

## Development of Educational Game Water Cycle Materials for Elementary School Grade 5 Students

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### Abstract

The purpose of this study was to develop educational games about the water cycle for fifth grade elementary school students. The research taken is research development or Research and Development (R&D). The stages of this research consisted of 10 stages which the researchers concluded into 7 stages, namely potentials and problems, data collection, product design, design validation, design revisions, product trials and product revisions. The selected technique in data collection using questionnaires, interviews, and tests. The data sources in this study were class V Dabin I teachers and fifth grade students in Dabin I Lasem District. Product feasibility is seen from the validation results of media experts and material experts. The validation results of media experts obtained a value of 91.6% in the very feasible category. The results of the material expert validation obtained a value of 94.4% in the very feasible category. Then the interactive educational game media was applied to the experimental class and the N-gain calculation result was 0.72 in the high category. The effectiveness test in this study was carried out by comparing the results of the learning written test in the control class and the experimental class. It was found that  $t_{count}$  was 2.425 in  $t_{table}$  with  $\alpha = 5\%$  obtained 2.012, so the result of  $t_{count} > t_{table}$ . From the results of this study, it can be concluded that interactive educational game media can be used in learning in class V of elementary school.

**Keywords:** *Game edukasi media, student cognitive, science*

### Abstrak

Tujuan penelitian ini adalah mengembangkan permainan edukatif tentang siklus air untuk siswa sekolah dasar kelas V. Penelitian yang dilakukan adalah penelitian pengembangan atau Research and Development (R&D). Tahapan penelitian ini terdiri dari 10 tahap yang peneliti simpulkan menjadi 7 tahap yaitu potensi dan masalah, pengumpulan data, desain produk, validasi desain, revisi desain, uji coba produk dan revisi produk. Teknik yang dipilih dalam pengumpulan data menggunakan angket, wawancara, dan tes. Sumber data dalam penelitian ini adalah guru kelas V Dabin I dan siswa kelas V di Kecamatan Dabin I Lasem. Kelayakan produk dilihat dari hasil validasi ahli media dan ahli materi. Hasil validasi ahli media memperoleh nilai sebesar 91,6% dengan kategori sangat layak. Hasil validasi ahli materi memperoleh nilai sebesar 94,4% dengan kategori sangat layak. Kemudian media permainan edukatif interaktif tersebut diaplikasikan pada kelas eksperimen dan hasil perhitungan N-gain sebesar 0,72 dengan kategori tinggi. Uji efektivitas dalam penelitian ini dilakukan dengan membandingkan hasil tes tertulis pembelajaran pada kelas kontrol dan kelas eksperimen. Diperoleh nilai thitung sebesar 2,425 pada ttabel dengan  $\alpha = 5\%$  diperoleh 2,012, sehingga hasil thitung  $>$  ttabel. Dari hasil penelitian ini dapat disimpulkan bahwa media permainan edukasi interaktif dapat digunakan dalam pembelajaran di kelas V Sekolah Dasar.

**Kata Kunci:** Media permainan edukasi, kognitif siswa, IPA

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## INTRODUCTION

The educational process has developed in accordance with the process of development of the times. Budiyo (2020) the development of education in the era of globalization requires experts in the field of education to develop various innovations to advance quality and character students, especially innovations in learning media which function to facilitate the teaching and learning process in class in order to streamline communication between teachers and students.

The various types of media that exist are now experiencing rapid development, especially in terms of presentation, which are increasingly innovative. The development of learning media is adapted to students and teachers, especially the responses and needs of students in the 4.0 era. Khairunnisa & Ismail (2020) era 4.0 is marked by the growing development of new data science technologies, artificial intelligence, and the increasing popularity of internet use in many aspects of life. Characterized by the rapid development of science and technology, thousands of digital content and various types of multi-platform educational applications to help students learn. Yuliana et al (2020) technology has an important position in the development of education today, through learning media can assist in the learning process. Sardiman (2014) the development of science and technology continues to encourage the learning process to be more applicable and interesting as an effort to improve the quality of education.

The role of the media is not only as a tool to convey the teacher's message to students, but learning media is expected to be able to attract students' interest to be able to understand more about the content of the material delivered by the teacher or instructor (Pratiwi 2019). So that it can be said that the media is a tool in facilitating the delivery of the material to be conveyed and serves to direct students to obtain various learning experiences (learning experiments) which are determined by the interaction of students with the media, especially in learning science.

Haryono (2013) explains that Natural Science is a process that implies a way of thinking and acting in dealing with or responding to problems that are in the environment. Science as a process implies a way of thinking and acting in response to natural events around it by observing, clarifying, measuring, and predicting and concluding scientifically. Rianto (2021) science subjects in elementary schools are subjects that play an important role in everyday life. One of the objectives of learning science in elementary school is for students to understand the natural environment and its surroundings, so that they are wise and behave positively in treating nature (Muttaqin 2021).

Against teachers in the thematic learning process, especially science content in SD class V Dabin 1 Lasem District which consists of 8 elementary schools namely SDN 1 Gedongmulyo, SDN 2 Gedongmulyo, SDN Bonang, SDN Sriombo, SDN Binangun, SDN 3 Soditan, SDN Sendangasri, and SDN 1 Sumbergirang. Found in the learning process is still not optimal there are problems encountered by researchers. The problems found by researchers are problems found in learning media, teachers and students. The first observation found that the teacher in using learning media was still simple. The learning media used is no technology-based media in accordance with the development of the digitalization era to make it easier for students to learn. The media used is not yet creative, only in the form of pictures, textbooks, worksheets, and student books. Teachers have not been able and not skilled in developing learning media to help students during the process of delivering learning material from teachers to students. Learning is still teacher-centered even though it has implemented the 2013 Curriculum. The teacher's learning process activities only provide concepts and students tend to memorize them. Problems were found with students, namely the lack of stimulation or stimulus to the media which resulted in students getting bored quickly and being less active in participating in learning, student motivation became low when the learning process occurred in class. So that the reciprocity between teachers and students is not

maximized, the learning process becomes monotonous so that the cognitive results obtained by students have not reached the specified minimum completeness criteria. Rahmi (2019) to improve the expected learning process, an interesting and innovative media is needed to foster enthusiasm, interest, and activate students in the process of teaching and learning activities in class. So that the learning outcomes obtained by students will also increase. One alternative to overcome the problem is by developing interactive media in the form of educational games that contain educational games in accordance with learning materials that are adapted to the times, especially the responses and needs of students in the digitalization era or in the 4.0 era.

Abidin et al (2021) research entitled "Electronic Educational Games as Interactive Multimedia for Elementary Schools in Rural Indonesia". The problem that arises is that children in rural areas use the internet to play online games which have a negative influence. So that researchers want to develop educational electronic game media for the learning process. This research uses a 4-D model, namely devine, design, develop, and disseminate. The results of this study indicate that educational game learning media for grade five elementary schools in rural Indonesia is feasible and effective. Children are very enthusiastic about using educational games. Based on the description above, it is necessary to develop of educational game water cycle materials for elementary school grade V students

Learning media has several functions which include, helping to accelerate understanding in the learning process, clarifying the presentation of messages so that they are not verbalistic, overcoming space limitations, learning is more communicative, learning time can be conditioned, eliminating student boredom, increasing student motivation in learning something, serving the various learning styles of students increase the level of activity (Sadiman 2014). While the function of learning media put forward by Levied an Lent (in Haryono 2014) learning media, especially visual media, has several functions, namely the first function of attention is to attract and direct the attention of students to concentrate on the content of the lesson. Both affective functions can be seen from the pleasure of students while learning. The third cognitive function is to understand and remember information. The four compensatory functions are to organize information and recall it. Learning media can be in the form of educational games.

Educational games can be interpreted as games designed or created to stimulate thinking, including increasing concentration and solving problems. Educational game is a type of media that is used to provide instruction, increase user knowledge through a unique and interesting media (Najuah, et al 2022). According to Naimah (2019) educational games are games that specifically have learning content or contain subject matter and are intended to improve the abilities of the players, namely students, so as to produce new experiences in the learning process such as feelings of joy and happiness. So that the material delivered by the teacher and the material contained in this educational game can be conveyed, distributed, and finally students can receive the material properly.

Studying phenomena in nature in science lessons is one of the ways to study the water cycle that occurs on this earth. According to Putri et al (2020) explained that the water cycle material explains the stages and processes of the water cycle which must be explained with illustrations because the material is abstract. Likewise, according to Putra & Suniasih (2021) that water cycle material is important to teach students with the aim that students know and understand how to behave towards nature and have a caring attitude, but it is not possible if students are asked to observe the water cycle process which occurs directly in nature, so that in the water cycle material media is needed that can facilitate student activities.

So that the water cycle material is material in science that studies natural phenomena that are abstract in nature and cannot be seen directly the process of the

water cycle. So that in the water cycle material learning media is needed that can help students to understand it with educational game media. The purpose of this study was to develop educational games about the water cycle for fifth grade elementary school students. Development of this educational game media to assist teachers in conveying water cycle material to grade 5 students so they can better understand and assist students in learning science

### METHOD

The type of researcher is Research and Development. Sugiyono (2019) explains Research and Development (R&D) is a step or process to produce a product that will be developed, and test the effectiveness of a product with validation criteria. The stages of this research consisted of 10 stages (Sugiyono 2019) which the researchers concluded into 7 stages, namely potentials and problems, data collection, product design, design validation, design revisions, product trials and product revisions. The selected technique in data collection using questionnaires, interviews, and tests. The data sources in this study were class V Dabin I teachers in Lasem District and fifth grade students at SDN in Dabin I Lasem District.

The initial stage of this research begins with examining the potential and problems carried out by distributing questionnaires and interviews to determine field conditions. Questionnaire distribution and interviews were conducted in class 5 of Dabin 1 Elementary School, Lasem District, Rembang Regency, which consisted of 8 elementary schools, namely SDN 1 Gedongmulyo, SDN 2 Gedongmulyo, SDN Bonang, SDN Sriombo, SDN Binangun, SDN 3 Soditan, SDN Sendangasri, and SDN 1 Sumbergirang. Interviewed 8 teachers in grade 5 and provided a questionnaire on teaching media needs. In addition, giving a questionnaire to grade 5 students at Dabin I Elementary School, Lasem District, Rembang Regency, a total of 177 students. After the data is obtained then the data is collected to be analyzed as a reference in designing the product.

The design of interactive media product development for educational games is tailored to the needs of teachers and students both in terms of learning materials and the learning media used. design validation by experts. The experts who become validators are material experts and media experts. Design validation aims to assess a media that has been made so that it becomes better than existing learning media. Material expert validation aims to test related to the completeness of teaching materials, the correctness of teaching materials, and the systematics of material (Siamy 2018). Then the design revision was carried out after validation by material experts and media experts when conducting the assessment. The purpose of the design revision is to find out weaknesses and improve the product media design that is developed if there is input from the validator.

Initial trials of the product were carried out in two Dabin I Elementary Schools in Lasem District. The subjects were fifth grade students at SDN 1 Gedongmulyo as an experimental class with a total of 25 students and SDN Sriombo as a control class with a total of 23 students. Trials were conducted to determine the feasibility of interactive media educational games that have been developed in relation to the development of media according to needs. Then seen from the effectiveness of the use of interactive media educational games through student learning outcomes.

Assessment of the validity of this educational game interactive media was obtained by presenting a prototype media interactive game educational water cycle material in improving students' cognitive abilities to experts equipped with the provided assessment sheets. The results of the assessment from the validator will then be analyzed with a percentage based on the scores obtained on each assessment item. The feasibility percentage assessment uses the following formula.

$$p = (\sum X) / N \times 100\%$$

Information

- p : validator percentage gain
  - $\sum X$  : total score of the validator's answers
  - N : total ideal score
- (Arikunto 2019)

Scores and categories of assessment by media experts and material experts can be seen in the table below.

Table 1. Eligibility Level Qualification

No	Achievement Level	Information
1	81 % - 100 %	very feasible
2	61 % - 80 %	eligible
3	41 % - 60 %	less feasible
4	21 % - 40 %	not feasible
5	< 21 %	very inappropriate

(Arikunto 2019)

The effectiveness of interactive media educational games on water cycle material in learning is obtained from a comparison of the results of the posttest scores of the control class and the posttest scores of the experimental class. Next, it will be tested whether there is an average difference using the t test. Then the N-gain score will be seen to see the effectiveness of the learning media.

To find out the level of effectiveness of interactive media educational games on the water cycle material, it can be seen using the Score Test (N-gain) adapted from the Journal of (Wahab 2021) with the following formula.

$$g = (S \text{ post} - S \text{ pre}) / (S \text{ max} - S \text{ pre})$$

Information:

- g = N-gain
- S post = Posttest score
- S pre = Pretest score
- S max = Maximum score

The results obtained are then classified according to the following predetermined criteria:

Table 2. Criteria for the N-Gain Index

Coefficient Interval	Criterion
N-gain < 0,3	low
0,3 ≤ N-gain < 0,7	currently
N-gain ≥ 0,7	hight

Source : (Wahab 2021)

To find out the learning outcomes in the experimental class and in the control class can be tested with a one-sided test, namely:

$$t_{\text{count}} > t_{\text{table}} = H_a \text{ accepted}$$

$$t_{\text{count}} < t_{\text{table}} = H_o \text{ is accepted}$$

H<sub>o</sub> : There is no difference in learning outcomes between the experimental class that applies interactive educational game media and the control class

$H_a$  : There are differences in learning outcomes between the experimental class that applies interactive educational game media and the control class  
The following is the t-test formula (Sugiyono 2019)

$$t = \frac{X_1 - X_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2} - 2r \left( \frac{S_1}{\sqrt{n_1}} \right) \left( \frac{S_2}{\sqrt{n_2}} \right)}}$$

Information:

$x_1$  = Sample mean of 1

$x_2$  = Sample mean of 2

$s_1$  = Standard deviation of sample 1

$s_2$  = Standard deviation of sample 2

$s_1^2$  = Variance of sample 1

$s_2^2$  = Variance of sample 2

$r$  = Correlation between two samples

The t test in this study used SPSS series 26.

## RESULT AND DISCUSSION

The product developed by the pin is the core of the implementation of this development research. This development research aims to obtain an Android-based interactive learning media product in the natural sciences subject of the water cycle which is aimed at fifth grade elementary school students. Needs analysis activities are carried out using questionnaires, interviews and tests. The results of the analysis show that students already use smartphone devices in their activities and are used to operating them. However, the utilization and use of students in learning activities has not been carried out optimally, because the smartphones they use are more often used to play games.

At the design stage, product design is carried out. The design activity begins with making an outline of the contents of the interactive educational game media followed by the preparation in accordance with KI, KD science material in class V about the Water Cycle. The development stage is the stage of realization of making interactive educational game media. An application that can be installed on an Android phone in the form of an .apk file (Android Package Kit). As for the development and planning of interactive educational game media, there is a good and attractive display design so that students are interested in using the learning media developed by researchers. Interactive buttons, buttons on each display aim to go to or move the display to the next screen/frame. Learning materials, this section includes the main part in making learning media. The material is arranged according to KD and indicators according to the material that the researcher wants to achieve. Game, contains games to help students better understand the material while playing so that students more easily understand the material. Pictures, supporting material to clarify the teaching material to be conveyed. This image aims to encourage students to be enthusiastic when using the media. Audio, aims to make learning media more interesting. Audio in learning media contains material, and music so that students don't feel bored. Videos are included in teaching materials so that students can more easily understand the material provided. Practice questions, questions regarding the learning material contained in the media, the form of practice questions on the media developed by researchers is in the form of multiple choices. The appearance of the water cycle educational game that has been developed by researchers can be seen as follows:



Figure 1. Loading Display



Figure 2. Menu Display



Figure 3. Display of KI



Figure 4. Display of KD IPA



Figure 5. Indicators Display



Figure 6. Material Display

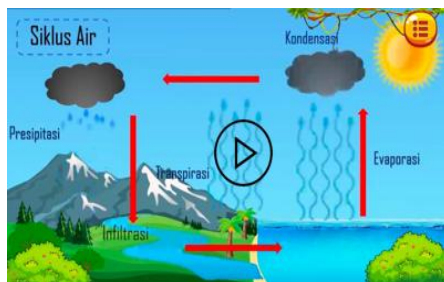


Figure 7. Video Display



Figure 8. Evaluation Display



Figure 9. Puzzle Game



Figure 10. Game Right/False

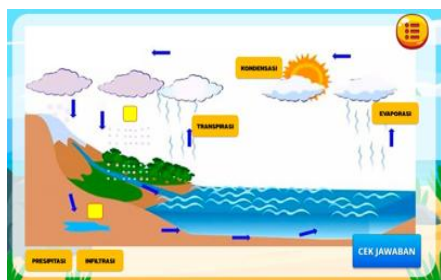


Figure 11. Pick One Game



Figure 12. Information Display

Based on the assessment data from the validation of material experts, media and experimental group trials, the following data were obtained. Material expert validation was carried out for one teacher, namely Ms. Dhina Widiati, M.Pd. She is an exemplary teacher and won 2<sup>nd</sup> place as an outstanding teacher at the Rembang Regency level in 2022, obtained:

Table 3. Material Expert Validation Results

Indicator	Score	Information
The accuracy of the material according to KD	4	Very good
Clarity of material description	4	Very good
The suitability of the illustration images with the material	3	Good
The suitability of the game/game with the material	4	Very good
Clarity of study instructions	3	Good
The suitability of the media with the level of understanding of students	4	Very good
Convolved material delivery	4	Very good
The suitability of the quiz questions with the material	4	Very good
<b>Total Score</b>	<b>34</b>	

Based on the results of the assessment that was carried out by the material expert, a total score of 34 was obtained with a value of 94.4% with a very feasible and usable category.

Media expert validation whose role is to provide an assessment of the forms of media developed by researchers from a technical point of view and the use of media during the learning process. The lecturer chosen by the researcher was Mrs. Fina Fakhriyah, M.Pd. as a Lecturer at Muria Kudus University and he has been a Lecturer since 2012. Apart from being a Science Lecturer, he has also taught several courses,



namely Science Applications, Science Concepts, Science PAKEM and also Integrative Thematic Classroom Action Research. Validation results obtained:

Table 4. Results of Media Expert Validation

Indicator	Score	Information
Clarity of instructions for using the media	4	Very good
Text readability	4	Very good
Accuracy of background color selection with writing	3	Good
Visual attractiveness	4	Very good
Display explanation	4	Very good
Screen density	3	Good
Font accuracy	4	Very good
Animation display	4	Very good
Color composition	3	Good
Ease of use	4	Very good
The accuracy of the size of the image with the composition of the size of the writing	4	Very good
Layout	4	Very good
Ease of navigation	3	Good
Order of frames	4	Very good
Accuracy of music or sound	3	Good
Total Score		55

The results of the assessment carried out by media experts, namely Ms. Fina Fakhriyah, M.Pd. is the last step in validation. The validation results obtained a total score of 55 with a value of 91.6% with a very feasible and usable category.

The results of the pretest and posttest values in the experimental and control classes show normal and homogeneous data. Then proceed with the t test and the N-gain is obtained as follows. Testing the effectiveness in the use of educational game interactive media was carried out with a t-test to find out whether there were differences in learning outcomes between the experimental class using interactive educational game media and the control class. The results of hypothesis testing using SPSS version 26. The significance level used in this hypothesis test is  $\alpha = 0.05$ . If significance  $> 0.05$  then  $H_0$  is rejected and  $H_a$  is accepted (Priyatno 2018). Based on the results of the Independent Samples Test data on the learning outcomes of the experimental class and the control class with the help of SPSS is significance (sig.2-tailed) of 0.019 is less than 0.05 ( $0.019 < 0.05$ ) t value is calculated = 2,425, t table = number of samples (n) of 48 with  $df = n - 2 = 48 - 2 = 46$  (Priyatno 2018), seen from the table distribution table with  $\alpha = 5\%$  to obtain a t table of 2,012 (Sugiyono 2019), then  $H_0$  is rejected and  $H_a$  is accepted. So, it can be concluded that  $H_0$  is rejected and  $H_a$  is accepted, meaning that there are differences in learning outcomes between the experimental class that applies interactive educational game media and the control class. The N-gain analysis test is used to analyze learning outcomes in the experimental class using interactive educational game media. The N-gain test is used to determine the difference between the pretest and posttest values to show the effectiveness of educational game interactive media. The following is the data for the N-gain test.

Table 5. N-gain test results

Information	Score
Pretest Average	48,70
Posttest Average	85,87
N-gain	0,72

N-gain results by comparing the average pretest and posttest scores. The calculation results obtained N-gain = 0.72 in the high category (Wahab 2021)

### CONCLUSION

The results of the feasibility test of interactive educational game media by media experts and material experts get very feasible criteria and can be used for the learning process. The results obtained by the validation of media experts get a score of 91.6% with very decent criteria. The results of the validation of material experts get a score of 94.4% with very decent criteria.

In the effectiveness test of the experimental class and the control class there is a significant difference, the result is an N-gain of 0.72 with a high category. While the comparison of the results of the assessment in the control class and the experimental class obtained  $t_{\text{count}}$  results of 2,425 in  $t_{\text{table}}$  with  $\alpha = 5\%$  obtained 2,012 so the results of  $t_{\text{count}} > t_{\text{table}}$ . So it can be concluded that interactive educational game media can improve students' cognitive learning outcomes in thematic learning in helping learning material in KD Natural Science.

As educators, teachers are expected to be able to continue to innovate and utilize learning media that can be used while the learning process is in progress so that students' knowledge becomes wider and improves students' cognitive abilities. Educational game interactive media can be used as an alternative as a teaching medium for water cycle material so that students can better understand and make it easier for students to learn. For future researchers, it is hoped that they can find more references so that the research results will be better.

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