

# Games Based on Contextual Teaching and Learning: Improving Science Learning Outcomes for Elementary Students

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**Abstract:** This study aims to: (1) produce learning media that are suitable for use in learning; (2) find out the practicality of the developed media; and (3) find out the effectiveness of CTL-based game learning media. This type of research is development research using the DDD-E development model, namely decide, design, develop, and evaluate. The game media developed consists of materials, match-up games, and quizzes. This research was conducted on fourth grade students at SD N 8 Kebayakan. The design of this study used a post-test only control design, with a sample of 38 students consisting of 19 students as an experimental class who were taught using CTL-based game learning media and 19 students as a control class who were taught with book media, print, and conventional models. The feasibility test obtained a result of 4.42, which means "Very Feasible" and the practicality test obtained a result of 4.57, which means "very practical". The results of the hypothesis test prove that there is a significant difference between the learning outcomes of students who use CTL-based game learning media and the learning outcomes of students who use textbook media. This is indicated by the acquisition of data, namely, a significance value of 0.000. Value (sig) < 0.05, then  $H_0$  is rejected and  $H_a$  is accepted. So it can be concluded that CTL-based game learning media can improve student learning outcomes in class IV Science subjects at SD N 8 Kebayakan.

**Keywords:** game learning media; contextual teaching and learning; science learning outcomes

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## 1. INTRODUCTION

Learning media using computers is developed and packaged in the form of interactive multimedia. There are several forms of learning interaction that can be used in the design of interactive learning media. The form in question starts with (a) drill and practice (drill and practice); (b) tutorials; (c) games (games); (d) simulation; (e) discovery; and (f) problem solving [1]. In the case of this research, media development is designed in the form of a game. Game-application-based learning is now a research trend in education. Based on this research, positive results were found in the development of game-based learning media, and the researcher suggested further research on this game should be continued on other research objects. The role of games can make students concentrate more, practice sportsmanship, and also train them to solve problems because in games there are problems that must be solved quickly and precisely. Games can be a source of learning if they aim to achieve learning goals. With the role of games in the learning process, it certainly reduces the boredom of students towards the conventional teaching and learning process in the classroom. The end of a fun learning process will make students achieve good learning outcomes as well.

Science subjects are subjects that were born with an independent learning curriculum for the elementary school level. Of course, the available learning media are not varied. Natural and Social Sciences (IPAS) is a science that examines living and inanimate things in the universe and their interactions, as well as human life as individuals as well as social beings who interact with their environment. With this, the game development carried out will visualize how

interactions that can be carried out in everyday life between humans and nature will be achieved.

In teaching and learning activities, an approach is needed [2]. The teacher must have a good teaching approach and choose the right learning approach in accordance with the concept of the subject to be delivered. The use of learning models in natural sciences subjects must of course be adapted to the characteristics of the subjects themselves. This subject examines nature and social issues; therefore, a suitable learning model is contextual teaching and learning.

At the time of the observation, at this school, the teacher was still using the lecture method, which focused on the teaching and learning process only. With the use of a contextual learning model (Contextual Teaching and Learning, or CTL), which is a holistic educational process that aims to motivate students to understand the meaning of the subject matter they are studying by linking the material to the context of their daily lives (personal, social, and cultural) so that students have knowledge and skills that can be flexibly applied (transferred) from one problem to another [3].

Saragi and Simbolon [4] explained that through a contextual learning approach, learning will be more meaningful because children will "experience" what they are learning, not "know it". Based on teaching and learning activities that emphasize contextual approaches, students will always be invited into the everyday environment because their knowledge is formed through the basic knowledge they already have. This is in line with the opinion of Hobri et al. [5], who state that Contextual Teaching and Learning (CTL) is a learning approach that links the material being studied with real-life situations of students

so that the knowledge gained by students becomes more meaningful and useful for their lives.

## 1.1 The Nature of Science Learning and Learning Outcomes

Learning is a process of thinking and changing through several stages or repeated exercises to acquire knowledge [6]. According to Maâ [7], learning is not limited to reading, listening, writing, assignments, and tests; there is also a change in behavior from the results of the learning process, where there is interaction with the environment, and these changes are permanent. In addition, Festiawan [8] argues that learning is a process of acquiring knowledge and experience in the form of relatively permanent or permanent changes in behavior and the ability to react due to individual interactions with their environment.

In a book written by Hapudin [9], it is explained that Skinner defines learning as "a process of progressive behavior adaptation". So, learning is a process of adaptation (adjustment) that is progressive. In addition, Robert M. Gagne defines learning as changes that occur in human abilities that occur after continuous learning, not only caused by growth processes. Then Piaget said that learning will be successful if it is adjusted to the stage of cognitive development of the students.

Marwa et al. [10] say that the combination of science and social studies subjects is expected to trigger students ability to manage the natural and social environment in one unit. In line with research conducted by Heny and Aviventi [11], science helps students solve real 21st century problems scientifically related to natural and social phenomena that surround them, using scientific concepts to gain decision-making skills.

The subject of Natural and Social Sciences (IPAS) is a science that studies non-living (abiotic) and living (biotic) things in the universe and their interactions, as well as human life as individuals as well as social beings related to the environment. In addition, Agustina et al. [12] explained the purpose of learning natural sciences in an independent curriculum, namely being able to develop students' curiosity and interest, being able to play an active role, developing inquiry knowledge, mastering oneself and the environment, and developing an understanding of the concepts that exist in learning natural sciences itself.

According to BKSAP [13], the Natural and Social Sciences (IPAS) is a science that examines living and inanimate things in the universe and their interactions, as well as human life as individuals as well as social beings who interact with their environment. Science helps students grow their curiosity about the phenomena that occur around them. The basic principles of scientific methodology in science learning will train scientific attitudes (high curiosity, critical thinking skills, analysis, and the ability to draw the right conclusions), which give birth to wisdom in students. As a country that is rich in culture and local wisdom, it is hoped that through IPAS, students will explore the wealth of local wisdom related to IPAS, including using it to solve problems.

## 1.2 The Nature of Game Learning Media

Learning media is anything that is used as an intermediary or liaison from the information provider, namely the teacher, to the recipient of the information or students, which aims to stimulate students to be motivated and able to follow the learning process as a whole and meaningfully [14]. According to Kustandi and Darmawan [15], learning media is a tool that

can help the teaching and learning process, which functions to clarify the meaning of the message conveyed so that the lesson objectives are better and more perfect.

Educational games are the same as games in general. The difference lies only in the benefits, content, and objectives. The benefits of using educational games include not only providing entertainment for users but also providing knowledge and understanding. The content of the educational game is in the form of learning materials. The goal contained in the education game is to foster students' desire to always learn so that it results in student interactivity, which makes students more relaxed, enthusiastic, and open to receiving learning material [16].

Rokhayani, Kuswandi, and Abidain [17] said that gamification-based interactive multimedia will contain explanations about the material, games that are able to attract students' attention, as well as practice questions. Through interactive multimedia, students will be guided by a computer to carry out several activities, namely watching, reading, and playing. The material will be packaged in communicative language so that this gamification-based interactive multimedia can make it easier for students to learn.

Then Citra [18] said games are all contests that cause interaction with one another between players by following existing rules that have been determined to achieve a goal. One of the interesting and interactive learning media that prioritizes collaboration and communication and can lead to interaction between students is through games, which have the characteristics of creating motivation in learning, namely fantasies, challenges, and curiosity [19].

Fitriati [20] said there are eight models of learning games that can be made, including: Crosswords (crossword), Multiple Choice (multiple choice), Word Search (looking for words among random letters), Noughts and Crosses (choosing the correct answer by up to the transverse position), spell It (giving answers by spelling letter by letter), Anagram (exchanging letters in words so that the word has another meaning), Match-up (matching), and memory (choosing answers according to the order determined). In research, researchers develop games in the form of match-ups.

Akbar and Hadi [21] stated that match-up (adjusting) is a game aimed at matching questions and functions or definitions. In line with what was explained by Andrea and Palupi [22], the match-up type Edugame has game rules, namely that players must match the same object images from the play menu. It was also explained by Fiah and Amaliah [23] that match-up games can train students' memory, cognitive skills, and problem-solving skills. Andrea stated that match-up is a type of game that hones players' memory to match pairs of the same picture. Fitriita [24] also explained match-up, or matching between questions and answers, where the answers are shifted to be attached to the correct question position. From the definition above, it can be concluded that Match-up is a form of game that has a scenario of matching or matching objects, be they pictures, words, or sentences, that are in the right position or menu.

## 1.3 CTL (Contextual Teaching and Learning) Based Learning Media

According to Sulfemi [25], contextual learning Contextual Teaching And Learning, or CTL, is a learning concept that

helps teachers connect the subject matter they teach with real-world situations of students and encourages making connections between the knowledge they have and its application in their daily lives. Then Alpian et al. [26] found that the learning model of contextual teaching and learning is a learning model that encourages students to take an active part in learning and engages students with real life situations. Thus, the contextual teaching and learning model is a learning concept that encourages students to be active learners by connecting the material being taught with their real-life situations every day.

From the definition above, science lessons are very suitable for using contextual learning models because this subject teaches about natural and social conditions that interact directly with students in their daily lives. CTL stages according to Widyaiswara et al. [27]: (1) At first, it leads to constructivism; (2) The second stage creates inquiry learning; (3) The third stage Directs the submission of questions; (4) Stage four organizes students in groups; (5) Stage five, the teacher presents the model in learning; (6) Stage six, The teacher reflects; and (7) The final stage is that the teacher conducts an authentic assessment.

According to Adawiyah [28], there are several general stages to introducing CTL in the classroom: (1) Growing the idea that children learn more effectively when they work independently, discover who they are, and create their own new knowledge and abilities; (2) completing as many question-based tasks as positive results.

possible for all themes; (3) Encouraging students' natural interest by asking questions; (4) Forming a learning community; (5) displaying each model as a learning example; (6) taking time to think; and (7) carrying out evaluation in various methods.

Then the learning stages with the contextual teaching and learning model using the media game are described as follows: (1) Asking trigger questions; (2) Giving students the opportunity to solve a problem; (3) Asking questions about the topic being discussed; (4) Making discussions with colleagues; (5) Providing game learning media that has been developed; (6) Reflecting using the results of quizzes in the media; and (7) Conducting evaluation

Aslam et al. [29] Mobile learning media based on a contextual approach to understanding mathematical concepts is feasible, practical, and has a positive effect on student learning outcomes.

Ramadhani et al. [30] in their research on contextual-based games showed that acquisitions that met the category were very effective in increasing student learning outcomes in economics subjects. In line with Ilmia, et al. [31] obtained research results showing that the application of contextual-based science board game learning media as a science-edutainment medium influences the understanding of class VIII students at SMP Bustanul Muta'allimin Blitar on material pressure and its application influences learning outcomes, obtaining



Figure 1. Display: (a) initial page view; (b) credit page; (c) presentation of material; (d) instructions for use; (e) material menu; (f) presentation of material; (g) game page; (h) game pages; (i) game page

The research problem is formulated as follows: (1) Is the CTL-based game learning medium in science subjects appropriate to use? (2) Is the CTL-based game learning medium practical for science subjects? (3) Is the CTL-based Game learning media in science subjects effective in increasing student learning outcomes?

## 2. METHOD

The type of research conducted is the method of R&D (Research and development). The research design used was a post-test only control design with a control group and an experimental group, where the experimental group was the group that was given special treatment (in this study, media games), while



the control group did not get special treatment or not. using game media only using ordinary methods.

This research was conducted at SD N 8 Kebayakan in Central Aceh District. The time for the research to be conducted is in the Even Semester of the 2022–2023 school year. The development of CTL-based game-based learning media requires evaluation. The evaluation was obtained from research subjects consisting of material experts, media experts, instructional design experts, and product user trials, namely class IV students at SD Negeri 8 Kebayakan. Trials were conducted to collect data as a measure of the success of the developed medium. Product trials will generate suggestions, responses, and assessments for revisions to the media after it is used in the trial phase. Revisions were made to improve the product being developed.

The development model used in this study is the DDD-E development model from Ivers and Barron. The background of using the DDDE model is that it is suitable for developing a multimedia product, and games are a form of multimedia product. This model also has systematic stages where each stage must refer to the previous stage, which has been revised so that it can produce a good product as well. The DDD-E research model is carried out sequentially and continuously and is simpler than other development research models. The stages in this development model are systematic and procedural. The following are the stages in the DDD-E development model:

Material eligibility

$$x = \frac{\sum X}{n}$$

**Table 1. Interpretation of Material Feasibility**

No	Interval Mean Score	Interpretation
1.	1,00 – 2,49	Not Eligible
2.	2,50 – 3,32	Less Feasible
3.	3,33 – 4,16	Decent
4.	4,17 – 5,00	Very Decent

(Sriadhi [32])

Media eligibility

$$x = \frac{\sum X}{n}$$

**Table 2. Interpretation of Media Construction Feasibility**

No	Interval Mean Skor	Interpretation
1.	1,00 – 2,49	Not Eligible
2.	2,50 – 3,32	Less Feasible
3.	3,33 – 4,16	Decent
4.	4,17 – 5,00	Very Decent

(Sriadhi [33])

Media Acceptance

$$x = \frac{\sum X}{n}$$

**Table 3. Interpretation of Media Acceptance**

No	Interval Mean Skor	Interpretation
1.	1,00 – 2,49	Low acceptance
2.	2,50 – 3,32	Acceptance is sufficient
3.	3,33 – 4,16	High acceptance
4.	4,17 – 5,00	Acceptance is very high

(Sriadhi [34])

Practicality Test Data Analysis Techniques. Data analysis in testing the practicality of CTL-based game learning media products in class IV science subjects, namely:

$$x = \frac{\sum X}{n}$$

**Table 4. Media Practicality**

No	Interval Mean Skor	Interpretation
1.	1,00 – 2,49	Impractical
2.	2,50 – 3,32	Less practical
3.	3,33 – 4,16	Practical
4.	4,17 – 5,00	Very practical

Prerequisite test. a test conducted with the aim of assessing the distribution of data in a group of data or variables, whether the distribution of the data is normally distributed or not. Homogeneity test, namely, a statistical test procedure that aims to show that two or more groups of data samples are taken from populations that have the same variance

Hypothesis testing. Testing a statement using statistical methods so that the test results can be declared statistically significant. The hypothesis of the effectiveness test to be tested is:

$$H_0: \mu_1 = \mu_2$$

$$H_a: \mu_1 \neq \mu_2$$

Keterangan:

$\mu_1$  : Average learning outcomes of students using developed CTL-based Game learning media

$\mu_2$  : Average learning outcomes of students without using the developed CTL-based Game learning media

$H_0$  : there is no difference in the learning outcomes of students using the developed CTL-based Game learning media

$H_a$  : there are differences in the learning outcomes of students using the developed CTL-based Game learning media

To test the hypothesis, the formula is used::

$$t_{hitung} = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Information

$\bar{x}_1$  : average score of sample 1

$\bar{x}_2$  : average score of sample 2

$S_1^2$  : variance of sample 1

$S_2^2$  : variance of sample 2

### 3. RESULTS AND DISCUSSION

#### 3.1 RESULTS

The results of the assessment by media experts, material experts, individual trials, small group trials, and limited field trials for all aspects of the assessment are determined by the average score. The results of the assessment are then analyzed and determined to determine whether or not it is appropriate to develop CTL-based game-based learning media. The average percentage of the results of the assessment of media experts, material experts, individual trials, small group trials, and field trials is shown in Table 5 below:

**Table 5. Feasibility of CTL-based game learning media for science subjects**

No	Categorization	Average score	Criteria
1.	Material Expert Validation	4,26	very feasible
2.	Media Expert Validation	4,41	very feasible
3.	Learning Design Validation	4,55	very feasible

No	Categorization	Average score	Criteria
4.	Individual Trial	4,26	very feasible
5.	Small Group Trial	4,47	very feasible
6.	Field Trials	4,55	very feasible
Average		4,42	very feasible

Based on Table 3 above, it can be concluded that CTL-based game learning media for science subject matter is very feasible; thus, it is known that the average rating ( $\mu$ ) from experts and trials on students is 4.42, while the criterion threshold value of feasibility ( $\mu$ ) is 70%, then  $\mu > \mu$ . So it can be concluded that the CTL-based game learning media in this study are said to be very feasible to use and can meet the needs of implementing science learning.

The product practicality test results are carried out to obtain user opinions regarding the practicality of the media that has been developed. The results of the practicality test are presented in Table 6 below:

**Table 6. Practicality Test Results**

Media Aspect	Ease of Use	Usefulness	Presentation	Information
Total Perspect	84,33	87,33	88,6	86,76
Perspect Mean	4,44	4,60	4,66	4,57
Peraspect Assessment Results	Very Practical	Very Practical	Very Practical	Very Practical

From the table above, we can describe that the results from the aspect of ease of use are 4.44, which means they meet very practical criteria, on the usability aspect, 4.60, which means they meet very practical criteria; and on the presentation aspect, 4.66, which means they meet very practical criteria. Meanwhile, the average of all aspects that were tested for practicality was an average of 4.57, which means "Very Practical".

Learning is done using game learning media based on contextual teaching and learning, resulting in the lowest score of 96, the highest of 56, the average value (mean) of 80, the mode of 80, the median of 80, and the standard deviation of 10. The following table shows the frequency distribution and histogram of the post- test of students in the experimental class.

**Table 7. Frequency Distribution of Experimental Class Post-test Learning Outcomes**

No	Interval	Frekuensi Absolut	Frekuensi Kumulatif
1	56 - 64	2	11%
2	65 - 72	3	16%
3	73 - 80	6	32%
4	81 - 88	5	26%
5	89 - 96	3	16%
Total		19	100%

Learning done using the conventional method resulted in the lowest score of 28, the highest of 76, a mean (mean) of 52.42, a mode of 52, a median of 52, and a standard deviation of 12.3.

The following is the distribution of frequencies and histograms from the post-test results of students in the control class.

**Table 8. Frequency Distribution of Control Class Post-test Learning Outcomes**

No	Interval	Frekuensi Absolut	Frekuensi Relatif
1	28 - 37	2	11%
2	38 - 47	3	16%
3	48 - 57	9	47%
4	58 - 67	2	11%
5	68 - 77	3	16%
Total		19	100%

The normality test is carried out to ascertain whether the samples taken from the population are normally distributed. After analyzing the data using the Lilliefors test. Normal data if the p-value (sig.) is  $> 0.05$ . Because the p-value is  $> 0.05$ , the data in the control and experimental classes are normally distributed. The results of the data normality test are presented as follows:

**Table 9. Data Normality Test**

	class	Shapiro-Wilk		
		Statistic	df	Sig.
learning outcomes	control class	0,957	19	0,509
	experimental class	0,943	19	0,296
a. Lilliefors Significance Correction				

**Homogeneity Test**

A homogeneity test is carried out to determine whether the research data is homogeneous. Homogeneous data if the p-value (sig.)  $> 0.05$ . Because the p-value is  $> 0.05$ , the variance of the control and experimental class data groups is the same (homogeneous).

**Table 10. Homogeneity Test**

		Levene Statistic	df1	df2	Sig.
learning outcomes	Based on Mean	0,56	1	36	0,45
	Based on Median	0,45	1	36	0,50
	Based on Median and with adjusted df	0,45	1	34,66	0,50
	Based on trimmed mean	0,53	1	36	0,46

After carrying out the prerequisite tests, namely the normality and homogeneity tests, a hypothesis test was carried out. Because it meets the assumptions of normality and homogeneity, it can be tested for differences with parametric statistics using the t-test. The results of the t-test from the average comparison of the experimental class and the control class. Because the p-value (sig.) is  $0.05$ ,  $H_0$  is rejected and  $H_a$  is accepted, meaning that there is a significant difference in the learning outcomes of students in the control class and the experimental class. The learning outcomes of students who were taught using game media were significantly different from

the learning outcomes of students who were not taught using game media. If you look at the average, the average value of student learning outcomes in the experimental class is better than that of students in the control class. The following table results from the hypothesis testing carried out:

**Table 11. Effectiveness Test**

		t-test for Equality of Means				
		Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
					Lower	Upper
learning outcomes	Equal variances assumed	0,00	-27,57	3,65	-34,99	-20,16
	Equal variances not assumed	0,00	-27,57	3,65	-35,00	-20,15

### 3.2 DISCUSSION

The media that has been developed has been prepared by considering material factors, instructional design, and media construction experts to produce the final product of game-based learning media based on contextual teaching and learning in class IV science subjects at the elementary school level. This research and development aims to create a media-based learning paradigm that can improve teaching standards and learning outcomes for fourth graders in SD N 8 Kebayakan in science subjects.

The initial steps taken when starting the research were needs analysis, followed by setting learning objectives, determining the theme or scope of the material, developing prerequisite skills, and assessing the availability of resources. After determining that the appropriate medium is a game, the design is carried out in the form of an outline, a flowchart, and a storyboard, which are the basis for developing a product. At the development stage, media components consisting of text, images, games, and audio are aligned so that they are mutually sustainable. Finally, evaluation is carried out by validating material experts, media construction experts, and instructional design experts, and to see the user, individual trials, small group trials, and field trials are carried out in order to create products that are feasible and useful in the learning process and can achieve learning objectives.

The concept is clear, simple, and methodical when the learning process uses game-based learning media based on contextual teaching and learning to make the learning atmosphere in the classroom fun, lively, and independent, as well as provide opportunities to interact with other students, teachers, and the media. Based on the justification given, it can be concluded that game learning media based on contextual teaching and learning have passed evaluations by material experts, media construction experts, instructional design experts, individual trials, small group trials, and field trials with the result "VERY DESERVE" with reference to the media eligibility criteria that have been determined. Supported by research conducted by

Pebriani [35], media is said to be feasible if it meets valid criteria with indicators of language, visual appearance, software engineering, and information about the media, correctness of the concept, systematics and clarity of the concept, implementation, evaluation, and learning strategy. Learning motivation, program design, ease of use, and benefits. Another study, namely Sari and Manuaba [36], stated that appropriate media must meet valid criteria in aspects of curriculum, materials, grammar, objectives, strategy, evaluation, message design, operations, and motivation. Supported by the above studies, it can be concluded that game-based learning media are suitable for use in the learning process.

Media that is suitable for use in the learning process is subjected to a practicality test to see how practical it is when used in the learning process in class. Based on the practicality test, it can be concluded that the media developed is very practical, which means that the media developed is easy to use in the learning process in the classroom by fulfilling the aspects of ease of use, usefulness, and presentation. The results of this study are in line with the results of research conducted by Firdaus [37], which states that educational game media are practical to use when users feel easy and comfortable in their use. Besides that, according to Maghfiroh et al. [38], Game learning media are said to be practical if they are valid in terms of quality, convenience, attractiveness, and usefulness. From these studies, it is proven that game media is practically used in the learning process.

Based on data processing and research results that have been carried out, the results found are that there are differences in learning outcomes between students who are taught using game-based learning media based on contextual teaching and learning and students who are taught with printed book media and conventional models in the form of lectures from the teacher only. Specifically, the average value of the science of science that is taught using contextual teaching and learning-based game learning media is higher than that using printed media and conventional models. Supported by research conducted by Sari and Manuaba [39] that game media is used effectively in the learning process because student motivation will appear by itself when the learning atmosphere is pleasant. If students are happy, then the learning process will be effective.

In addition to learning outcomes, there are other aspects that can measure the effectiveness of the media, one of which is critical thinking. According to research conducted by Supandi and Senam [40], the use of game media in the classroom during the learning process can improve students' critical thinking skills, which in the end will also lead to increased student learning outcomes. It can be concluded that the use of game-based learning media is effectively used in the learning process to improve student learning outcomes.

### 4. CONCLUSION

Conclusions that can be drawn from the formulation, objectives, and discussion of research on the development of contextual teaching and learning-based game learning media in class IV Science subjects at SD N 8 Kebayakan, namely:

1. The development of game learning media based on contextual teaching and learning in class IV Science subjects at SD N 8 Kebayakan is very suitable for use in the learning process.
2. The development of game learning media based on contextual teaching and learning in class IV science subjects at

SD N 8 Kebanyakan is very practical to use in the learning process.

3. The development of game learning media based on contextual teaching and learning on science subjects in class IV SD N 8 Most can effectively improve student learning outcomes.

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