

Development of Multimedia-Based Learning Media Healthy and Nutritious Balanced Diet Materials to Improve the Understanding of Grade III Elementary School Students

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ABSTRACT

This development research aims to develop multimedia-based learning media for healthy and nutritious balanced diets that are feasible and effective to improve the understanding of grade III elementary school students. Development research using 4D assessment steps, namely the Define stage, was carried out by analyzing the needs of PJOK teachers through a survey using Google Form. The Design stage includes designing media and making research instruments for students who have gone through validity and reliability tests at SD Pleret Lor with 20 samples. Furthermore, the media products were validated by 2 material experts and 2 media experts. The Development stage involves three types of trials, namely a small-scale test at SDN 1 Pengasih with 13 samples, a large-scale test at SDN Experiment 4 with 77 samples, and an effectiveness test at SDN Experiment 4 with 20 samples of students. The test results are used to revise and improve the product. Thus, it can be concluded that the learning media of healthy and balanced nutrition in elementary school students in grade III is feasible and effective to use.

INTRODUCTION

One way to build the Indonesian nation is through education, including through the subject of Physical Education, Sports and Health (PJOK). PJOK plays an important role in developing students' potential as a whole, including physical, social, mental, emotional, and health aspects. According to Supriyadi (2018), PJOK contains values such as discipline, creativity, cooperation, and healthy living habits that support the cognitive and moral development of students. PJOK learning also has a great contribution to the formation of students' personalities and the achievement of national education goals. One of the important aspects of PJOK is health education that encourages students' awareness to maintain a healthy lifestyle, including in terms of consuming nutritious food. However, the reality on the ground shows that many elementary school-age children still experience malnutrition, both in the form of undernutrition and overnutrition, as found by several studies (Fitri & Wiji, 2019; Santoso & Wahjuni, 2022; Nurusyaikha et al., 2023; Winarni & Mustikawati, 2022).

The success of PJOK learning is greatly influenced by various factors, especially the role of teachers. Based on the results of a survey of elementary school teachers, only a small percentage have implemented multimedia-based learning, although most are aware of the benefits. The low implementation of digital media can be caused by limited facilities, lack of training, and low digital literacy of teachers. In fact, multimedia-based learning is believed to increase students' enthusiasm, independence, and understanding of the material. Therefore, it is necessary to develop and implement learning media that is interesting, interactive, and in accordance with the needs of students so that PJOK learning runs more optimally and meaningfully.

In the implementation of the Independent Curriculum, teachers are required to be creative and innovative in utilizing technology as a learning medium. The characteristics of elementary school students who like to play, move, and learn directly demand the use of interesting and interactive learning media. Through image, video, and sound-based multimedia, students can be more active and motivated in the learning process. This is in line with the learning outcomes (CP) of the 2024 Independent Curriculum which emphasizes the importance of introducing health risks, a balanced nutritious diet, and the implementation of healthy living. Thus, the development of multimedia-based learning media not only provides a fun learning experience, but is also effective in increasing students' understanding of healthy and nutritious balanced eating materials in elementary schools.

THEORETICAL REVIEW

Learning Media

Learning media is a means used in the teaching and learning process to help convey messages from teachers to students so that learning goals are achieved. Media functions not only as a teaching aid, but also as a stimulus that can increase students' motivation, attention, and learning interactions (Moto, 2019; Scott, 2018). The use of learning media provides many benefits, including making learning more interesting, interactive, efficient, and improving the

quality of learning outcomes and student motivation (Rasyid & Rohani, 2018; Febrita & Ulfah, 2019). Good media must meet several criteria such as relevance, ease of use, availability, and usefulness (Rivai in Pratiwi & Meilani, 2018). In the context of PJOK learning, especially nutritious food materials and healthy snacks, the use of multimedia is the right choice because it combines text, sound, images, animations, and videos to create a more interesting and interactive learning experience (Marjuni & Harun, 2019; Kurniawati & Nita, 2018; Manurung, 2020). One of the applications that supports the development of interactive media is **Adobe Animate**, a software that is a development of Adobe Flash Professional. Adobe Animate is used to create animations, videos, interactive media, and learning applications based on HTML5 Canvas and WebGL, so it is very relevant to create innovative learning media that is in line with the development of educational technology (Saputro, 2018).

Healthy Living Behavior

Healthy living behavior is a habit that is carried out regularly and continuously to maintain body balance through a nutritious diet, regular exercise, adequate rest, and avoiding bad habits such as smoking and consuming alcohol (Septianto et al., 2020; Afdinda et al., 2021). A healthy lifestyle also includes personal and environmental hygiene, maintaining physical and mental fitness, and fulfilling adequate nutrition (Susanti & Kholisoh, 2018). The application of healthy living behaviors from an early age is important to form sustainable positive habits and support children's development at home and at school. The benefits of healthy living include improving sleep quality, maintaining stamina, preventing disease, fostering confidence, and creating a balance of physical and mental life (Limbong et al., 2020; Sumihar & Fernando, 2021). Thus, the application of healthy living behaviors can improve the quality of health, prevent diseases, and provide comfort in carrying out daily activities.

Nutrient

Nutrition is the science of the body's processes of using food for growth, tissue repair, and energy sources (Irianto, 2006; Fitri & Wiji, 2019). Nutrients are differentiated into energy producers, building substances, and regulatory substances (Azam et al., 2019), all of which are important for school-age children to support growth and intelligence. A balanced healthy and nutritious diet according to the Indonesian Ministry of Health includes food diversity, clean living behaviors, physical activity, and weight monitoring. Nutritious foods must contain carbohydrates, proteins, fats, vitamins, minerals, and water in balanced proportions and minimal preservatives and saturated fats (Azzahra, 2021). In addition, it is important to pay attention to safe food because school snacks often contain harmful additives (Fardani & Abdurrahim, 2023). By understanding nutrition and choosing healthy foods, children can avoid nutritional problems and grow healthy and optimal.

Characteristics of elementary school students

The characteristics of elementary school students according to Kurniawan in Mutia (2021:118) include four main things, namely: (1) love to play, so teachers need to include elements of play in learning; (2) likes to move, so learning should allow students to move or be physically active; (3) enjoy working in groups, because through cooperation children learn responsibility, sportsmanship, and democracy; and (4) enjoy doing or demonstrating something in person, so learning needs to be designed so that students can be actively involved in real practice.

METHODOLOGY

Development Model

This research uses **the Research and Development (R&D) method with a 4D development model** (Define, Design, Develop, Disseminate) according to Thiagarajan. This model is used to develop and test the effectiveness of **multimedia-based learning media** on *healthy and nutritious balanced diet materials* for grade III elementary school students according to the Independent Curriculum.

Development Procedure

The development procedure follows four main stages of the 4D model:

1. **Define**

Includes preliminary analysis, student analysis, concept analysis, task analysis, and formulation of learning objectives to determine the needs and basis for the development of PJOK learning media.

2. **Design**

Determine the material, preparation strategy, and design of assessment instruments that are validated by experts before use.

3. **Development**

Validating material and media experts, revising according to suggestions, and limited trials in the field to obtain suitable media for use.

4. **Disseminate**

Disseminate the product after it has been declared valid and effective based on the results of the trial.

Product Trial Design

The trial was conducted to assess the quality and feasibility of multimedia-based learning media. Data was obtained from the validation of media experts, material experts, and user input which was used as the basis for product evaluation and improvement.

Trial Subject

The trial was carried out on 13 third grade students of SD Negeri 1 Pengasih, with permission to use technology and information-based media from the school.

Data Collection Techniques and Instruments

Data is collected in both quantitative and qualitative form.

1. The media member's instrument assesses eligibility based on aspects of navigation, content, presentation, aesthetics, and overall functionality.
2. A Likert scale questionnaire is used to assess expert and learner responses.

Data Analysis Techniques

The data was analyzed using quantitative descriptive analysis with the help of SPSS software.

1. Validity and Reliability Tests

Using Pearson Correlation and Cronbach's Alpha to ensure the instrument is accurate and consistent.

2. Questionnaire Data Analysis

Using the Likert (Very Good–Very Poor) scale to assess media eligibility.

3. Test Data Analysis (Product Effectiveness)

Using a pre-experimental design with pretest-posttest to measure improved learning outcomes. Effectiveness was tested through a t-test; the increase in grades showed an effective learning medium for grade III elementary school students.

RESULTS

Initial Product Development Results

This research produced **multimedia-based learning media** using **Adobe Flash Player** with the material "*Healthy and Balanced Nutrition*" for grade III elementary school students. The main goal is to improve students' understanding through interactive media that is interesting and effective.

Define Stage

This stage aims to identify the needs, problems, and characteristics of PJOK students and teachers.

1. Preliminary analysis:

The results of the survey on 14 PJOK teachers showed that only 5 teachers had ever used multimedia-based media. Teachers consider interactive media important because it can increase learning motivation, but its application is still minimal due to limited technological capabilities.

2. Student analysis:

Grade III students (age ± 9 years) think concretely and like interesting visuals. The media is developed with pictures and examples of real food to make it easy to understand.

3. Concept analysis:

The media contains healthy eating materials, practice questions (20 multiple-choice questions), and interactive games. The material is arranged according to the indicators of competency achievement (GPA).

4. Analysis of learning tasks and objectives:

Students are expected to be able to recognize examples of healthy foods, understand the benefits of balanced nutrition, and design healthy menus according to daily life.

Design Stage

This stage includes designing instruments and preparing learning media.

1. Preparation of assessment instruments:

- a) Instruments were given to students, media members, and material experts.
- b) The validity test results show that all question items are valid ($r\text{-count} > 0.4438$).
- c) The results of the reliability test showed that Cronbach's Alpha = 0.751 was a reliable instrument.

2. Preparation of learning media:

The media is organized in an **interactive** form with the Play Button *initial view*, containing the menu:

- a) Learning objectives
- b) Healthy diet material
- c) Practice questions
- d) Educational games

This media is made to be interesting, interactive, and makes it easier for students to understand the material independently.

Development Stage

This stage involves a validation test of material experts and media experts.

a) Subject matter expert validation:

Total score = 62, categorized as worth using (because $64 > 62 \geq 40$). Experts provide input related to simplifying terms and adjusting language to be more communicative.

b) Media expert validation 1:

Total score = 78, categorized as feasible ($80 > 78 \geq 50$). Media is considered easy to operate, interesting, and suitable for learning functions.

c) Media expert validation 2:

Total score = 74, also included in the eligible category. Experts consider this interactive media interesting and effective to improve student understanding.

d) Conclusion of the development stage:

Based on the validation results of all experts, learning media is worth being tested on both small and large scales.

Disseminate Stage

After being declared feasible, the learning media is disseminated to grade III students. Teachers use pre-test and post-test results to assess the effectiveness of the media. The results of the analysis showed an increase in value after the use of media, which means that the media effectively increases students' understanding of healthy and nutritious diet materials.

Product Trial Results

1. Small-Scale Trials

Table 1. Categories of Small Scale Trial Results

Indicator	Criterion	Formula	Account
Ease of navigation	Highly feasible	$X \geq \text{Mean} + 1 \text{ SD}$	$X \geq 12$
	Proper	$\text{Mean} + 1 \text{ SD} > X \geq \text{Mean}$	$12 > X \geq 10$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1 \text{ SD}$	$10 > X \geq 8$
	Very less feasible	$X < \text{Mean} - 1 \text{ SD}$	$X < 8$
Cognition content	Highly feasible	$X \geq \text{Mean} + 1 \text{ SD}$	$X \geq 12$
	Proper	$\text{Mean} + 1 \text{ SD} > X \geq \text{Mean}$	$12 > X \geq 10$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1 \text{ SD}$	$10 > X \geq 8$
	Very less feasible	$X < \text{Mean} - 1 \text{ SD}$	$X < 8$
Presentation of information	Highly feasible	$X \geq \text{Mean} + 1 \text{ SD}$	$X \geq 8$
	Proper	$\text{Mean} + 1 \text{ SD} > X \geq \text{Mean}$	$8 > X \geq 5$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1 \text{ SD}$	$5 > X \geq 2$
	Very less feasible	$X < \text{Mean} - 1 \text{ SD}$	$X < 2$
Media integrity	Highly feasible	$X \geq \text{Mean} + 1 \text{ SD}$	$X \geq 8$
	Proper	$\text{Mean} + 1 \text{ SD} > X \geq \text{Mean}$	$8 > X \geq 5$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1 \text{ SD}$	$5 > X \geq 2$
	Very less feasible	$X < \text{Mean} - 1 \text{ SD}$	$X < 2$
Artistic and aesthetic	Highly feasible	$X \geq \text{Mean} + 1 \text{ SD}$	$X \geq 20$
	Proper	$\text{Mean} + 1 \text{ SD} > X \geq \text{Mean}$	$20 > X \geq 12,5$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1 \text{ SD}$	$12,5 > X \geq 5$
	Very less feasible	$X < \text{Mean} - 1 \text{ SD}$	$X < 5$
Overall Function	Highly feasible	$X \geq \text{Mean} + 1 \text{ SD}$	$X \geq 12$
	Proper	$\text{Mean} + 1 \text{ SD} > X \geq \text{Mean}$	$12 > X \geq 7,5$

	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1\text{SD}$	$7.5 > X \geq 3$
	Very less feasible	$X < \text{Mean} - 1\text{SD}$	$X < 3$

After compiling the categories, the test results will be converted with Table 2 as follows:

Table 2. Small-scale trial conversion

Ye s	Aspects	Average	Category
1	Ease of navigation	13,3	Highly feasible
2	Cognition content	13,6	Highly feasible
3	Presentation of information	6,9	Proper
4	Media integrity	7	Proper
5	Artistic and aesthetic	17,5	Proper
6	Overall functionality	10,2	Proper

The results of the students' assessment showed that the aspects of ease of navigation (13.3) and cognition content (13.6) were included in the very feasible category, while the aspects of information presentation (6.9), media integrity (7), artistic and aesthetic (17.5), and overall function (10.2) were considered feasible. Thus, learning media is considered feasible and easy to use by students.

2. Large-Scale Trials

Table 3. Category Large-Scale Trial Results

Indicators	Criterion	Formula	Account
Ease of navigation	Highly feasible	$X \geq \text{Mean} + 1\text{SD}$	$X \geq 12$
	Proper	$\text{Mean} + 1\text{SD} > X \geq \text{Mean}$	$12 > X \geq 10$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1\text{SD}$	$10 > X \geq 8$
	Very less feasible	$X < \text{Mean} - 1\text{SD}$	$X < 8$
Cognition content	Highly feasible	$X \geq \text{Mean} + 1\text{SD}$	$X \geq 12$
	Proper	$\text{Mean} + 1\text{SD} > X \geq \text{Mean}$	$12 > X \geq 10$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1\text{SD}$	$10 > X \geq 8$
	Very less feasible	$X < \text{Mean} - 1\text{SD}$	$X < 8$
Presentation of information	Highly feasible	$X \geq \text{Mean} + 1\text{SD}$	$X \geq 8$
	Proper	$\text{Mean} + 1\text{SD} > X \geq \text{Mean}$	$8 > X \geq 5$

Indicators	Criterion	Formula	Account
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1\text{SD}$	$5 > X \geq 2$
	Very less feasible	$X < \text{Mean} - 1\text{SD}$	$X < 2$
Media integrity	Highly feasible	$X \geq \text{Mean} + 1\text{SD}$	$X \geq 8$
	Proper	$\text{Mean} + 1\text{SD} > X \geq \text{Mean}$	$8 > X \geq 5$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1\text{SD}$	$5 > X \geq 2$
	Very less feasible	$X < \text{Mean} - 1\text{SD}$	$X < 2$
Artistic and aesthetic	Highly feasible	$X \geq \text{Mean} + 1\text{SD}$	$X \geq 20$
	Proper	$\text{Mean} + 1\text{SD} > X \geq \text{Mean}$	$20 > X \geq 12,5$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1\text{SD}$	$12,5 > X \geq 5$
	Very less feasible	$X < \text{Mean} - 1\text{SD}$	$X < 5$
Overall Function	Highly feasible	$X \geq \text{Mean} + 1\text{SD}$	$X \geq 12$
	Proper	$\text{Mean} + 1\text{SD} > X \geq \text{Mean}$	$12 > X \geq 7,5$
	Less worthy	$\text{Mean} > X \geq \text{Mean} - 1\text{SD}$	$7,5 > X \geq 3$
	Very less feasible	$X < \text{Mean} - 1\text{SD}$	$X < 3$

After compiling the categories, the test results will be converted with Table 4 as follows:

Table 4. Large-Scale Test Result Conversion

Ye s	Aspects	Average	Category
1	Ease of navigation	13,6	Highly feasible
2	Cognition content	13,7	Highly feasible
3	Presentation of information	6,9	Proper
4	Media integrity	7	Proper

5	Artistic and aesthetic	17,6	Proper
6	Overall functionality	11	Proper

The aspects of ease of navigation (13.6) and cognition content (13.7) are included in the very feasible category, while the aspects of information presentation (6.9), media integrity (7), artistic and aesthetics (17.6), and overall function (11) are considered feasible. Overall, learning media is considered feasible and effective for use by students.

Field Test

The field test on grade III students of SDN Experiment 4 was carried out to assess learning media as well as measure improvement in understanding through pre-test and post-test results.

Table 5. Students' Assessment of Learning Media

Ye s	Aspects	Average	Category
1	Ease of navigation	13	Highly feasible
2	Cognition content	13,1	Highly feasible
3	Presentation of information	6,7	Proper
4	Media integrity	6,9	Proper
5	Artistic and aesthetic	16,4	Proper
6	Overall functionality	10,4	Proper

The aspects of ease of navigation (13) and cognition (13.1) are very feasible, while the aspects of information presentation (6.7), media integrity (6.9), artistic and aesthetic (16.4), and overall function (10.4) are considered feasible. Furthermore, an effectiveness test was carried out by comparing the results of the pre-test and post-test of students after using multimedia-based learning media.

Table 6. Pre-test and Post-test scores

Ye s	Pre-test scores	Post-test scores
1.	50	100
2.	60	85
3.	65	80
4.	70	85
5.	65	90
6.	50	80
7.	60	85
8.	50	85
9.	55	90

10.	50	95
11.	45	90
12.	45	85
13.	50	85
14.	70	100
15.	75	95
16.	70	90
17.	75	90
18.	75	100
19.	50	90
20.	55	95

The pre-test and post-test scores were then analyzed using the paired sample t-test to determine the influence of the use of ICT-based learning media on student learning outcomes.

Table 7. T Test Results

Paired Sample Test					
T Test	Std	Mean	T-Count	Df	Sig
<i>Pretest-posttest</i>	<i>10.132</i>	<i>30.557</i>	<i>15.388</i>	<i>25</i>	<i>0.000</i>

A significance value of 0.000 indicates that multimedia-based learning media has a significant effect, and the N-Gain test is used to assess its effectiveness.

Table 8. NGain Test Results

Category	N	Min	Max	Mean	SD
Ngain_score	20	.43	1.00	.7436	.16136
Ngain_persen	20	42.86	100.00	74.3582	16.13577

The test results showed an N-Gain value of 74.3%, indicating that multimedia-based learning media is very effective in improving the understanding of grade III students about a healthy and nutritious balanced diet. Consistently, this media is considered feasible and effective in small, large, and field tests.

Product Revision

1. Addition of Games

The final product of learning media was revised by adding two interactive games, namely Pick the Food and Food Drop, to increase student engagement.



Figure 1. Games Menu Display



Figure 2. Pick The Food Games Display



Figure 3. Food Drop Games Display

2. Addition of salt, sugar, and oil alert material

Material on being aware of salt, sugar, and oil was added to increase students' understanding of the impact of excessive consumption and the importance of maintaining nutritional balance.



Figure 4. Addition of Material 1



Figure 5. Addition of Material 2

Addition of pause button

Added a pause button in the lower left corner so that users can pause learning media as needed.



Figure 6. Addition of Pause Button

DISCUSSION

Adobe flash player-based multimedia-based learning media was developed to increase the understanding of grade III elementary school students about a healthy and nutritious balanced diet through the stages of define, design, development, and dissemination. This media is considered feasible and effective by experts and students based on the six aspects of Thorn's assessment, with an N-Gain score of 74.3% (high category). In addition to increasing understanding, this media also encourages learning motivation, nutritional awareness, and healthy food consumption behavior through interactive materials, practice questions, and two educational games (Food Drop and Pick the Food).

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of research and development, multimedia-based learning media adobe flash player with healthy and nutritious balanced diet materials for grade III elementary school students was declared feasible and effective for use in learning. In order to maximize the use of media, teachers are expected to be able to understand all available features and guide students to not only focus on the game, but also on understanding the material. Meanwhile, students can use this media not only at school but also at home, so they can relearn the material independently until they really understand the content of learning.

FURTHER STUDY

Future studies are recommended to explore the molecular mechanisms underlying the cytotoxic effects of kepel leaf extract and its fractions, as well as to validate these findings using in vivo models for broader clinical relevance.

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