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The Impact of Multimedia-Based Education on Dietary Diversity and Protein Intake among School Children: A Quasi-Experimental Analysis

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ABSTRACT

Nutritional problems among school-age children in Indonesia remain a concern due to low consumption of balanced diets. Basic Health Research 2018 reported that only 5.3% of children meet the recommended fruit and vegetable intake. This highlights the need for more effective nutrition education strategies, with multimedia-based approaches offering a more engaging and understandable way to promote healthy eating behaviors. This study aimed to assess the effectiveness of multimedia-based balanced nutrition education in improving the eating behavior of school-age children. A quasi-experimental study with a one-group pre-test–post-test design was conducted among 75 students in grades IV and V at SDN Seuriget, Langsa City, selected using total sampling. The intervention was implemented over five weeks through a gradual educational approach combining leaflets and animated videos on balanced nutrition. Data were collected at four time points: before the intervention (pre-test), after leaflet education (post-test 1), after animated video education (post-test 2), and one week after the intervention (follow-up). Eating behavior was assessed using the IDDS and dietary intake measurements. The results showed significant improvements in several variables. The median IDDS increased from 6 to 11 ($p < 0.001$). Median protein intake increased from 49.9 g to 57.4 g ($p < 0.001$). Median fat intake decreased significantly from 72.7 g to 54.8 g ($p < 0.001$), while carbohydrate intake showed significant changes ($p < 0.001$). However, energy intake did not show a statistically significant change ($p = 0.667$). In conclusion, multimedia based nutrition education improved dietary diversity and protein intake. These result suggest that external factors such as family dietary habits and household food availability may affect children's overall nutrient intake.

Key Messages:

- The observed changes in nutritional behavior indicate that multimedia-based educational interventions have the potential to serve as sustainable promotive and preventive strategies in the school setting.

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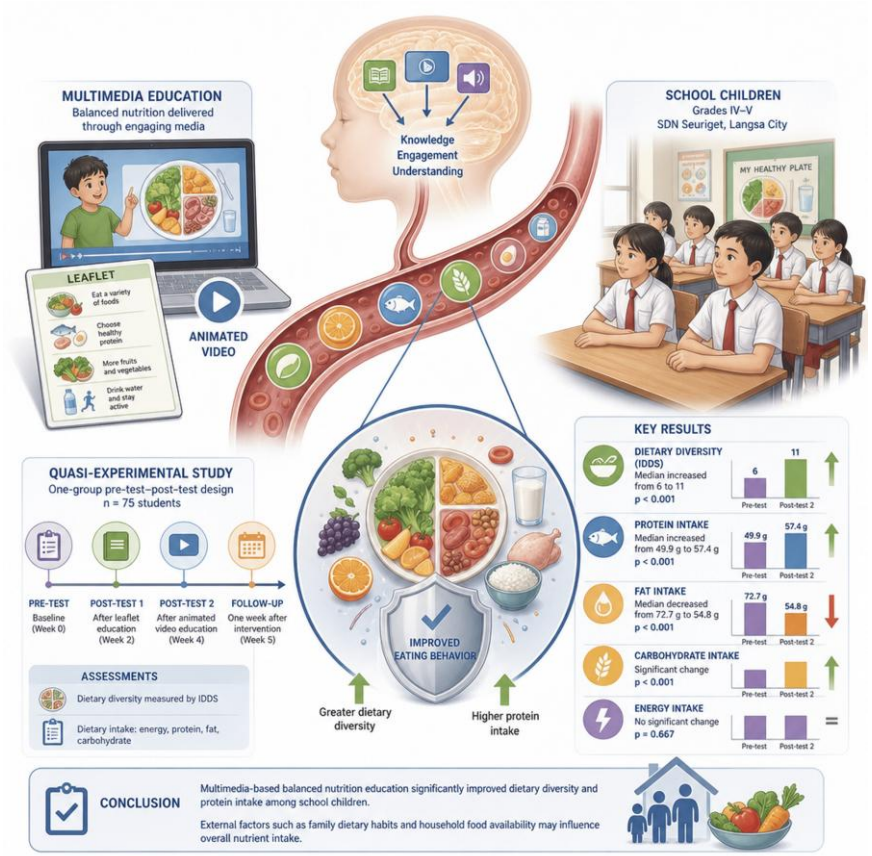
GRAPHICAL ABSTRACT



INTRODUCTION

The problem of nutrition in school-age children is still a serious challenge in Indonesia. Based on the results of the 2024 Indonesian Nutrition Status Survey (SSGI), the national stunting prevalence in 2024 was recorded at 19.8%, showing a decrease from the previous year. However, in Aceh Province, the stunting rate is still relatively high, which is around 29.4% based on SSGI data, thus showing that child nutrition problems are still an important challenge in the region (1).

This figure illustrates that dietary imbalance and low nutritional literacy are still significant problems in various regions. School-age children are a group that is in the period of active growth and the formation of long-term eating habits. If not directed properly, this condition has the potential to have an impact on nutritional status, learning achievement, and health quality in the future (2). Therefore, nutrition education interventions from elementary school age are a strategic step in forming healthy and sustainable eating behaviors.

Various nutrition education programs have been implemented both nationally and locally, but the gap between children's nutrition knowledge and practices is still evident. The results of the 2018 Basic Health Research (Riskesdas) show that only about 5.3% of Indonesian children consume vegetables and fruits as recommended (3). The low consumption of balanced nutritious foods indicates that increasing nutritional knowledge has not fully implicated changes in eating behavior. In the digital era, the use of educational media such as multimedia-based leaflets and animated videos is considered to be able to increase the effectiveness of nutrition messages through attractive and easy-to-understand visual displays (4). The multimedia-based approach is also in line with the learning characteristics of elementary school children who are more responsive to visual and interactive stimulation. Children aged 9–13 years are in the stage of concrete operational cognitive development, which is the phase when children begin to be able to think logically but are still highly dependent on objects or representations that are real and visual (5). At this stage, it is easier for children to understand the information presented through pictures, concrete examples, and contextual stories compared to abstract explanations. Therefore, the use of animated videos

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in nutrition education has advantages over conventional methods such as lectures or textual information delivery. Animated videos are able to combine interesting visual, audio, and movement elements so that they can increase children's attention, understanding, and memory of the nutritional messages conveyed (6). Through dynamic visual presentation, the concepts of balanced nutritious food, food variety, and healthy eating habits can be understood more concretely by school-age children.

A growing body of international evidence suggests that multimedia-based nutrition education is effective in improving knowledge and eating behaviors (7). Video-based and interactive interventions have been shown to improve knowledge, attitudes, and healthy eating practices in children and parents (8). This shows that the multimedia approach is an interesting and effective strategy to address nutritional problems in various populations. In addition, educational approaches using visual displays have been shown to be effective in shaping balanced nutrient consumption behaviors, including protein, fruit, and vegetable intake (9).

Furthermore, changes in eating behavior in children can be understood through a health behavioral theory approach. The Health Belief Model (HBM) explains that health behavior is influenced by an individual's perception of benefits, barriers, and the level of vulnerability to a health problem (10). Meanwhile, the Theory of Planned Behavior (TPB) emphasizes that behavior is influenced by individual intentions formed through attitudes, subjective norms, and perceptions of control over behavior (11). In the context of nutrition education, the delivery of information through interesting media such as animated videos has the potential to increase children's understanding, form a positive attitude towards healthy food, and encourage the formation of an intention to implement a better diet in school-age children.

The multimedia-based approach is also in line with the learning characteristics of elementary school children who are more responsive to visual and interactive stimulation. Research shows that the use of multimedia-based educational media can increase the effectiveness of nutrition education in school-age children. In line with previous research showing that increased nutritional knowledge can encourage changes in healthy eating behaviors in children and adolescents (12). A study in Taiwan found that nutrition education interventions based on animated videos and interactive visual media significantly improved nutrition knowledge and fruit and vegetable consumption in primary school children. However, the study did not find significant changes in students' eating behavior after the intervention was administered (13).

The research gap arises because there is still limited scientific evidence regarding changes in school children's eating behavior that is comprehensively measured using two nutritional measuring instruments, namely the 24-Hour Recall and the Individual Dietary Diversity Score (IDDS). The 24-Hour Recall method is used to quantitatively measure the amount and type of food consumed by individuals in a single day, thus providing an overview of actual intake, while IDDS is used to assess the diversity of food consumption as an indicator of qualitative quality of food patterns (4)(14) The combination of these two methods allows for a more thorough assessment of changes in children's eating behavior after nutrition education interventions, both in terms of the amount of consumption and the variety of foods consumed. However, studies evaluating eating behavior changes using both indicators simultaneously remain limited, particularly in multimedia-based nutrition education interventions among school-age children in Indonesia. Therefore, this study was conducted to assess changes in schoolchildren’s eating behavior after nutrition education delivered through a combination of leaflet media and animated videos using a single-group design. This study also provides initial evidence that behavioral changes may occur within a relatively short period following nutrition education.

Based on this, this study was conducted to answer the question: The extent of the impact of multimedia-based balanced nutrition education, through leaflet media and animated videos, in changing the eating behavior of school children?. The results of this study are expected to provide empirical evidence on the effectiveness of nutrition education media and support efforts to achieve the Sustainable Development Goals (SDGs), especially Goal 2 (Zero Hunger) and Goal 3 (Good Health and Well-being), through increasing nutritional literacy, balanced nutritional intake, and forming healthy eating habits from an early age.

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METHODS

This study uses a quasi-experimental method and a one-group pretest–posttest design. The research was carried out in July-August 2025 at SDN Seuriget, Langsa City, Aceh. The population in this study is all students in grades IV and V of SDN Seuriget which totals 75 students. The sampling technique uses total sampling, so that the entire population is used as a research sample. The inclusion criteria in this study include students in grades IV and V aged 9–13 years, able to communicate and read well, able to choose food independently, and obtain written permission from parents. The exclusion criteria include students who are sick or absent during the data collection process.

The research stage began with the collection of preliminary data (pre-test) using IDDS questionnaires and 24-Hour Food Recall. Furthermore, the intervention was carried out through multimedia-based balanced nutrition education which was given in two structured sessions. The first session (first week) used leaflet media, while the second session (second week) used animated videos. Each educational session lasts approximately 30–45 minutes, which includes material delivery and interactive discussions. Evaluation was carried out through post-test 1, post-test 2, and final evaluation in the fifth week to assess changes and resilience in eating behavior after the intervention.

The multimedia educational material was developed based on the Balanced Nutrition Guidelines and covers topics such as the concept of "Isi Piringku", the importance of healthy breakfast and snacks, water consumption, Clean and Healthy Living Behavior (PHBS), physical activity, and weight and height monitoring. The material used has gone through a validation process and is in accordance with the balanced nutrition guidelines of the Ministry of Health of the Republic of Indonesia (Kemenkes RI) to ensure the suitability of content and accuracy of information for school-age children. Animated video media has a duration of about 30 minutes, while leaflets are concisely arranged as a media to reinforce educational messages.

The intervention was carried out by the principal investigator with the support of trained researchers. Before the research begins, trained researchers are briefed on intervention procedures and data collection to ensure uniformity of implementation and minimize bias in the data collection process.

The independent variable in this study is multimedia-based balanced nutrition education through leaflet media and animated videos. Dependent variables are changes in the nutritional behavior of school-age children, which include diversity in food consumption and fulfillment of daily food intake.

The research instruments used were the 24-Hour Dietary Recall form and the Individual Dietary Diversity Score (IDDS) questionnaire which was compiled based on the guidelines of the Food and Agriculture Organization (FAO). Both instruments are methods that have been widely used in nutrition research to assess individual consumption patterns and food diversity so that they have good validity and reliability. During data collection, the interview process was assisted by visual aids in the form of pictures of food portions and lists of foods commonly consumed by school-age children to help respondents remember the food consumed. The interview was conducted in stages starting from the main meal, the interlude meal, to the time and portion of the meal in the last 24 hours. During the interview process, the researcher used simple language according to the characteristics of school-age children and re-clarified the respondents' answers to minimize reporting errors and improve the accuracy of the data obtained.

Data analysis was carried out using SPSS software version 25. This study uses a total sampling technique with a total of 75 students who meet the inclusion criteria, which is considered adequate for non-parametric statistical analysis. Data normality tests were carried out using the Kolmogorov–Smirnov and Shapiro–Wilk tests. The test results showed that the data were not normally distributed ($p < 0.05$), so the next analysis used a non-parametric test. Changes in values before and after the intervention were analyzed using the Friedman test to see the difference in several measurement times, followed by the Wilcoxon Signed Ranks Test to determine the difference between measurement times.

CODE OF HEALTH ETHICS

This research has been approved by the Health Research Ethics Committee, Faculty of Health Sciences, Universitas Brawijaya with number 195/UN10. F17.10.4/TU/2025

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RESULTS

Table 1 shows that most of the respondents were 9 years old with a total of 39 people (52%). The majority of respondents were female with a total of 45 people (60%). Furthermore, most of the parents of students have a high school education/equivalent consisting of 41 people (54.7%). The majority of students' parents work are housewifes, with a total of 58 people (77.35).

Table 1. Characteristics of the Informant

Characteristics	n	%
Age		
8 Years	3	4.0
9 Years	39	52.0
10 Years	29	38.7
11 Years	4	5.3
Gender		
Male	30	40
Women	45	60
Parental Education		
Primary School	5	6.7
Junior High School	5	6.7
Senior High School	41	54.7
Higher Education	24	32.0
Parental Occupation		
Midwife	1	1.3
Teacher	3	4.0
Housewife	58	77.3
Private Employee	2	2.7
Civil Servant	8	10.7
Self-employed / Entrepreneur	3	4.0

Table 2 shows that the results of the descriptive analysis test showed changes in the median value of IDDS and macronutrients at four measurement times. In the IDDS variable, proteins, fats, carbohydrates showed a p value of <0.001, which showed a significant increase between measurement times. However, the energy variable did not show a significant difference between measurement times with a value of p = 0.667. Compared with the Target AKG, energy intake remained below the recommendation, protein intake exceeded the requirement after intervention, while fat and carbohydrate intake tended to be below the recommended levels at follow-up.

Table 2. Results of Descriptive Analysis and Friedman Test on Increasing Food Diversity and Macronutrient Nutrients

		Median					
Variabel	**Target AKG**	**Before Nutrition Education (Pre – Test)**	**After Nutrition Education (Post-Test)**		**Follow up (Post – Test 3)**	**P - Value**	**W**
			Post-Test 1	**Post-Test 2**			
IDDS		6	8	11	11	<0,001*	0.41
Energy	1900	1637,6	1629,8	1679,3	1623,3	0.667	0.007
Protein	55	49,9	53,9	56,3	57,4	<0,001*	0.04
Fat	65	72.7	69.8	56,2	54,8	<0,001*	0.09
Carbohydrates	280	162,4	169,9	256,4	154,1	<0,001*	0.32

Table 3 shows that the results of the Wilcoxon analysis test showed a significant difference in the IDDS and protein variables between pre-test and post-test 3 with a p value of <0.001, a difference In contrast, no significant differences were found in the energy variables p = 0.847, fat p = 0.257, and carbohydrate p = 0.157.

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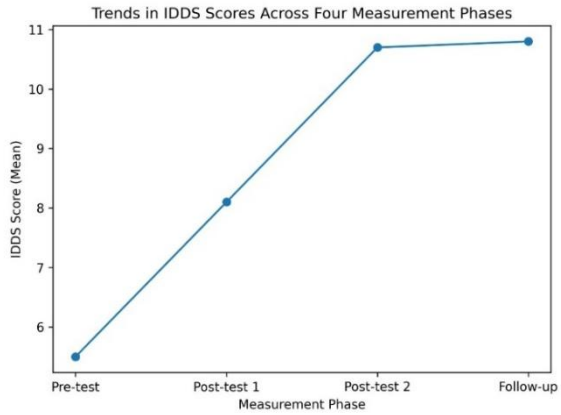
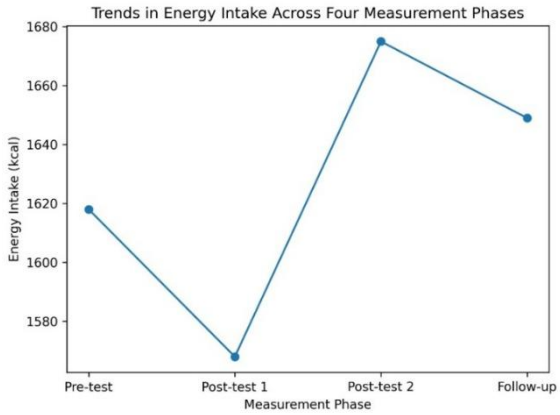
Table 3. Results of the Wilcoxon Signed Ranks Test Analysis on Differences in Food Diversity and Macronutrient Nutrients

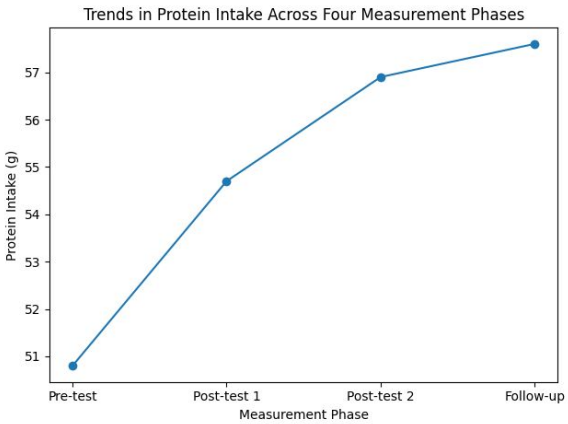
Variables analyzed	p value	*r*
IDDS Pretest-Posttest 3	<0.001*	0.63
Energi Pretest-Posttest 3	0.847	0.02
Protein Pretest-Posttest 3	<0.001*	0.26
Fat Pretest-Posttest 3	0.257	0.13
Carbohydrates Pretest-Posttest 3	0.157	0.16



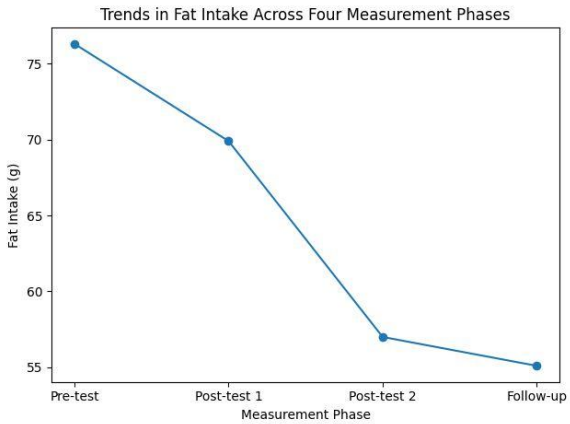
a. Trends in IDDS Scores Across Four Measurement Phases



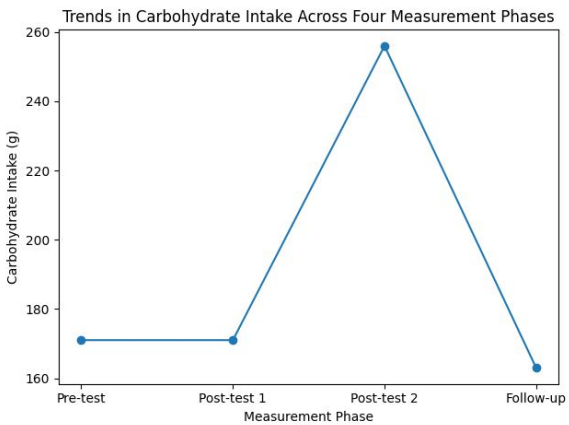
b. Trends in Energy Intake Across Four Measurement Phases



c. Trends in Protein Intake Across Four Measurement Phases



d. Trends in Fat Intake Across Four Measurement Phases



e. Trends in carbohydrate Intake Across Four Measurement Phases

Figure 1. Trend intake across four measurement phases

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The results of the analysis showed that there was a difference in the pattern of results between the Friedman test and the Wilcoxon test on several variables such as fat and carbohydrate variables. The Friedman test in table 2 showed significant changes at four measurement points p <0.001, indicating a change in intake patterns during the intervention period. However, the Wilcoxon test in table 3 comparing pre-test and follow-up values showed no significant difference. These findings suggest that the changes that occurred during the intervention have not reflected changes in sustained consumption patterns

Figure 1.a, shows a consistent increase in IDDS scores from pre-test to post-test 2, followed by a slight increase at follow-up, indicating a sustained improvement in dietary diversity after the intervention. Figure 1.b, shows fluctuations in energy intake across the four measurement phases, with no consistent increasing trend, supporting the non-significant statistical result. Figure 1.c, shows an increase in protein intake in the four phases of measurement. The average protein intake increased from the pre-test phase to post-test 1, then continued to increase in post-test 2 and reached the highest value in the follow-up phase. Figure 1.d, showed a decrease in fat intake in the four phases of measurement. Average fat intake decreased from the pre-test phase to post-test 1, then decreased even more in post-test 2, and remained lower in the follow-up phase. Figure 1.e, showed that carbohydrate intake was relatively stable in the pre-test and post-test phases 1. A considerable increase occurred in the post-test phase 2, then decreased again in the follow-up phase.

DISCUSSION

Some studies show that demographic factors, such as age, gender, class, education and parental occupation, play a significant role that can affect the reception of nutrition education as well as the eating behavior of school-age children. The age of school children in the age range of 9–11 years, where children begin to be able to think logically about real things and understand simple cause-and-effect relationships, these age characteristics are characterized by high curiosity and the ability to focus better attention on simple visual displays and narratives (15). The level of parental education is a determinant that greatly affects the parenting style of health information. Parents with higher education usually have a better level of nutritional literacy so that they are better able to provide support for healthy eating practices (16). On the other hand, low education can have implications for limited knowledge about the importance of consuming nutritious food. Mother's employment status can affect parenting, attention to health, and feeding children. Housewives, have a dominant role in determining children's diets at home (17). In line with this, the findings of this study show that most of the respondent mothers are housewives (77.3%). Therefore, the multimedia approach can not only be used to increase children's knowledge at school, but can also be directed to mothers as decision-makers in providing family food so that nutritional messages are more consistently applied at home.

This study uses a gradual education approach, where respondents are first given balanced nutrition education through leaflets, then followed by advanced education using animated videos. This gradual intervention pattern is designed to progressively strengthen children's understanding, starting from exposure to text- and image-based information to more interactive audiovisual learning. Leaflets as an initial medium of knowledge that introduces basic concepts of nutrition, while animated videos as a strengthening medium that helps deepen understanding through the delivery of more visual and interesting information.

The findings of this study show an interesting improvement between the Individual Dietary Diversity Score (IDDS) and the results of the 24-Hour Recal over time after being given a gradual education. Using flyers and animated videos. In the Individual Dietary Diversity Score (IDDS) variable, which shows that school-age children are able to expand the type of food consumed, changes in the diversity of children's food consumption were observed. The increase in the IDDS variable shows that school-age children are able to expand the type of food consumed, so that there is a real change in the diversity of daily consumption. This indicates that the intervention in this study not only affects cognitive and affective aspects, but also encourages concrete changes in eating behavior (18). These findings are in line with previous research that confirms that multimodality-based nutrition education can influence children's food choices through increased awareness and understanding of the importance of diverse food consumption

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(19). Thus, the use of interesting and varied educational media can be an effective strategy in supporting changes in nutritional behavior in school-age children.

The same thing also happens with the protein intake variable. This increase shows that nutrition education through leaflets and animated videos is able to influence the selection of protein sources in school children. These findings are also consistent with some previous studies. It was found that nutrition education videos were able to increase the consumption of side dishes and fruits in elementary school students because of the delivery of interesting and memorable messages (20). Research by also reported that animated videos improve animal protein consumption behavior in children because they feature more concrete and fun visuals (21). Latif et al. (2018) reinforce that educational media will be more effective when the message conveyed focuses on a specific food group that is clear and easy to apply in daily life (22).

Based on the results of observations during the 24-Hour Recall data collection, it was observed that there was a change in the protein consumption patterns of the respondents between measurement times. In the early stages (pre-test), most children tend to consume only one type of protein source, especially eggs. As the intervention progressed, especially in post-test 1 to post-test 3, respondents began to show variations in protein consumption by adding other animal protein sources such as chicken and fish, so that they no longer depended on just one type of protein. This change indicates an increase in awareness in the selection of more diverse protein sources, although this increase has not been fully reflected in the fulfillment of protein intake according to the AKG. This intervention is designed to improve children's knowledge, attitudes and intentions to consume fish as a source of animal protein, which is an important part of meeting the protein and micronutrient needs of school children (23).

In contrast to IDDS and protein intake, which showed significant changes. In energy intake, fats and carbohydrates did not show a significant change between pre-test and post-test 3. The absence of significant changes in these three components suggests that nutrition education interventions are gradually more successful in influencing the type of food children choose, compared to the amount of food they consume. Certain energy and macronutrient intake, especially in fats and carbohydrates, are closely related to meal portions, types of household food, and family consumption habits, which cannot be changed by education alone in a short time.

Theoretically, these results are in accordance with the concepts of the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB) (10). Although education can increase perceived benefits as well as change attitudes toward behavior, changes in eating portions require stronger perceived behavioral control, especially since school-age children do not fully regulate the food they consume(10). Decisions on portions, daily menus, and snacks are greatly influenced by parents, home environment, and food availability.

On energy intake, the absence of a significant effect showed that although children were more aware of healthy foods, they did not necessarily consume foods with greater total energy or as recommended. This may be due to a fixed portion size, an unchanged eating intensity, or a pre-formed eating habit. For example, research shows that children's eating habits are often influenced by parents' diets, the availability of food at home, and the cultural values associated with certain foods (24). Based on the results of observations during the 24-Hour Recall data collection, most respondents reported eating patterns three times a day, namely morning, noon, and night. This diet reflects the cultural customs of the local people, where the main frequency of meals has been met. However, even though the frequency of meals is appropriate, the amount and type of food consumed are not able to meet energy needs according to the Nutritional Adequacy Index (AKG) for the respondents' age group. This condition shows that energy fulfillment is not only determined by the frequency of meals, but also by the quality and energy density of the food consumed. These findings are reinforced by a contextual understanding of local conditions, which suggests that the culture of eating breakfast, lunch, and night has become a common habit. However, the selection of portions and types of daily food still tends not to consider energy adequacy in accordance with applicable nutritional recommendations.

As for fat intake, although in this study fat intake showed a downward trend towards a figure that was more in line with the Nutritional Adequacy Rate (AKG), which is around 55 grams per day for 9 years of age and increased to 65 grams per day for 10-11 years old as set by the Ministry of Health, the change

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has not had a significant enough impact to produce a statistically significant difference (25). This shows that although the direction of improvement is seen, the decrease in fat intake is still within the normal range of variation in children's daily consumption so that it has not been able to achieve meaningful changes. In addition, fat consumption is strongly influenced by family food processing patterns and daily eating habits, so education alone is not strong enough to substantially change fat intake in a relatively short intervention period.

Meanwhile, in carbohydrate intake, although there is an increasing trend in certain phases, the change is not large or consistent enough to produce a significant difference. Carbohydrates are staple foods (rice, bread, noodles) whose portions have been determined by habits at home, so it is difficult to change in a short time without a family approach or a change in household diet. On the other hand, additional side dishes such as fish or eggs are more flexible and can change according to children's preferences and the availability of food at home. Therefore, nutrition education interventions are more likely to affect the selection of types of side dishes, such as increased consumption of protein sources, compared to changes in the amount of food.

The results of this study show that providing education using two media, namely leaflet media and animation video media, can have a positive impact on nutritional behavior. This increase can be seen from significant changes in food consumption diversity (IDDS), and protein intake after intervention. The provision of leaflets as an initial medium helps build the basis of understanding, while animated videos as reinforcement are able to clarify, deepen, and strengthen nutritional messages through attractive visual-audiovisual presentations. This is also supported by Mayer's multimedia learning theory, which explains that the presentation of content through a combination of visual and audio strengthens the viewer's understanding and memory through dual cognitive processing (26). In addition, a systematic review stating that animated videos consistently improve information recall in the context of health, confirms that the combination of visual and audio media has broad potential in encouraging changes in school children's eating behavior (27).

The findings of this study can be explained through the framework of the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB). The increase in the diversity of food consumption and protein intake may reflect the increase in perceived benefits and self-efficacy after children receive nutrition education through animated videos and leaflets (28). Multimedia nutrition education helps children understand the importance of a variety of protein sources and encourages positive attitudes towards a more diverse diet. However, the absence of significant changes in energy, fat and carbohydrate intake suggests that perceived barriers, such as the availability of food at home and parental control over food choices, still limit changes in children's eating behavior.

However, this study has several limitations that need to be considered in interpreting the results. First, this study used a single-group design without a control group, so that the influence of external factors outside the intervention could not be completely eliminated. In addition, data collection using the 24-Hour Recall method and the Individual Dietary Diversity Score (IDDS) questionnaire has the potential to cause recall bias and response bias, especially because respondents are school-age children who still have limitations in remembering and understanding questions related to food groups (29). To minimize the potential for bias, data collection was carried out through direct interviews by researchers using simple language and assisted by visual aids, such as pictures of food portions and lists of foods that are commonly consumed by children, so that it is expected to improve the accuracy of the data and provide a closer picture of the actual consumption patterns of the respondents.

Comprehensively, the results of this study indicate that the educational intervention was most effective in improving cognitive and affective aspects, as well as dietary diversity (IDDS) and the selection of protein-rich side dishes. However, the intervention was not sufficient to produce significant changes in the intake of certain macronutrients, such as energy, fat, and carbohydrates. These findings suggest that while nutrition education plays an important role in improving children's knowledge, attitudes, and food choices, quantitative changes in nutrient intake may require a longer and more sustained process. Therefore, nutrition education should be implemented gradually and repeatedly, particularly through school-based programs where children can receive consistent health messages. In addition, children's

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dietary behaviors are also influenced by family eating habits and the home food environment, indicating that parental involvement and household support are important to strengthen the impact of school-based nutrition education.

This finding is also relevant to national efforts to reduce the prevalence of stunting in Indonesia, which targets 14%. The increase in food consumption diversity (IDDS) and protein consumption found in this study showed an improvement in the quality of the diet of school-age children, which is an important factor in supporting optimal growth and stunting prevention. Thus, the integration of school-based nutrition education with family involvement and a supportive food environment has the potential to make a more sustainable contribution to improving children's eating behavior while supporting the national stunting prevention strategy.

CONCLUSION

This study shows that a gradual nutrition education intervention that combines leaflets and animated videos is effective in improving the quality of children's diet, especially by increasing the diversity of food consumption and protein intake consumed. In this approach, leaflets help build a cognitive foundation by introducing key nutritional concepts, while animated videos serve as behavioral catalysts that reinforce messages through engaging visual and narrative elements. However, the intervention did not result in a significant change in the quantity of food intake, which was reflected in total energy intake. These findings likely reflect the strong influence of household food availability and family eating habits, which are generally determined by parents, not by the child himself. Thus, although the intervention was successful in influencing food selection, its impact on the overall amount of food consumed was still limited. Most importantly, increasing dietary diversity through multimedia-based nutrition education in schools is a feasible and expandable strategy to support national nutrition priorities, including efforts to reduce the prevalence of stunting to 14% as targeted in the 2024 Indonesian Nutrition Status Survey (SSGI). Therefore, future interventions need to integrate parental involvement and strategies at the household level to complement nutrition education in schools to influence both the quality and quantity of children's diets.

Based on the findings of the study, it is recommended to apply the Dual Target Model in nutrition education, which simultaneously targets children at school and parents at home. Multimedia-based education in schools is focused on improving the quality of diets, particularly food diversity and protein variation, while integrated nutrition messages to parents emphasize portion sizes, balanced meal composition, and energy needs. This approach aims to bridge the gap between children's food choices and practices at home, so that children's knowledge is supported by the family environment. By aligning school education and household practices, the Dual Target Model can improve the quality and quantity of diet more effectively and become an expandable strategy to support the stunting reduction target in the 2024 Indonesian Nutrition Status Survey (SSGI).

Building on these findings and acknowledging the study limitations, the results provide practical implications for school-based nutrition programs. Schools can integrate engaging multimedia tools, such as leaflets and animated videos, into routine nutrition education to promote healthier eating behaviors among students. Future research should involve larger sample sizes and more robust study designs, while also incorporating parental involvement, strengthening the school environment, supporting healthy eating practices at home, and providing long-term follow-up or mentoring.

DECLARATION OF THE USE OF AI

The authors declare that no artificial intelligence (AI), AI-assisted technologies, or large language models (LLMs) were used in the conception of the study, data analysis, or the drafting, writing, and editing of this manuscript

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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