JPPIPA 10(8) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Interactive Media Based on GIPAS Application Assisted by Self-Directed Learning Model to Improve Critical Thinking Skills

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Received: April 22, 2024
Revised: June 12, 2024
Accepted: August 25, 2024
Published: August 31, 2024

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DOI: 10.29303/jppipa.v10i8.7462

Abstract: The results of the initial interview were explained by the class teacher that grade V students of SD Negeri Punggursugih still had low critical thinking skills, especially in the food chain and food web materials. Then, the results of observations also prove that in general teachers still do not use learning media by utilizing technology. The purpose of this research is to develop interactive learning media based on the Gipas application so that it can facilitate students in the process of understanding food chain material and food webs. The type of research used is research and development (RnD) with the ADDIE model modified into 5 stages. Methods for gathering data include documentation, interviews, surveys, and observation. The evaluation of the product yields media validation from material and media experts, with a classification of "very feasible" at 86% and 89%, respectively. The T-test yielded a significance value of 0.000 for the media's effectiveness. The result of the N-gain calculation is obtained at 0.74 with the criterion "high". So gips interactive media based on gipas application food chain material and food webs are said to be very similar and effective to be applied in improving critical thinking skills. Researchers advise using application-based interactive media to ensure that it is fully utilized and that learning is engaging and enjoyable so that students can comprehend the information being presented.

Keywords: Critical thinking skills; Interactive media applications; Self directed learning

Introduction

Education is an effort to master knowledge obtained from formal and non-formal environments to produce quality individuals. To get the best results, national education objectives must be organized according to Law Number 20 of 2003 governing the National Education System. National education is supposed to mold pupils into individuals who respect and revere God Almighty and are virtuous, intelligent, competent, imaginative, autonomous, and democratic. In the development of quality human resources and the ability to compete with the era of technological innovation, it is necessary to strive for critical thinking skills by the nation's next generation to find information that can be obtained efficiently. Therefore, education must enable students to be more critical and find their path. But in reality, not all educators hone critical thinking skills for their students. To keep up with advances in technology, information, and communication, it has become the goal of future education to concentrate on forming the awareness and critical attitude of each student to meet the demands of global development.

The 21st-century curriculum focuses on future needs that require students to think critically,

How to Cite:
Lestari, Y., & Sunarso, A. (2024). Development of Interactive Media Based on GIPAS Application Assisted by Self-Directed Learning Model to Improve Critical Thinking Skills. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 4461–4469. https://doi.org/10.29303/jppipa.v10i8.7462

communicate well, collaborate with others, solve problems, and be creative (Van Laar et al., 2020). In the 21st century which is also referred to as the "age of knowledge", rapid progress in the field of technology and information has become a major need for human beings (Al-Youbi et al., 2021). In addition, the integration of technology into education is a new aspect in this period (Kaminskienė et al., 2022). There are four abilities that students must master in this century, namely communication, collaboration, critical thinking, and creativity. Human resources that will survive in this century must have flexible intelligence and be able to analyze and evaluate problems to find solutions (Chowdhury et al., 2023). When it comes to educating future pupils to fulfill the demands it comes to educating future pupils to fulfill (Davidescu et al., 2020).

In the modern era like today, education uses a learning approach based on 21st century learning which has a shift in learning approaches (Kim et al., 2019). Curricula designed by educator institutions lead to a shift in learning approaches that were originally educator-centered to student-focused. With the learning system focused on students rather than teachers, it aims that students are not easily influenced by hoaxes and not easily influenced by misinformation (Lan & Tung, 2024; Ali et al., 2021). 21st-century learning emphasizes the concept of critical thinking as the main focus in classroom education. Therefore, the role of teachers as teachers and students as learners is very important to support the learning process (Keiler, 2018).

Critical thinking is a way of thinking logically and wisely, with an emphasis on making decisions based on beliefs (Ho et al., 2023). Critical thinking is also defined as a way of thinking students use cognitive skills to improve learning outcomes, such as carefully analyzing thoughts and opinions in solving problems (Sellars et al., 2018; O'Reilly et al., 2022). To select what they receive, critical thinking skills students will allow them to evaluate information based on prior knowledge. In another sense, students who have such critical thinking skills always monitor the way they think to avoid making wrong decisions or choices. Interpretation; analysis; evaluation; inference; export, and self-regulation.

Based on the results of TIMSS 2016, it shows that Indonesia's ability in science and mathematics is ranked 48th and 45th out of 50 participating countries respectively with an average score obtained by both 39 points out of 500 points. In addition, based on the findings of the PISA science literacy study, Indonesia's educational system continues to lag both developed and developing nations. Results from the PISA survey in 2018 revealed Indonesia's low position in reading, science, and mathematics, further supporting the country's reputation for having poor educational standards. Out of the 79 nations that were included in the survey, Indonesia came in at position 74 (Dewi et al., 2023). The results of TIMSS 2011 show that Indonesia is in a low position, the Indonesian state is under Palestine, a country that has been in a state of war. This happens because students have low critical thinking skills and fail to complete tasks that require critical thinking. Several factors contribute to students' low achievement on the TIMSS and PISA, including their poor problem-solving skills. These factors include the questions' commonality—that is, they require reasoning, argumentation, and critical thinking to be answered (Pradita et al., 2021). Teachers should find additional, more reliable sources of information in addition to simply copying what is written in their textbooks to support this. Other ways can also be done by educators by utilizing innovative technology in learning. Just like an educator who is required to explain or provide material to students using digital-based learning media 21st-century learning (Landina & Agustiana, 2022). Previous research findings also stated that the use of the educational game media "Travel Si Maya" based on Android can help students improve critical thinking skills and learning interests of elementary school students (Anggraeni et al., 2023). The difference between this media and media is Android-based with the material taken, which is the style of science death. In addition, creating this media can also help improve students' learning abilities both in terms of critical thinking skills and interest in learning.

Based on this, researchers are interested in conducting research related to the development of interactive media based on the GIPAS application (IPAS Game) assisted by a self-directed learning model on Class V elementary school science content. The purpose of this study is to design a product in the form of interactive media based on the GIPAS application assisted by a self-directed learning model for grade V elementary school students, with the hope that the resulting learning media is innovative and can improve students' critical thinking skills, especially in science lesson content.

Method

This type of research is research and development (R&D). The research methodology known as "research and development" is used to create products and evaluate their efficacy. The ADDIE development model that is substantially assessed as effective in the development of learning media is used in this study. The ADDIE model emphasizes iteration and reflection that allows continuous improvement focused on feedback (Harjanta & Herlambang, 2018). The five phases of the

ADDIE model are analysis, design, development, implementation, and evaluation (Setiawan et al., 2021).

Applications-based interactive media are being developed as a result of this research. According to research on learning media development employs the ADDIE model development methodology (Spatioti et al., 2022). This research focuses on analysis, design, and development stages, thus the ADDIE model was chosen because it comprises several systematic sequences based on the needs, problem-solving, and learning characteristics of Indonesians.

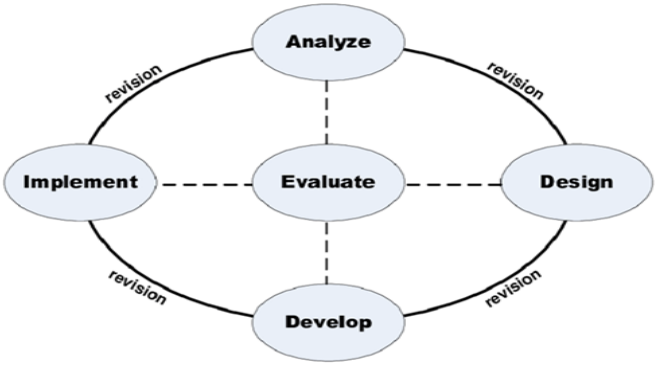

Figure 1. Phase of creating flowcharts for the ADDIE model

The trial site for application-based interactive learning media on food chain material and food webs was carried out in grade V of SD Negeri Punggursugih and the implementation time was carried out in the even semester of the 2023/2024 academic year. Data collection is carried out using tests and non-tests. The test method is done by giving an initial test before the media treatment (pretest) and giving a test at the end after being given media treatment (posttest). With this approach, the critical thinking abilities of SD Negeri Punggursugih's grade V students are monitored for improvement. Holding pretests and posttests can make it easier to find more accurate results before and after treatment with the media. Meanwhile, for non-test methods, researchers carry out observations, interviews, questionnaires, and documentation.

Small-scale trials were conducted to determine the qualitative evaluation of application-based interactive media that has been designed by media experts and material experts. The purpose of the study is to ascertain how students react to the display test of media design, the functionality of media content, and the effective use of buttons in media that follow the researcher's developed guidelines. The small-scale trial was conducted using research subjects as many as 6 grade V students of SD Negeri Punggursugih. Meanwhile, large-scale trials were conducted to determine the effectiveness of application-based interactive media to improve students' critical thinking skills. The large-scale trial was conducted using research subjects as many as 24 grade V students of SD Negeri Punggursugih. In this large-scale trial, researchers used a one-group pretest and posttest research design. The use of one group pretest and posttest design aims to compare conditions before and after treatment using media. The following is a table of research designs for one group pretest-posttest design:

Table 1. One Group Pretest Posttest Design

Before Treatment	Treatment	After Treatment
O_1	X	O_2

Information:
0_1 : Value before the treatment of learning media Gipas application
0_2 : Final grade after Gipas application learning media treatment
X : Application of Gipas application learning media

The characteristics developed in the Gipas application use descriptive method data analysis techniques. The feasibility of Gipas application media is analyzed according to the validation results from media experts and material experts using the following percentage formula:

$$NP = \frac{R}{SM}\ x\ 100\% \quad (1)$$

Information:
NP : Percent value sought or expected
R : Raw scores obtained by students
SM : The ideal maximum score of the test in question

Then the percentage of data is converted based on the criteria of very feasible, feasible, decent enough, less feasible, and not feasible.

Table 2. Product feasibility assessment criteria

Percentage	Criterion
86 – 100	Very decent
71- 85	Proper
56- 70	Pretty decent
41- 55	Less viable
25- 40	Not worth it

Data analysis was used to determine the effect of using interactive media Gipas developed to improve students' critical thinking skills based on before and after media treatment which was then calculated using the N-Gain Score formula as follows (Vedechkina & Borgonovi, 2021).

$$N - Gain = \frac{Skor\ postest - skor\ pretest}{Skor\ maks - pretest} \quad (2)$$

The calculation results are then categorized based on the N-Gain score assessment criteria as follows:

Table 3. N-Gain Score Category

Average	Criterion
g > 0.70	Tall
0.30 ≤ g ≤ 0.70	Keep
g < 0.30	Low

The variable relationship used in the study is independent and bound variables. The variable is free in the study, namely interactive media based on the Gipas application, while the dependent variable is to improve critical thinking skills grade V SD Negeri Punggursugih.

Result and Discussion

This research resulted in a product in the form of a Gipas application. The Gipas application is developed using construct 2 which can be accessed through the application using Android. The design used in the learning media is tailored to the needs of students and natural and social science materials in elementary schools. The following link will allow you to use the Gipas application learning media *https://drive.google.com/file/d/11d4oXoJRYfBRonpadbE7o0YcDr6YQXTT/view?usp=drivesdk*. The media display of the Gipas application can be seen in the following image.

Figure 2. Gipas application cover display

Figure 3. Gipas application menu display

The Gipas application media is equipped with images, illustrations, and backgrounds that make students more interested in learning. In addition, the language used in the media uses language that is easily understood by students. The first step in the research and development of Gipas application media is the analysis of problems contained in SD Negeri Punggursugih. Analysis was conducted by observation, interviews, questionnaire dissemination, and documentation. Based on observations and interviews, there are several problems including natural and social science learning, teachers do not use learning media by utilizing technology, lack of facilities and infrastructure in schools, and teachers only rely on textbooks as learning resources that have an impact on students' low critical thinking skills. In this analysis step, researchers collect information about product development with the aim that the products produced are by the needs of teachers and students and can overcome problems in SD Negeri Punggursugih.

Product design is carried out by adjusting the results of the analysis of the distribution of questionnaires for teacher and student needs. In this step, researchers begin to design product ideas that are interesting and not monotonous. To overcome this, researchers began to realize media at the development stage using a combination of contrasting colors and adjusting to the background. In addition, the Gipas application media is also equipped with a menu display that can be selected by users in the form of profiles, learning outcomes, learning objectives, instructions for use, materials, quizzes, and games that can be easily accessed in the application and become one of the main attractions for students. The media creation process is designed using Figma, after the design the application has all features with Construct 2 and is exported to HTML 5, then converted to APK with the website. At this stage of development, researchers also create instruments to measure product performance. Subsequently, material and media specialists validate the instruments and produce media. The following conclusions were drawn from the evaluations of material and media experts.

Table 4. Product Validation Result

Validators	Percentage(%)	Criterion
Material	86	Very decent
Media	89	Very decent
Average	88	Very decent

After an interactive media assessment based on the Gipas application by material experts, a percentage of 86% was carried out in the very decent category. Meanwhile, media experts get a percentage of 89% with a very decent category. From this assessment, it can be

concluded that interactive materials and media based on the Gipas application are worthy of trial. Small-scale and large-scale trials are carried out at the implementation stage. Small-scale trials were conducted by several grade V students of SD Negeri Punggursugih to prove the effectiveness of the products to be developed. Product effectiveness tests are carried out using assessment instruments so that the data obtained is complete and meets effectiveness standards. In the small-scale trial, there were 6 students sampled, including 2 upper ranks, 2 middle ranks, and 2 final ranks. This is so that small-scale trials can run evenly and balanced. The results of small-scale trials obtained a value of 100% showing that the Gipas application media is very good and there is no suggestion input, so it can be used for large-scale trials.

A large-scale trial was conducted by grade V students of SD Negeri Punggursugih as many as 24 students to test the feasibility and effectiveness of interactive media products based on the Gipas application that had been made. The results obtained show that 100% of students say that the Gipas application media is very good and interesting. Below are the normality test results of small-scale and large-scale trials.

Table 5. Small-Scale Normality Test Results

	Tests of Normality					
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	Df	Sig.
Pre_Test	.288	6	.130	.853	6	.166
Post_Test	.185	6	.200*	.960	6	.822

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 6. Large-Scale Normality Test Results

	Tests of Normality					
	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	Df	Sig.
Pre_Test	.174	24	.059	.920	24	.060
Post_Test	.183	24	.036	.923	24	.067

a. Lilliefors Significance Correction

Based on the table above, it can be interpreted that the significant values of the pretest and postest on a small scale of 0.16 and 0.82 whose results are both greater than 0.05, then the pretest and postest data are normally distributed. Meanwhile, the significant values of the pretest and posttest on a large scale are 0.06 and 0.06 whose results are both greater than 0.05, then the pretest and posttest data can be said to be normally distributed. From the results of the normality test, it can be concluded that the significant values of pretest and postest from both small and large-scale trials show that the two data are normally distributed. The normality test is initial data analysis, then with t-test analysis data to determine the effectiveness of application-based learning media Gipas chain and food web materials on critical thinking skills by knowing the average pretest and post-test scores. The following are t-test results for small and large-scale applications.

Table 7. Small-Scale and Large-Scale t-Test Results

		Paired Samples Test							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	Df	Sig. (2-tailed)
Pair 1	Before treatment – after treatment	-35.33	3.44	1.40	-38.94	-31.71	-25.12	5	.000
Pair 1	Before treatment – after treatment	-32.33	5.40	1.10	-34.61	- 30.05	- 29.31	23	.000

It can be seen in the table that sig. (2-tailed) 0.000 < 0.05 so it can be concluded that there is a significant difference between pretest and posttest results on a small scale and a large scale. Furthermore, in the fifth stage, an evaluation was carried out to test the increase in the average N-gain value by comparing the increase in the results of the pretest and posttest values calculated using gain index analysis with the following results.

Table 8. Small & Large Scale N-Gain Test Results

	N	Min	Max	Mean	Std. Deviation
N-Gain	6	.61	1.00	.8036	.13459
Valid N (listwise)	6				
N-Gain	24	.50	1.00	.7499	.14325
Valid N (listwise)	24				

The aforementioned table suggests that using the Gipas application learning medium has improved students' average scores in both small- and large-scale trials with high criteria. This is evidenced by the results of the mean value on large and small scales greater than 0.07. The teacher's response questionnaire reached 100% with no revisions or suggestions from the class teacher.

Having undergone both small and large-scale trials, the learning materials for the Gipas application are highly successful. To ascertain the effectiveness of the media produced, it was evaluated not only based on students' critical thinking test scores but also on the answers to surveys from teachers and students. This demonstrates how interactive learning resources can help students develop their critical thinking abilities.

However, field observations and interview data revealed that teachers did not employ technology to create learning materials for scientific classes (Muhaimin et al., 2020; Kafyulilo et al., 2016). This is due to the lack of facilities and infrastructure in schools to support learning activities such as one of which is not available library at school. So, teachers only rely on textbooks as learning resources (Fan et al., 2021; Knight, 2015). As a result, learning becomes monotonous, and low critical thinking skills of students because it still involves the ability to think abstractly which does not maximize the role of learning media in the learning process in the classroom (Lestari et al., 2022; Juwita & Fauzan, 2020). The low critical thinking ability of students at school is proven when students do questions directly given by the teacher and the results are not what is expected (Davies & Willing, 2023; Li, 2023). Students are less able to master the questions given, It is different when the work on the questions given is done at home where the results of the work are collected without the teacher knowing who is doing the questions.

The creation of digital learning materials that enhance students' critical thinking skills can be the answer to these issues (Meirbekov et al., 2022; Vong & Kaewurai, 2017; Tan et al., 2023); Almulla, 2023). The demands and features of students have led to the adjustment of many components in learning media (Sivakumar et al., 2023; Amerstorfer et al., 2021; Darling-Hammond et al., 2020). The learning media is made by utilizing technology that can make learning more interesting and fun (David & Weinstein, 2023). Using technology to create educational media makes it simpler for teachers to present content to students (Haleem et al., 2022). In addition, learning using technology can make it easier for students to understand and remember the material that has been delivered by the teacher. Not only that, learning media will also help increase students' interest and desire to learn (Heriansyah, 2020). One of the developments in science and technology of the educator era 4.0 is the use of applications as learning media.

In maximizing media, the learning model used is Self Directed Learning (Zamnah & Ruswana, 2019; Sriarunrasmee et al., 2015). Self Directed Learning is a learning model that gives students the freedom to identify learning needs by using learning strategies that are by the student's learning abilities. It is hoped that this will enable students to think critically, work collaboratively, and communicate. By creating learning activities that allow students to learn on their own, teachers can improve their critical thinking skills (Wale & Bishaw, 2020).

Conclusion

The results of this study show that Gipas application-based interactive media has been developed to improve the critical thinking skills of grade V students of SD Negeri Punggursugih. Based on the validation results of material and media expert lecturers, it was found that the results were very feasible to be used to support the teaching and learning process. The results of large-scale trials show that interactive learning media based on the Gipas application is quite effective in improving students' critical thinking skills.

Acknowledgments
The researcher expresses gratitude to SD Negeri Punggursugih's principal, staff, and instructors for their support and opportunity during the research process. We express our gratitude to the supervisor for helping us finish this piece.

Author Contributions
Conceptualization, methodology, validation, formal analysis, investigation, formal analysis, investigation, resources,; Y. L.; and data curation, writing-original draft preparation, writing—review and editing, visualization, supervision, project administration,.; funding acquisition,; A. S. All authors have read and agreed to the published version of the manuscript.

Funding
The research received no external funding.

Conflicts of Interest
The author declares no conflict of interest.

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