting a formative evaluation of the three experts who have been determined, the evaluation results are as follows:

Table 1. Expert Evaluation Result

	Expert	Result
1	Material	4.105263
2	Leaning Design	3.789474
3	Media	3.921053
	Average	3.94

Based on the table above, the average result of Expert Evaluation is 3.94 with a good conclusion. Thus, the Papuan local culture-oriented science learning game is suitable for use in research. The evaluation given by the material, learning design, and media experts was improved by the researchers so that the following improvement results (draft 1) were obtained:



Figure 1. Draf 1 Science Learning Game

Furthermore, a one-to-one evaluation was conducted with 3 learners whose results can be seen in table 2.

Table 2. One to One Evaluation Result

Subject	Score	Total
Elm	3.526316	67
Elf	2.631579	50
Jav	3	57
Average	3.05	

Referring to the data in the table above, it is known that the average result of one-to-one evaluation with 3 students is 3.05, with a good conclusion. The results of the improvement of the one-to-one evaluation with students resulted in the following draft 2:



Figure 2. Draf 2 Science Learning Game

Furthermore, a small group evaluation was conducted, the results of which can be seen in the following table:

Table 3. Small Group Evaluation Result

Subject	Score	Total
Anc	2.842105	54
Cal	3.631579	69
Hei	3.578947	68
Nur	3.315789	63
Gle	3.421053	65
Pas	3.368421	64
Deb	3.631579	69
Els	3.684211	70
Average	3.43	

Referring to the data in table 3 above, it is known that the average result of the small group evaluation is 3.43, with a very good conclusion. The improvement results of the small group evaluation resulted in the following draft 3:



Figure 3. Draf 3 Science Learning Game

Furthermore, a field trial evaluation was conducted, the results of which can be seen in the following table:

Table 4. Field Trial Evaluation Results

Subject	Score	Total
Ard	3.684211	67
Des	3.684211	67
Fas	3.684211	66
Hct	3.684211	66
Iml	3.631579	66
Kar	3.631579	66
Kfs	3.736842	67
Mra	3.684211	66
Mna	3.578947	65
Mhr	3.631579	66
Nbr	3.473684	62
Srk	3.789474	68

Subject	Score	Total
Sqj	3.210526	58
Wtr	3.368421	61
Wcp	3.684211	66
Average	3.61	

Referring to the data in the table above, it is known that the average result of the field trial evaluation is 3.61, with a very good conclusion. The results of the improvements to the field trial evaluation resulted in the final draft which is described as follows:



Figure 4. Final Draft of Science Learning Game

The effectiveness of the game-based science learning model oriented to Papuan local culture can be known by analyzing the data of the pre-test and post-test results by conducting a t test. The results of the pre-test and post-test are:

Table 5. Results of t test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre Test–Post Test	-41.000	6.601	1.704	-44.655	-37.345	24.056	14	.000

The t-test results contained in table 4.9, show that the Sig value. (2-tailed) value of 0.000 < 0.05, so there is a significant difference between science learning

outcomes in pretest and posttest data. Thus it can be concluded that the game-based science learning model oriented to Papuan local culture is effective for improving the learning outcomes of fourth grade elementary school students.

Research on the development of game-based science learning models oriented to local Papuan culture for grade IV elementary school students was carried out through a collaboration of 3 (three) development models, namely the first step of the Borg & Gall model, the Dick & Carey model, and the Lee & Owen model. The research and development steps are: 1) conduct preliminary research (needs analysis); 2) determine general learning objectives; 3) conduct learning analysis; 4) identify learners' behavior and characteristics and context; 5) determine specific learning objectives; 6) develop assessment tools; 7) develop learning strategies; 8) develop learning materials; and 9) design and conduct formative evaluation. The researcher included the first step of the Borg & Gall model to further complement the steps of the Dick & Carey model.

The reason for using the Dick & Carey model is because this model is suitable and easy to use in the past to develop learning. This is in line with (Fajarini, 2018) which states that the Dick & Carey model is easy to use because it has advantages including having clear and regular steps, details, revisions, and has relatively complete components. Furthermore, researchers used the Lee and Owen model to develop Papuan local culture-oriented science learning games 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 the form of multimedia. In developing this Papuan local culture-oriented game-based science learning model, of course, pay attention to factors that can have an impact on the climate of science learning. These factors include: 1) the internal spirit of the teacher, the overall development efforts of students; 2) Social aspects of teaching; 3) relationship with authority; and 4) existence and adherence to rules (Grecmanová, Gonda, Urbanovská, & Cabanová, 2020).

To test the feasibility of the product, a one to one evaluation was conducted with material, learning design, and media experts, a one to one evaluation with students, a small group evaluation, and a field trial. The overall improvement results have been declared suitable for use. Furthermore, to test the effectiveness of the model development results, a t-test was conducted. The t-test results show that the Sig. (2-tailed) value of $0.000 < 0.05$, so there is a significant difference between science learning outcomes in pretest and posttest data. Thus it can be concluded that the game-based science learning model oriented to Papuan local culture is effectively used in learning.

This finding is in accordance with the results of research conducted by (Cotič, Plazar, Starčič, & Zuljan, 2020) which suggests that the MNSL model (The Mobile Natural Science Learning), is 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 were presented by (Partovi & Razavi, 2019) that computer educational games have an impact on the academic achievement motivation of elementary school students. In addition to science learning outcomes, the use of this Papuan local culture-oriented game-based learning model also motivates students in learning. This is also in

accordance with (Sung & Hwang, 2013) who found that a collaborative game-based learning approach can improve learning achievement, learning attitudes and motivation, and student self-efficacy.

The findings above show that the use of game-based learning models in learning not only improves students' cognitive aspects, but can also improve their affective aspects. This is in accordance with the findings of (Pratama & Setyaningrum, 2018) which suggests that students who take part in game-based learning have a positive effect on their cognitive and affective aspects. (Hwang, Sung, Hung, Yang, & Huang, 2013) reinforces that computer games not only improve students' learning attitudes, but also improve their learning achievement. The use of this game-based science learning model is also an effort to familiarize students in using technology. This is in accordance with the findings (Rakimahwati & Ardi, 2019) that interactive games can improve students' digital literacy skills. (Huang, Chiu, Huang, Zhong, & Lai, 2020) suggested that collaborative learning approaches related to mobile learning are more effective than personalized learning.

The findings above show that the use of game-based learning models in learning not only improves students' cognitive aspects, but can also improve their affective aspects. This is in accordance with the findings of (Pratama & Setyaningrum, 2018) which stated that students who take part in game-based learning have a positive influence on their cognitive and affective aspects. (Hwang et al., 2013) emphasized that computer games not only improve students' learning attitudes, but also improve their learning achievements. The use of this game-based science learning model is also an effort to familiarize students with using technology.

This is in accordance with the findings (Rakimahwati & Ardi, 2019) that interactive games can improve students' digital literacy skills. (Huang et al., 2020) stated that the collaborative learning approach related to mobile learning is more effective than personal learning. Apart from that, the use of game-based learning models in this research also increases students' self-confidence and learning satisfaction. This finding is in accordance with previous findings (Cahyana, Paristiowati, Nurhadi, & Hasyrin, 2017) which stated that mobile game based learning can develop students' learning motivation in the aspects of relevance, attention, self-confidence and satisfaction.

The game-based science learning model in this research is oriented towards 3 elements of local Papuan culture, namely elements of local knowledge, elements of living equipment and technology, and elements of art. The element of local knowledge is associated with Papua's natural resources, including marine products, forests, rivers/lakes, and mining products which are presented in the natural resource guessing game menu. By incorporating Papuan natural resource material into the game, local students can increase knowledge of Papua's natural resources. Students can differentiate between types of fish from sea and lake/river fish. Apart from that, students can also get to know animals endemic to Papua such as deer, sun bears, birds of paradise, cassowaries, and others.

The next local cultural elements that are integrated with the games being developed are elements of living equipment and technology. This element is integrated into the game menu of puzzle play and box play. Through this game

menu, students can learn about productive tools for the Papuan people such as arrows, noken, typical foods such as papeda, traditional clothing such as koteka and tassel skirts, as well as the traditional Papuan shelter/house called honai. Next, artistic elements are included in the game play box menu. Through this menu, students can identify musical instruments typical of Papua as well as artistic clothing such as the tifa musical instrument, tassel skirts and cassowary crowns. Through this research, researchers found that a game-based science learning model which is oriented towards 3 elements of local Papuan culture, can improve student learning outcomes in basic competency 3.7, namely describing the relationship between natural resources and the environment, technology and society.

In its implementation, this research and development has supporting and inhibiting factors. Supporting factors include; 1) access to communication with teachers and principals is very easy; 2) good support from students, teachers, and principals; and 3) adequate facilities and infrastructure in supporting the implementation of research. The inhibiting factor in this research is that it coincides with the Eid holiday so that researchers have to postpone the implementation of research for approximately 2 weeks.

The game-based science learning model oriented to Papuan local culture that has been developed certainly has strengths and weaknesses. The strengths are: 1) the developed learning model facilitates student involvement/activity in learning; 2) the learning game used is interesting and interactive; 3) the material contained in the learning game is oriented to elements of Papuan local culture so that it is close to the student's environment; 4) the game navigation buttons are adjusted to the level of grade IV elementary school students making it easier to explore the game; 5) can use a computer/laptop or smartphone device to run the game; and 6) learning games can be run offline. The advantages above are in accordance with the findings of (Chen, Tsai, & Chang, 2019) who said that quiz-based interactive game play is an innovative and fun source for students to learn. Students are very interactive and have the convenience of learning using their smartphones. In another section, (Fitriyana, Wiyarsi, Ikhsan, & Sugiyarto, 2020) suggested that the use of android-based games and blended learning can improve self-efficacy and student achievement. For students who have high anxiety, digital game-based learning is also very beneficial to changes in their learning performance (Yang, Lin, & Chen, 2018).

The weaknesses of the game-based science learning model oriented to Papuan local culture lie in: 1) the material is still limited (only for one subject matter only); 2) requires a computer/laptop or smartphone device in the implementation of learning, so that if the learning facility is not available, the application of the game-based science learning model oriented to local Papuan culture cannot be implemented.

CONCLUSION

Referring to the results of the research obtained, it was concluded that: 1) a game-based science learning model oriented to Papuan local culture for grade IV

elementary school students was developed through the stages of research and development (Research & Development) which combines the first step of the Borg & Gall model, the Dick & Carey model, and the Lee & Owen model; 2) the feasibility of developing a game-based science learning model oriented to Papuan local culture for grade IV elementary school students was tested theoretically and empirically.

The theoretical feasibility test was conducted through expert judgment with material experts, learning design experts, and media experts. The results show that the game-based science learning model is feasible to use. The average results of the feasibility test of material experts, learning design experts, and media experts amounted to 3.938597 with a good conclusion. Empirical feasibility test was conducted through one-to-one evaluation with students, obtained an average score of 3.05 with a good conclusion. At the small group evaluation stage, an average score of 3.43 was obtained with a very good conclusion.

At the field trial evaluation stage, an average score of 3.61 was obtained with a very good conclusion, the Papuan local culture-oriented science learning game is feasible to use; 3) The effectiveness of the development of a game-based science learning model oriented to Papuan local culture for grade IV elementary school students was tested through the t-test. The results show the value of Sig. (2-tailed) value of $0.000 < 0.05$, so there is a significant difference between science learning outcomes in pretest and posttest data. Thus it can be concluded that the game-based science learning model oriented to local Papuan culture effectively improves learning outcomes of grade IV elementary school students.

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