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Implementation of the Balanced Nutrition Pocket- Flipbook to Improve Elementary School Children's Nutritional Knowledge

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Abstract: This study aimed to examine the effect of E-Bukuku, a flipbook-based digital pocketbook on balanced nutrition, in improving nutrition knowledge among elementary school children. The study employed a pre-experimental one-group pretest–posttest design conducted at Purin Muhammadiyah Kendal Elementary School. A total of 162 students aged 7–9 years were selected using purposive sampling. The intervention was delivered through a structured nutrition education session. Students were guided by the researcher or classroom teacher to interactively explore the E-Bukuku flipbook through page navigation, illustrations, question-and-answer sessions, brief discussions, and practical examples to reinforce balanced nutrition messages. After the session, students were given time to independently review the material before completing the posttest using the same questionnaire as the pretest. Nutrition knowledge was measured using a structured questionnaire integrated with the E-Bukuku content. Data were analyzed using the Wilcoxon signed-rank test, as the paired pretest and posttest data did not meet the normality assumption. The results showed a statistically significant improvement in nutrition knowledge following the intervention, with mean scores increasing from 55.30 ± 8.12 at pretest to 82.75 ± 6.45 at posttest ($p < 0.001$). In conclusion, the use of E-Bukuku significantly improved balanced nutrition knowledge among elementary school children. E-Bukuku can be considered an innovative digital-based nutrition education medium. This study provides preliminary evidence supporting the effectiveness of flipbook-based digital nutrition education and offers insights for future large-scale interventions.

Keywords: balanced nutrition; elementary school children; nutrition knowledge; pocket flipbook.

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INTRODUCTION

Nutrients are substances found in food and are necessary for metabolism. A balanced nutritional intake supports this metabolic process, thus ensuring a balanced diet is essential. A balanced diet is a daily menu tailored to the needs of each age group. Portion sizes for each individual are a valuable tool for monitoring and evaluating calorie intake for a healthy body (Kadam et al., 2022). Portion measurements can be used to estimate food portions. These tools can enhance children's knowledge about balanced nutrition according to their needs. Knowledge needs to be provided from an early age to foster behaviors that promote balanced nutritional consumption (Nasution & Nasution, 2020).

The prevalence of malnutrition among school-aged children in Indonesia is reported at 7.4%, while the prevalence of stunting reaches 19.8%. According to the 2022 Indonesian Nutrition Status Survey (SSGI), the national prevalence of stunting remains high at 21.6%, indicating persistent nutritional problems among Indonesian children. At the regional level, Central Java Province reports a stunting prevalence of 17.1% (Kemenkes RI, 2022), while Kendal Regency shows a considerably higher prevalence of 23.93% (DKK Kendal, 2022). This condition is a particular concern for the Kendal Regency Government, prompting efforts to reduce malnutrition and stunting through various programs that emphasize improving nutritional knowledge prior to the provision of supplementary nutritious foods. One such strategy is the implementation of nutrition promotion and education interventions.

This research aligns with the National Research Master Plan (RIRN) in the health and food sector, specifically focusing on improving the nutritional status of school-age children through innovative nutrition education (Kemenristekdikti RI, 2021). Technology-based education programs support the government's promotive and preventive efforts to reduce stunting and malnutrition rates through behavior-based interventions starting at school age (Damayanti et al., 2024). Research conducted by Anggraeni and Naimah shows that the maze game is an educational game that not only increases knowledge but also improves motor skills (Anggraeni & Na'imah, 2022).

One-way parents educate their children in the digital age is by allowing them to experience technological developments within certain limits to avoid negative effects. One solution is educational games(Mannell et al., 2024). This digital maze educational game aims to improve elementary school children's knowledge of balanced nutrition.

Based on this description, innovative educational media are needed as digital guidance. Therefore, this research aims to improve elementary school children's nutritional knowledge to support the government's free nutritious meal program.

METHODS

Research Design, Time, and Location

This research was a quantitative study with a pre-experimental, one-group pretest-posttest design. The study was conducted from August 22-24, 2025. The study location was Muhammadiyah Purin Elementary School, Kendal, Central Java. This research has been declared feasible and has

received ethical clearance from Muhammadiyah University of Semarang under ethics number 014/KE/07/2025.

Population and Sample

The population consisted of 273 elementary school students aged 7-9 years at Purin Muhammadiyah Elementary School in Kendal. A sample size of 162 was calculated using the Slovin formula. Respondents were selected purposively, with inclusion and exclusion criteria including willingness to participate, good health, and age 7-9 years.

Instruments

The research instruments included a balanced nutrition knowledge questionnaire that had been tested for validity and reliability, as well as a flipbook-based e-book. The study was conducted in three stages. First, a pretest was administered in which students completed a nutrition knowledge questionnaire consisting of 10 pictorial questions accompanied by short nutrition-related narratives to assess baseline knowledge. Second, the intervention phase involved the delivery of nutrition education using a flipbook-based e-book that included balanced nutrition content and an interactive maze game designed for elementary school children. Finally, a posttest was conducted using the same 10-item pictorial questionnaire to measure changes in students' nutrition knowledge after the intervention.

The questionnaire consisted of multiple-choice questions accompanied by images, for example, about the nutritional needs of carbohydrates (rice, cassava, corn), protein (eggs, nuts), fat (milk, butter), and several images of vegetables and fruits.

Figure 1.

Appearance of E-Bukuku

Source: Personal documents.

Data Collection and Analysis

This makes the questionnaire easy to understand for children aged 7-9 years old. Data analysis using the Shapiro-Wilk normality test because the number of samples was <200. The results showed that the data were not normally distributed, so the non-parametric Wilcoxon Signed Rank Test was used to analyze the differences in pretest and posttest scores.

RESULTS AND DISCUSSION

Respondent Characteristics

The results show that most respondents were aged 9 years (50 students) and 8 years (42 students), with a total of 70 children (43.29%). The majority of participants were male, accounting for 85 students (52.5%), while 77 students (47.5%) were female. Based on the pretest results, nutrition knowledge was predominantly classified as poor among 105 children (64.8%), whereas 35.2% were categorized as having good knowledge. In contrast, posttest findings indicated that nutrition knowledge was mostly classified as good for 140 children (86.4%), while only 22 children (13.6%) remained in the poor category (Table 1).

Table 1

Respondent Characteristics

Respondent Characteristic	n	Percentage (%)
Ages		
7 years old	70	43.29
8 years old	42	25.9
9 years old	50	30.9
Gender		
Male	85	52.5
Female	77	47.5
Pre-test knowledge		
Good	57	35.2
Poor	105	64.8
Post-test knowledge		
Good	140	86.4
Poor	22	13.6
Total	162	100

Source: Primary data.

Most respondents were 7 years old, according to the study findings. Children aged 7–9 years are in a cognitive development stage in which they begin to comprehend logical concepts, including knowledge related to balanced nutrition (Sari et al., 2021). This finding supports the effectiveness of nutrition education interventions for elementary school children in improving nutritional knowledge, as children at this age are more receptive to information delivered through visual and interactive methods. Digital-based educational media, such as flipbooks, are able to enhance children's memory and help them understand nutrition concepts that were previously considered abstract (Sari et al., 2021; Nugrahaeni & Wulandari, 2022).

Furthermore, gender-specific characteristics indicate that both boys and girls experienced increased knowledge after the E-Bukuku intervention. Although some studies report that girls tend to have better nutritional knowledge than boys due to a greater interest in health and healthy foods, the use of digital media such as E-Bukuku can be an innovative alternative in nutrition education in elementary schools, regardless of gender (Utsmani et al., 2020).

Based on the research results in Table 1, it shows that before the intervention, over half of the students still had insufficient nutritional knowledge (64.8%). This condition aligns with research stating that elementary school children often do not fully understand the concept of balanced nutrition due to limited information sources and a lack of educational media appropriate to children's characteristics (Manalu, 2023). Inadequate nutritional knowledge can impact unhealthy consumption behaviors, such as low consumption of vegetables and fruit and high consumption of foods high in sugar, salt, and fat. Therefore, early nutritional education interventions are crucial to raise children's awareness of the importance of a balanced diet (Nuryani & Astuti, 2022).

After being educated using E-Bukuku, there was a significant increase in the number of students with good nutritional knowledge (86.4%). This demonstrates that digital-based educational media can facilitate children's understanding through visual and interactive displays, making balanced nutrition messages easier to accept and remember, and can improve nutritional knowledge in elementary school children. This aligns with research that shows that research using digital applications significantly improves nutritional knowledge in elementary schools (Wulandari et al., 2022; Safitri et al., 2023). Therefore, nutritional interventions using E-Bukuku can be an innovative strategy to improve balanced nutrition knowledge in elementary school children and are expected to encourage changes in healthier eating behaviors.

Knowledge of Balanced Nutrition

The average score for balanced nutrition knowledge among respondents in the pretest was 55.30 ± 8.12, while in the posttest it was 82.75 ± 6.45. The Wilcoxon test revealed a p-value of less than 0.001, which is statistically significant, indicating a meaningful difference in nutritional knowledge scores before and after the intervention using E-Bukuku, as shown in Table 2.

Table 2

Knowledge Score (Pretest and Posttest)

Measurement Stage	Mean ± SD	p- value
Pretest knowledge	55.30 ± 8.12	p<0.001
Posttest knowledge	82.75 ± 6,45	

Source: Primary data.

The increase in the average score of balanced nutrition knowledge from the pretest and posttest indicate that the intervention using E-Bukuku is effective in improving the knowledge of elementary school students. Flipbook-based educational media is considered interesting and easy for children to understand because it presents information visually, interactively, and can be accessed repeatedly. This E-Bukuku consists of several pieces of information about balanced nutrition knowledge for elementary school children presented in the form of colorful images, for example about examples of carbohydrate foods (rice, corn, cassava), vegetables (broccoli, carrots, etc.), fruit (watermelon, apple, pear, grapes, etc.), and protein (eggs, fish, tofu, tempeh, chicken). This is in line with previous research, which states that interactive digital media can increase the effectiveness of nutrition learning in school-age children (Sari et al., 2023).

The outcomes of the study also support previous research that technology-based nutrition education can be an innovative strategy to improve nutritional literacy in children. Good nutritional knowledge is expected to impact changes in healthier eating behaviors, such as increased consumption of fruits, vegetables, and balanced nutritious foods (Safitri & Hasanah, 2025). Therefore, the use of E-Bukukuku not only improves short-term knowledge but also has the potential to shape healthy eating habits throughout a child's development.

Item-Based Analysis of Balanced Nutrition Knowledge

The analysis of the questionnaire results show an overall improvement in students' balanced nutrition knowledge following the intervention. For Item 1, which assessed the definition of balanced nutrition, there was an increase in the proportion of correct answers from pretest to posttest, indicating that students initially had limited understanding of this basic concept but demonstrated better comprehension after exposure to the flipbook. A substantial improvement was also observed for Item 2 regarding the four pillars of balanced nutrition, suggesting that the visual presentation and simplified explanations effectively enhanced students' recall and understanding of this core concept. For Item 3, related to food sources of energy, the proportion of correct responses increased after the intervention, although the improvement was relatively lower compared to other items, indicating the need for additional reinforcement on the classification of energy-giving foods. Item 4 showed notable posttest improvement in students' ability to distinguish between animal-based and plant-based protein sources, likely supported by the use of familiar food examples and illustrations in the flipbook. Item 5 demonstrated a high level of improvement, reflecting the effectiveness of clear visual representations in helping students understand appropriate balanced meal portions.

Regarding Item 6 on the importance of fruit and vegetable consumption, most students already had moderate baseline knowledge; however, the posttest results still showed an increase in correct answers, indicating reinforcement and strengthening of existing knowledge through the intervention. Item 7, which focused on healthy breakfast habits, showed moderate improvement, indicating that while the importance of breakfast was generally understood, additional practical examples of healthy breakfast menus could further enhance comprehension. A clear improvement was observed for Item 8 concerning water intake and physical activity, highlighting the positive contribution of interactive elements and illustrations in improving students' understanding. Item 9, related to hygiene and healthy behaviors, demonstrated a good increase in nutrition-related knowledge, indicating that integrating hygiene and nutrition messages in the flipbook was effective for elementary school students. Finally, item 10 the consequences of unbalanced dietary patterns showed moderate improvement, suggesting that abstract or long-term consequences of unhealthy eating behaviors may be more challenging for children to understand and may require repeated exposure and reinforcement.

The limitations of this study are that the questionnaires were not administered simultaneously because they were adjusted to the children's study hours in class, and that each item in the questionnaire had to be read individually because several children could not read fluently, especially children in grade 1 of elementary school.

CONCLUSION

The use of E-Bukuku, a flip-pocketbook-based digital medium, effectively improved nutritional knowledge among elementary school children. This was evidenced by a significant increase in the average score from 55.30 ± 8.12 in the pretest to 82.75 ± 6.45 in the posttest ($p < 0.001$). E-Bukuku can thus be considered an innovative, interactive, and easily accessible digital nutrition education medium that aligns with the cognitive and developmental characteristics of elementary school-aged children. These findings suggest that E-Bukuku has the potential to support early behavioral changes and the development of healthy eating habits.

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Author Contribution Statement

Ardian Candra Mustikaningrum : Conceptualization; study design, data collection, data analysis and interpretation, and drafting of the initial manuscript and substantive revision of the article. **Erna Infitharina**: Development and validation of research instruments, Methodological supervision, and data analysis. **Nafilah Nafilah**: Critical review of the manuscript, improvement of the discussion.

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