

Development of a Coloring Book as an Educational Medium on Animal-Based Protein Foods for Students at SD Negeri 2 Lamcot, Darul Imarah District, Aceh Besar Regency

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Abstract

Poor oral and dental health can impair food intake by causing pain and difficulty chewing, leading to inadequate nutrient consumption and increasing the risk of malnutrition in children. Inadequate nutrition knowledge is one of the factors contributing to poor dietary habits among school-aged children. Nutrition education using engaging learning media may improve children's understanding of healthy food choices. This study aimed to develop and evaluate a coloring book on animal protein sources as a nutrition education medium for elementary school children. This study employed a Research and Development (R&D) approach using the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The coloring book was validated by experts in content, media, and language and tested among 30 elementary school students. Data were collected using validation and knowledge questionnaires and analyzed using a paired-samples *t*-test. The validation results demonstrated that the coloring book was highly feasible, with average scores of 92.77% from content experts, 90.76% from media experts, and 90.00% from language experts. Students also rated the coloring book as easy to understand. The mean knowledge score increased significantly from 11.17 before the intervention to 15.90 after the intervention ($p < 0.001$). These findings indicate that the coloring book is a valid and feasible educational medium that effectively improves elementary school children's knowledge of animal protein sources and has the potential to support nutrition education programs in primary schools.

Keywords: animal protein, coloring book, elementary school children, nutrition education, nutrition knowledge

Introduction

Nutritional status reflects the balance between nutrient intake and the body's physiological requirements for maintaining normal metabolic functions. It is influenced not only by dietary intake but also by the body's capacity to digest, absorb, and utilize nutrients efficiently. Adequate nutrient intake combined with optimal nutrient utilization contributes to good nutritional status, which is essential for physical growth, cognitive development, academic performance, work productivity, and overall health (Cahyanto et al., 2021).

Elementary school children, particularly those living in urban areas, are increasingly exposed to unhealthy dietary habits characterized by frequent consumption of fast foods and energy-dense, nutrient-poor snacks. Such dietary patterns may adversely affect children's nutritional status and compromise the quality of future human resources by impairing physical

development and cognitive function. School food environments also contribute to these unhealthy eating behaviors. Many elementary schools lack healthy canteen facilities, while foods sold around schools are often attractive because of their bright colors and appealing appearance but frequently fail to meet nutritional and food safety standards, including the potential presence of harmful food additives (Ken Ardi Wicaksana Wiwik Eko Pertiwi et al., 2022).

Dental and oral health problems remain a major public health concern in many developing countries, with dental caries being one of the most prevalent chronic conditions among children. The burden of dental caries is disproportionately higher among children from low socioeconomic backgrounds, partly because of inadequate dietary practices and limited access to preventive oral healthcare. Although primary teeth are temporary, poor oral hygiene during childhood can lead to chronic infections, impair food intake due to pain and chewing difficulties, and subsequently interfere with nutrient consumption and growth. Consequently, poor oral health may contribute to nutritional problems, including undernutrition. Previous research by Aluckal et al. demonstrated that underweight children exhibited a significantly higher prevalence of dental caries than children with normal nutritional status (Maryam et al., 2021).

Data from the Indonesian Basic Health Research Survey (Riskesdas) revealed a substantial increase in dental and oral health problems nationwide, rising from 25.9% in 2013 to 57.6% in 2018. In Aceh Province, approximately 56% of the population experienced dental and oral health problems. Furthermore, the national prevalence of active dental caries reached 45.3% in 2018, while the prevalence in Aceh Province was slightly higher at 47%. School Dental Health Program examinations conducted among children aged 6–14 years in Banda Aceh reported that 34% of students had dental caries (Reca & Restuning, 2022). One important contributing factor is children's limited knowledge regarding foods and beverages that increase the risk of dental caries. Children generally prefer cariogenic foods because of their sweet taste, sticky texture, and attractive appearance. In addition, inadequate awareness and poor oral hygiene practices further increase the risk of dental caries (Kusuma et al., 2020).

Nutrition education is an effective strategy for improving nutrition-related knowledge, fostering healthy dietary behaviors, and ultimately enhancing nutritional status. Delivering nutrition education during elementary school years is particularly important because children at this developmental stage are highly receptive to new information and are beginning to establish lifelong dietary habits. Previous studies have demonstrated that nutrition education interventions can significantly improve children's nutrition knowledge and healthy eating behaviors, although the magnitude of the effect varies depending on the educational approach employed (Perdana et al., 2017). Research by Mustikaningsih and colleagues further demonstrated that elementary school students' understanding of balanced nutrition improved significantly following nutrition education delivered through lectures and educational games. Children aged 6–14 years are in a critical period of intellectual development, making this an ideal stage for implementing effective nutrition education interventions (Yuningsih & Kurniasari, 2021).

The effectiveness of nutrition education largely depends on the educational methods and media used to communicate health messages. Educational media that stimulate children's visual attention can facilitate understanding, improve information retention, and increase learning motivation. Visual learning materials also simplify complex concepts, enabling children to better

comprehend nutrition-related information while maintaining their interest throughout the learning process (Priawantiputri et al., 2019).

Coloring books represent an engaging and developmentally appropriate educational medium for young children. Coloring activities combine learning with play, thereby creating an enjoyable educational experience while simultaneously promoting creativity, imagination, and fine motor skill development. Previous studies have demonstrated that coloring books are effective in enhancing children's nutrition knowledge and encouraging active participation during educational sessions (Lisnawaty et al., 2021; Mellia Silvy Irdianty et al., 2017).

Based on these considerations, this study aimed to develop and evaluate a coloring book as a nutrition education medium focusing on animal protein for first-grade students at SD Negeri 2 Lamcot, Darul Imarah District, Aceh Besar Regency. The study further examined the feasibility of the developed educational media and its effectiveness in improving students' knowledge of animal protein sources.

Methods

This study employed a Research and Development (R&D) design using the ADDIE instructional design model, which consists of five sequential phases: Analysis, Design, Development, Implementation, and Evaluation. The study was conducted at SD Negeri 2 Lamcot, Darul Imarah District, Aceh Besar Regency, Indonesia, in February 2025. The study population comprised all first-grade students enrolled in Class IA at SD Negeri 2 Lamcot, aged 7–8 years. According to recommendations from the school principal, first-grade students were selected because they were considered capable of understanding written instructions, comprehending simple educational messages, and actively participating in learning activities. A total sampling technique was employed, in which all eligible students were invited to participate. Of the 32 eligible students, 30 completed the study and were included in the final analysis.

The coloring book was developed following the five phases of the ADDIE model. Students' knowledge regarding animal protein was assessed using a structured questionnaire administered immediately before (pre-test) and after (post-test) the nutrition education intervention. The feasibility and acceptability of the coloring book were evaluated using structured questionnaires completed by expert validators and student participants. The evaluation covered four main aspects: visual appearance, clarity of information, ease of understanding, and usefulness as a nutrition education medium. The collected data underwent several processing steps, including editing, coding, scoring, data entry, and data cleaning before statistical analysis. Descriptive statistics were used to summarize participants' characteristics and questionnaire responses. Continuous variables are presented as means and standard deviations, whereas categorical variables are presented as frequencies and percentages. The effectiveness of the intervention was evaluated by comparing pre-test and post-test knowledge scores using a paired-samples t-test (dependent t-test). Statistical significance was established at a 95% confidence level, with a p -value < 0.05 considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics.

Result

Development of the Coloring Book Media

Literature Review and Needs Assessment

The literature review identified several important issues related to children's nutrition and health, including the high prevalence of dental and oral health problems among school-aged children in Aceh, inadequate knowledge of healthy eating, and limited awareness of nutritious foods. These findings highlighted the need for an engaging nutrition education medium that could effectively improve children's understanding of healthy food choices.

A formative needs assessment was subsequently conducted through in-depth interviews with ten elementary school students at SD Negeri 2 Lamcot, Darul Imarah District, Aceh Besar Regency. The interviews revealed that students had limited knowledge regarding the definition of animal protein, examples of animal protein sources, the nutritional benefits of animal protein, foods rich in animal protein, and the concept of healthy and balanced eating.

Development of the Coloring Book

Based on the findings from the literature review and formative assessment, a coloring book focusing on animal protein was developed using the ADDIE model. The educational media was developed through five sequential stages: (1) needs analysis, (2) design and preparation of the coloring book prototype, (3) expert validation, (4) field testing, and (5) evaluation of media feasibility.

The educational content included the definition of animal protein, types of animal protein, illustrations of common animal protein sources, nutritional benefits of animal protein, and examples of foods containing animal protein. The layout was designed using age-appropriate illustrations, readable typography, attractive colors, and concise educational messages to enhance children's interest and comprehension.

Expert Validation

The developed coloring book was evaluated by six experts, consisting of two nutrition experts, two media experts, and two language experts. The average feasibility scores obtained from each group of validators are presented below:

1. Material experts: 92.77% (very feasible)
2. Media experts: 90.76% (very feasible)
3. Language experts: 90.00% (very feasible)

These findings indicate that the developed coloring book met the criteria for use as a nutrition education medium for elementary school students.

Feasibility of the Coloring Book

Students evaluated the coloring book based on its appearance, clarity, ease of understanding, and usefulness as a nutrition education medium. Overall, participants rated the coloring book as highly attractive, easy to understand, visually clear, and very helpful for learning about animal protein. These findings demonstrate a high level of acceptability of the developed educational media among elementary school students.

Participant Characteristics

A total of 30 first-grade students participated in the field trial. Half of the participants were 8 years old (50.0%), while the remaining half were 7 years old (50.0%). Male students accounted for 56.7% of the participants, whereas females represented 43.3%.

Table 1. Characteristics of the Participants

Characteristic	n	%
Age		
7 years	15	50.0
8 years	15	50.0
Sex		
Male	17	56.7
Female	13	43.3
Total	30	100.0

Changes in Knowledge Scores

The mean pre-test knowledge score was 11.17 ± 3.323 , with scores ranging from 5 to 17. Following the nutrition education intervention, the mean post-test score increased to 15.90 ± 2.708 , with scores ranging from 10 to 20.

Table 2. Knowledge Scores Before and After the Intervention

Variable	n	Minimum	Maximum	Mean $\pm$ SD
Pre-test	30	5	17	11.17 ± 3.323
Post-test	30	10	20	15.90 ± 2.708

Effect of the Coloring Book on Students' Knowledge

The paired-samples *t*-test demonstrated a statistically significant improvement in students' knowledge following the nutrition education intervention using the coloring book. The mean knowledge score increased by 4.73 points, representing an improvement of 42.34%. The mean difference was 4.73 ± 0.61 (95% CI: 4.020–5.447), and the increase was statistically significant ($p < 0.001$).

Table 3. Effect of the Animal Protein Coloring Book on Students' Knowledge

Variable	Mean $\pm$ SD	Mean Difference $\pm$ SD	95% CI	<i>p</i> -value
Pre-test	11.17 ± 3.323			
Post-test	15.90 ± 2.708	4.73 ± 0.61	4.020–5.447	<0.001

These findings indicate that nutrition education delivered through the developed coloring book significantly improved elementary school students' knowledge of animal protein sources.

Discussion

This study developed and evaluated a coloring book as a nutrition education medium to improve elementary school students' knowledge of animal protein. The findings demonstrated that the developed educational media was highly feasible based on expert validation and well accepted by students. More importantly, the intervention significantly improved students' knowledge regarding animal protein, indicating that coloring books can serve as an effective educational tool for nutrition promotion among young children.

The initial needs assessment, including both the literature review and formative interviews, revealed substantial gaps in students' knowledge of animal protein. Most participants had limited understanding of the definition, food sources, nutritional benefits, and examples of animal protein-rich foods. These findings suggest that elementary school children require age-appropriate educational interventions to enhance their nutrition knowledge. Previous studies have consistently shown that nutrition education plays a fundamental role in improving children's nutritional knowledge, dietary behaviors, and overall health outcomes (Perdana et al., 2017; Yuningsih & Kurniasari, 2021).

The coloring book was developed using the ADDIE instructional design model, which provides a systematic framework for designing educational media that are responsive to learners' needs. The educational content was developed based on evidence gathered during the analysis phase and included essential information on the definition, types, benefits, and food sources of animal protein. Age-appropriate illustrations, attractive colors, simple language, and interactive coloring activities were incorporated to enhance children's attention and engagement during the learning process. Interactive visual media have been widely recognized as effective tools for facilitating learning among young children because they stimulate curiosity, increase motivation, and improve information retention.

Expert validation demonstrated that the developed coloring book achieved excellent feasibility, with mean scores exceeding 90% across material, media, and language evaluations. These findings indicate that the educational content was scientifically accurate, the visual design was appropriate for elementary school children, and the language was clear and easily understood. According to Ernawati and Sukardiyono (2017), educational media with feasibility scores above 81% are classified as highly feasible for implementation, supporting the use of the developed coloring book as a nutrition education resource.

Students also reported a high level of acceptance of the coloring book during the field trial. They rated the media as visually attractive, easy to understand, and helpful for learning about animal protein. Attractive educational materials are known to increase children's motivation to participate actively in learning activities, thereby improving educational outcomes. The integration of play-based learning with nutrition education allows children to acquire knowledge in an enjoyable and less intimidating learning environment.

The present study demonstrated a statistically significant improvement in students' knowledge following the nutrition education intervention. The mean knowledge score increased from **11.17 ± 3.32** before the intervention to **15.90 ± 2.71** after the intervention, representing an average increase of **4.73 points (42.34%)**. The paired-samples *t*-test confirmed that this

improvement was statistically significant ($p < 0.001$). These findings suggest that the coloring book effectively enhanced children's understanding of animal protein and its nutritional importance.

The improvement observed in this study is consistent with previous research demonstrating the effectiveness of coloring books as educational media. Lisnawaty et al. reported that coloring-based nutrition education significantly improved children's nutrition knowledge while simultaneously fostering creativity and fine motor development. Similarly, Heriska (2023) found that coloring book interventions significantly increased children's knowledge of dental and oral health. Collectively, these findings suggest that coloring books provide an engaging and developmentally appropriate educational strategy capable of enhancing children's learning outcomes across different health topics.

The effectiveness of coloring books may be explained by principles of active learning and visual learning. Compared with conventional lecture-based approaches, coloring activities encourage children to participate actively in the learning process through observation, coloring, reading, and interaction with educational illustrations. Such multisensory learning experiences facilitate better attention, comprehension, and long-term memory retention. Moreover, children in the early elementary school years naturally prefer learning through play and visual exploration, making coloring books particularly suitable for nutrition education within this age group.

Despite these promising findings, several limitations should be acknowledged. First, the study was conducted in a single elementary school with a relatively small sample size, which may limit the generalizability of the findings. Second, the effectiveness of the intervention was evaluated only through short-term knowledge assessment, and no follow-up evaluation was conducted to determine long-term knowledge retention or behavioral changes. Finally, the study focused exclusively on knowledge outcomes without assessing dietary practices or nutritional status. Future studies involving larger and more diverse populations, longer follow-up periods, and behavioral outcome measures are recommended to provide stronger evidence regarding the long-term effectiveness of coloring book-based nutrition education.

Overall, the findings indicate that a coloring book is a feasible, acceptable, and effective educational medium for improving elementary school students' knowledge of animal protein. Incorporating interactive and visually engaging educational materials into school-based nutrition programs may contribute to strengthening children's nutrition literacy and promoting healthier dietary behaviors from an early age.

Conclusion

The findings of this study indicate that, based on evaluations conducted by experts and students during the trial, the coloring book effectively improved students' knowledge of different types of animal protein. These results suggest that the coloring book is an appropriate and feasible educational medium for elementary school children. The use of this coloring book is expected to enhance elementary school students' understanding of various types of animal protein and support nutrition education initiatives at the primary school level.

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