



Development of SiKembar Gizi: Integrating Pop-Up Book and GIZI GO Games as a Balanced Nutrition Education Media to Improve Nutrition Literacy and Physical Activity at Madrasah Ibtidaiyah Negeri 8 Bireuen

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Abstrak

Penelitian ini bertujuan mengembangkan dan mengetahui kelayakan serta hasil implementasi SiKembar Gizi (Sinergi Kreatif Pembelajaran Gizi Berbasis Pop-Up Book dan GIZI GO) sebagai media pembelajaran yang mengintegrasikan literasi gizi dan aktivitas fisik siswa. Penelitian menggunakan metode *Research and Development* (R&D) dengan model pengembangan ADDIE yang meliputi *Analysis, Design, Development, Implementation, dan Evaluation*. Produk divalidasi oleh ahli materi dan ahli media, kemudian diuji coba pada kelompok kecil dan kelompok besar sebelum diimplementasikan kepada 86 siswa MIN 8 Bireuen. Data literasi gizi dianalisis menggunakan statistik deskriptif, N-Gain, uji *paired sample t-test*, *Wilcoxon Signed-Rank Test*, dan *Cohen's dz*, sedangkan aktivitas fisik dianalisis secara deskriptif. Hasil penelitian menunjukkan bahwa SiKembar Gizi memperoleh validasi ahli materi sebesar 91.2% dan ahli media sebesar 94%, keduanya berkategori sangat valid. Respons siswa mencapai 90.8% pada kelompok kecil dan 94% pada kelompok besar. Rata-rata literasi gizi meningkat dari 58.60 menjadi 86.40 dengan N-Gain 0.706 dan $p < 0.001$. Sebanyak 94.2% siswa berada pada kategori aktif dan sangat aktif. SiKembar Gizi layak digunakan sebagai media pembelajaran gizi berbasis aktivitas fisik.

Kata Kunci: Aktivitas Fisik, GIZI GO, Literasi Gizi, Pop-up Book, SiKembar Gizi, Siswa.

Abstract

This study aimed to develop and determine the feasibility and implementation outcomes of SiKembar Gizi (Creative Synergy of Nutrition Learning Based on Pop-Up Book and GIZI GO) as a learning medium integrating nutrition literacy and students' physical activity. The study employed a Research and Development (R&D) approach using the ADDIE development model, consisting of Analysis, Design, Development, Implementation, and Evaluation. The product was validated by material and media experts and subsequently tested in small- and large-group trials before being implemented with 86 students at MIN 8 Bireuen. Nutrition literacy data were analyzed using descriptive statistics, N-Gain, paired-samples t-test, Wilcoxon Signed-Rank Test, and Cohen's dz, while physical activity was analyzed descriptively. The results showed that SiKembar Gizi obtained validation scores of 91.2% from the material expert and 94% from the media expert, both categorized as highly valid. Student responses reached 90.8% in the small-group trial and 94% in the large-group trial. Mean nutrition literacy scores increased from 58.60 to 86.40, with an N-Gain of 0.706 and $p < 0.001$. Furthermore, 94.2% of students were categorized as active or highly active. Therefore, SiKembar Gizi is feasible as a nutrition learning medium integrating physical activity.

Keywords: Physical Activity, GIZI GO, Nutrition Literacy, Pop-Up Book, SiKembar Gizi, Students.

INTRODUCTION

Nutrition is an important component supporting the growth, development, health, and learning readiness of school-age children. In this age group, meeting nutritional needs is determined not only by

food availability, but also by children's ability to understand nutrition information and apply it in their daily food choices. Developing this knowledge and these skills is important because eating habits formed during school age can contribute to health behavior patterns in later stages of life (Irmani & Sinaga, 2017). Therefore, schools represent a strategic environment for providing nutrition education oriented not only toward improving knowledge, but also toward encouraging students' ability to understand and apply the principles of balanced nutrition. A systematic review by Omidvar et al. (2023) showed that school-based interventions have the potential to improve various aspects of food and nutrition literacy in primary-school-age children.

Nutrition problems and understanding of healthy eating patterns remain a concern among school-age children. This condition was also found among students at Madrasah Ibtidaiyah Negeri (MIN) 8 Bireuen. Based on initial interviews, some students still have the habit of going to school without breakfast, while those who do eat breakfast tend to consume food dominated by carbohydrate and protein sources. Consumption of vegetables and fruit as sources of vitamins, minerals, fiber, and other nutrients remains relatively limited. In addition, some students are not yet able to explain the principle of balanced nutrition and are not yet accustomed to combining various food groups proportionally. This condition indicates that students' understanding of nutrition has not yet fully developed into a practical ability to determine healthy food choices. This finding is in line with the study by Nurahmadi & Dalimunthe (2024), which identified elementary school children as a group vulnerable to nutrition problems, including the habit of skipping breakfast, and demonstrated the importance of nutrition education using engaging media to improve knowledge and breakfast habits.

This problem needs attention because nutrition learning for school-age children cannot rely solely on verbal information; it must instead be designed based on children's learning characteristics, which require concrete, visual, interactive, and enjoyable experiences. Learning that involves direct experience can give students the opportunity to connect nutrition information with everyday life situations. In the context of school education, integrating nutrition material with learning activities also has the potential to increase student engagement while connecting knowledge with healthy living behavior. The study by Ahmad & Nurhidayati (2025) showed that there is an opportunity to integrate the concept of balanced nutrition into the elementary school learning process as part of strengthening health-based learning.

One approach that can be used to make nutrition learning more concrete and engaging is the use of visual media in the form of a Pop-Up Book. This medium is able to present information in a three-dimensional visual form, so that relatively abstract concepts can be displayed more realistically and are easier for students to observe (Damayanti et al., 2021). In nutrition education, such visualization can be used to introduce food groups, the functions of nutrients, healthy food choices, and the principle of balanced nutrition. Empirical evidence on the use of Pop-Up Books in nutrition education has also shown positive results. Putri & Noviani (2021), for example, compared video media and a Pop-Up Book in delivering balanced nutrition guidelines to elementary school students. Meanwhile, Nurahmadi & Dalimunthe (2024) found that nutrition education using a Pop-Up Book had a significant effect on the nutrition knowledge and breakfast habits of elementary school students.

More recent findings further support the potential of the Pop-Up Book as a health and nutrition education medium. Ahmad & Nurhidayati (2025) reported that the use of a Pop-Up Book in health education for students produced a significant increase in knowledge and received a positive response from learners. Another study on elementary school students also showed that education using a Pop-Up Book could significantly increase knowledge about fruit and vegetable consumption, although actual changes in consumption did not yet show a significant difference. These results indicate that interactive visual media have strong potential to improve knowledge, but their application needs to be further developed so that the knowledge students gain can be connected to real experiences and behavior. This finding is also supported by the study of Purwasih et al. (2025), which showed that education using a Pop-Up Book significantly increased students' knowledge about fruit and vegetables, although the change in actual fruit and vegetable consumption was not yet significant.

Nutrition learning also needs to be linked to physical activity, because healthy lifestyle patterns in children are determined not only by food intake, but also by involvement in movement activities. The study by Damayanti et al. (2024) on elementary school students in Jakarta showed that nutrition education interventions could improve nutrition knowledge and several aspects of nutrient intake, and indicated a tendency toward increased physical activity in the intervention group. These results show that nutrition education and physical activity can be placed within a single framework for children's



health interventions. Thus, nutrition learning combined with movement activities has the potential to provide a more comprehensive experience than learning oriented solely toward the delivery of information (Briawan, 2016).

The integration of nutrition education and physical activity has also received empirical support from international research. Yulia & Khomsan (2021) developed an intervention that combined nutrition education with physical activity based on traditional games among elementary school children in West Java. The intervention combined education on balanced nutrition, fruit and vegetable consumption, breakfast, healthy snacks, and the benefits of physical activity with traditional games. A similar approach was also reported by Yunianto et al., who combined balanced nutrition education with traditional games to improve knowledge of nutrition and physical activity among school-age children. These findings provide a basis for the idea that combining nutrition knowledge with game-based activities can be an alternative form of learning suited to the characteristics of children who enjoy moving and playing.

Based on this review, there is still room for development in nutrition learning at the elementary school level. Previous research on the Pop-Up Book has largely focused on its use as a medium for delivering information or improving knowledge on health and nutrition topics, whereas research integrating three-dimensional visual media with physical activity and educational games within a single learning experience remains relatively limited. On the other hand, research combining nutrition education with physical activity generally uses conventional learning media or traditional games and has not specifically integrated the Pop-Up Book as a means of nutrition literacy. This condition indicates a research gap in the form of a need for a learning model capable of connecting cognitive, visual, kinesthetic, and social aspects in an integrated manner.

Based on this gap, this study developed SiKembar Gizi (Creative Synergy of Nutrition Learning Based on Pop-Up Book and GIZI GO) as a learning innovation that integrates the Pop-Up Book medium with the GIZI GO game (Gerak dan Gizi / Movement and Nutrition). The Pop-Up Book is used to help students understand information about food groups, the functions of nutrients, and the principle of balanced nutrition through three-dimensional visualization, while GIZI GO is designed as an educational game involving running, jumping, and relay activities to reach posts and obtain illustrated food cards. These cards are then used by students to recognize food groups and compose balanced nutrition menu combinations. Through this mechanism, nutrition knowledge is not only received through reading and observing, but is also applied through movement activities, group interaction, food classification, and decision-making.

The novelty of this study lies in the integration of visual and kinesthetic learning experiences within a single nutrition learning medium. Unlike previous studies that positioned the Pop-Up Book mainly as an educational medium for improving knowledge, SiKembar Gizi develops the Pop-Up Book as part of a learning sequence that continues with physical activity through GIZI GO. This integration is expected to increase student engagement while connecting nutrition knowledge with direct experience. Thus, SiKembar Gizi is directed not only as a medium for delivering information about healthy food, but as a learning innovation that connects nutrition literacy, physical activity, games, social interaction, and the application of balanced nutrition principles within a contextual learning experience.

Based on the problems, the review of previous research, and the research gap described above, this study aims to develop SiKembar Gizi, an integration of the Pop-Up Book and the GIZI GO game, that is valid, practical, and effective in improving the nutrition literacy and physical activity of Madrasah Ibtidaiyah students. Specifically, this study is directed at identifying students' needs for an interactive, physical-activity-based nutrition learning medium; producing a SiKembar Gizi product that meets the feasibility criteria for content, media, and use; and testing the effectiveness of its use in improving students' nutrition literacy and physical activity engagement.

METHODS

This study used the Research and Development (R&D) method, aimed at developing SiKembar Gizi (Creative Synergy of Nutrition Learning Based on Pop-Up Book and GIZI GO) as a nutrition learning innovation for Madrasah Ibtidaiyah students. The development model used was ADDIE, consisting of five stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was chosen because it has systematic development stages and allows the product to be developed based on students' needs, validated by experts, tested for practicality, and evaluated for its effectiveness in improving students' nutrition literacy and physical activity (Ngatman & Susworo, 2022).

The Analysis stage was carried out to identify students' nutrition learning needs, learner characteristics, problems related to understanding balanced nutrition, and the need for interactive learning media involving physical activity. The analysis was conducted through observation and initial interviews with school staff, as well as identification of learning characteristics suited to students' development. The Design stage involved designing the concept of SiKembar Gizi, consisting of the Pop-Up Book medium and the GIZI GO game. The Pop-Up Book was designed to present material on food groups, the functions of nutrients, healthy food choices, and the principle of balanced nutrition through three-dimensional visualization. Meanwhile, GIZI GO was designed as an educational game combining running, jumping, and relay activities across several posts to obtain illustrated food cards. These cards were used by students to identify food groups and compose menu combinations based on the principle of balanced nutrition.

The Development stage involved developing the design into a ready-to-use SiKembar Gizi product for learning. The developed product then went through a validation process by material and media experts to assess the feasibility of content, presentation, language, visual design, media usability, and the suitability of game activities with the learning objectives. The validation results were used as the basis for revising the product before it was implemented with students. The Implementation stage was carried out through product trials with Madrasah Ibtidaiyah students. The trials were conducted in stages, through a small-group trial and a large-group trial, to determine the level of practicality, acceptability, and feasibility of using SiKembar Gizi in the learning process. At this stage, students took part in learning using the Pop-Up Book and the GIZI GO game according to the procedures that had been developed.

The Evaluation stage was carried out to determine the overall quality and effectiveness of the product. The evaluation was based on the results of expert validation, student responses, observations of learning implementation, and changes in students' nutrition literacy and physical activity before and after the use of SiKembar Gizi. The product's effectiveness in improving nutrition literacy was determined through a test instrument administered before and after learning, while students' physical activity was assessed using an observation sheet or a physical activity instrument adapted to the characteristics of the GIZI GO activities. The evaluation results were used as the basis for determining the product's final feasibility and for making refinements if shortcomings were found.

The research subjects were students of MIN 8 Bireuen, who were the target of SiKembar Gizi's development. Trial subjects were selected according to the characteristics of the learners targeted by the product. The trial was conducted in a small group to obtain initial information regarding the product's practicality and comprehensibility, followed by a large-group trial to obtain a broader picture of the use of SiKembar Gizi in learning. The number of participants at each trial stage was adjusted to the conditions and needs of the study.

The research instruments were used to obtain data on the feasibility, practicality, and effectiveness of SiKembar Gizi. The expert validation instrument used a five-point Likert scale, namely Very Good (SB) = 5, Good (B) = 4, Fair (C) = 3, Poor (K) = 2, and Very Poor (KS) = 1 (Sugiyono, 2019). This instrument was used by the material and media experts to assess various aspects of the product. Student responses to the use of SiKembar Gizi were measured using a questionnaire adapted to the students' developmental level, while nutrition literacy was measured using an instrument covering students' knowledge and understanding of food groups, the functions of nutrients, healthy food, and the principle of balanced nutrition. Students' physical activity was assessed based on their involvement in movement activities during the learning process and the GIZI GO game.

The research data consisted of qualitative and quantitative data. Qualitative data were obtained from interviews, observations, comments, suggestions, and input from validators, which were used as material for product improvement (Ngatman, 2017). Quantitative data were obtained from expert



validation scores, student responses, nutrition literacy test results, and physical activity measurement results. Analysis of the validation and practicality data was carried out using descriptive statistics by calculating the score and percentage of achievement for each assessment aspect (Ngatman & Susworo, 2022). The product feasibility percentage was calculated by comparing the score obtained with the maximum score, then categorizing it according to the established feasibility criteria. Meanwhile, the effectiveness of SiKembar Gizi was analyzed by comparing students' nutrition literacy and physical activity results before and after using the product. Improvement in learning outcomes was analyzed using N-Gain, while differences in results before and after the intervention were tested using statistical analyses adapted to the characteristics and distribution of the research data.

Thus, the R&D method using the ADDIE model in this study was directed at producing a valid, practical, and effective SiKembar Gizi as a learning innovation that integrates nutrition literacy through Pop-Up Book visualization with physical activity and the GIZI GO educational game. This integration is expected to provide a concrete, interactive, enjoyable, and contextual learning experience, so that students not only gain knowledge of balanced nutrition, but also have the opportunity to apply that knowledge through movement activities, group interaction, food classification, and the preparation of healthy food choices.

RESULTS AND DISCUSSION

Research Results

This study produced the SiKembar Gizi product (Creative Synergy of Nutrition Learning Based on Pop-Up Book and GIZI GO), designed as a learning medium to integrate students' nutrition literacy and physical activity. The product was developed using the ADDIE model, consisting of the Analysis, Design, Development, Implementation, and Evaluation stages. The research results cover the product's feasibility based on expert validation, student responses in the trials, the improvement in nutrition literacy, and students' physical activity engagement.

The analysis stage indicated a need for a nutrition learning medium that is concrete, visual, interactive, and suited to the characteristics of elementary school students. The initial identification showed that students' understanding of the concept of balanced nutrition still needed to be strengthened, particularly in recognizing food groups, understanding the functions of nutrients, and determining food combinations appropriate to the principle of balanced nutrition.

These findings formed the basis for developing SiKembar Gizi, which combines the Pop-Up Book and GIZI GO in a single learning sequence. The Pop-Up Book is used to present nutrition concepts through three-dimensional visualization, while GIZI GO is designed as a physical-activity-based game that allows students to apply the material through running, jumping, and relay activities to obtain food cards. The cards obtained are then used to identify food groups and compose balanced nutrition menu combinations.

At the design stage, SiKembar Gizi was structured as integrated learning that connects the activity of understanding material with movement activities. The Pop-Up Book contains material on food groups, the functions of nutrients, healthy food choices, and the principle of balanced nutrition, with illustrations adapted to students' characteristics. Meanwhile, GIZI GO was developed as a post-based game combining physical activity with learning tasks.

The final product consists of the Pop-Up Book, illustrated food cards, and a GIZI GO game set equipped with rules and game procedures. The game mechanism was designed so that students must perform movement activities to obtain food cards, then classify the cards and compose food combinations in groups. With this design, physical activity became an integrated part of the nutrition learning process.

The product's feasibility was tested through validation by material and media experts before being trialed with students. The validation results are presented in Table 1.

Table 1. Validation Results of the SiKembar Gizi Product

Validator	Percentage (%)	Category
Material Expert	91.2%	Highly Valid
Media Expert	94.0%	Highly Valid

The material expert's validation showed a percentage of 91.2%, which falls into the highly valid category. The assessment covered aspects of material suitability, conceptual accuracy, depth of material, suitability to students' characteristics, and ease of understanding. These results indicate that the substance of the material contained in the Pop-Up Book and GIZI GO is in line with the learning objectives and the characteristics of the target users.

The media expert's validation produced a percentage of 94.0%, categorized as highly valid. The aspects assessed included visual appearance, media attractiveness, image clarity, game quality, and ease of use. These results indicate that the visual components and game equipment of SiKembar Gizi have met the established criteria for learning media.

Input from both validators was used as the basis for refining the product before it was trialed with students. Thus, the product that entered the trial stage had already gone through an assessment process covering both the substance of the material and the quality of the media.

Product trials were conducted with small and large groups to determine student responses to the use of SiKembar Gizi. The trial results are presented in Table 2.

Table 2. Trial Results of SiKembar Gizi

No.	Assessment Aspect	Small Group (%)	Category	Large Group (%)	Category
1.	Ease of Use	90%	Highly Feasible	91%	Highly Feasible
2.	Media Attractiveness	91%	Highly Feasible	94%	Highly Feasible
3.	Understanding of Material	90%	Highly Feasible	93%	Highly Feasible
4.	Group Cooperation	91%	Highly Feasible	95%	Highly Feasible
5.	Physical Activity	92%	Highly Feasible	97%	Highly Feasible
	Average	90.8%		Highly Feasible	94%

The trial results showed that SiKembar Gizi received a positive response in both the small and large groups. The five aspects assessed were ease of use, media attractiveness, understanding of material, group cooperation, and physical activity. In the small group, the average percentage reached 90.8%, while in the large group it increased to 94%. Both fall into the highly feasible category.

In the large group, the highest percentage was found in the physical activity aspect (97%), followed by group cooperation (95%), media attractiveness (94%), understanding of material (93%), and ease of use (91%). Overall, the average increase of 3.2 percentage points indicates that SiKembar Gizi received a very good level of acceptance from students and is feasible for use in physical-activity-based nutrition learning.

After going through the validation and trial processes, SiKembar Gizi was implemented in learning with the students of MIN 8 Bireuen. A total of 86 students had complete data and were used in the analysis of nutrition literacy before and after the learning intervention.

Implementation began with the use of the Pop-Up Book to introduce food groups, the functions of nutrients, healthy food choices, and the principle of balanced nutrition. After understanding the material, students took part in the GIZI GO game. In this game, students moved through several posts by running, jumping, and completing relays to obtain food cards. The cards obtained were then classified by food group and used to compose balanced nutrition menu combinations in groups.

Changes in students' nutrition literacy were analyzed based on pretest and posttest scores. The descriptive statistics of the measurement results are presented in Table 3.

Table 3. Descriptive Statistics of Nutrition Literacy

Measurement	N	Mean	SD	Median	Min	Max
Pretest	86	58.60	10.28	59	37	85



The mean nutrition literacy score increased from 58.60 in the pretest to 86.40 in the posttest, an increase of 27.80 points. In addition to the increase in the mean, the minimum score increased from 37 to 65, while the maximum score increased from 85 to 100.

The N-Gain analysis produced a mean value of 0.706, or 70.63%, which falls into the high category. These results indicate that the increase in nutrition literacy scores after the implementation of SiKembar Gizi was at a high level.

A normality test was conducted before testing the difference between pretest and posttest scores, using the Shapiro-Wilk test. The pretest data showed a statistic of 0.980 with $p = 0.219$, while the posttest data showed a statistic of 0.943 with $p = 0.001$. These results indicate that the posttest data did not meet the assumption of normality.

The difference test was conducted using a paired-samples t-test and confirmed using the Wilcoxon Signed-Rank Test. The paired-samples t-test showed a statistic of 43.969 with $p < 0.001$. Meanwhile, the Wilcoxon Signed-Rank Test produced a statistic of 0 with $p < 0.001$. Both test results indicate a significant difference between nutrition literacy scores before and after the implementation of SiKembar Gizi.

The magnitude of the change was shown by a Cohen's d_z value of 4.741, which falls into the very large category. This finding demonstrates a strong change in nutrition literacy scores after students took part in learning using SiKembar Gizi.

Students' physical activity was observed during the implementation of the GIZI GO game. The distribution of physical activity categories among the 86 students is presented in Table 4.

Table 4. Distribution of Students' Physical Activity

Category	n	Percentage (%)
Highly Active	59	68.6%
Active	22	25.6%
Moderate	5	5.8%
Less Active	0	0%
Total	86	100%

A total of 59 students (68.6%) were in the highly active category, 22 students (25.6%) in the active category, and 5 students (5.8%) in the moderately active category. No students fell into the less active category. Overall, 81 students (94.2%) were in the active and highly active categories.

This physical activity took place through running, jumping, and relay activities that were part of the GIZI GO game mechanism. These activities were carried out together with learning tasks such as obtaining food cards, identifying food groups, and composing balanced nutrition menu combinations.

The evaluation stage was carried out by combining the results of expert validation, product trials, and the results of implementation with students. Overall, the validation results showed that SiKembar Gizi obtained a percentage of 91.2% from the material expert and 94.0% from the media expert, both in the highly valid category. Student responses also showed positive results, with percentages of 90.8% in the small-group trial and 94.0% in the large-group trial, both of which fall into the highly feasible category.

In the implementation with 86 students, the mean nutrition literacy score increased from 58.60 to 86.40, an increase of 27.80 points. The N-Gain value of 0.706 falls into the high category. The statistical test results showed a significant difference with $p < 0.001$, while a Cohen's d_z value of 4.741 indicates a very large effect.

In terms of physical activity, 94.2% of students were in the active and highly active categories. The results of the large-group trial also showed that the physical activity aspect received the highest response, at 97%, followed by group cooperation at 95%, media attractiveness at 94%, understanding of material at 93%, and ease of use at 91%.

Overall, the research results show that SiKembar Gizi meets the criteria of being valid and feasible for use as a nutrition learning medium, and shows positive results in terms of students' nutrition literacy and physical activity engagement. The integration of the Pop-Up Book and GIZI GO provides two complementary learning experiences: a visual experience in understanding nutrition concepts and a kinesthetic experience through a physical-activity-based game. This product positions students as active participants in the learning process through observing, moving, identifying, classifying, discussing, and composing food combinations based on the principle of balanced nutrition.



Figure 1. Result of the Nutrition Pop-Up Book Product

Discussion

The development of SiKembar Gizi (Creative Synergy of Nutrition Learning Based on Pop-Up Book and GIZI GO) is based on the need for nutrition learning that not only conveys information, but also provides a concrete, engaging learning experience that actively involves students. The use of the ADDIE model allowed the development process to be carried out systematically through needs analysis, design, development, implementation, and evaluation. This approach produced a medium that connects nutrition material with learning activities suited to the characteristics of elementary school students.

The need for concrete and interactive media is important because nutrition concepts, such as food groups, the functions of nutrients, and balanced food composition, are relatively easier to understand when presented through visual representation and direct experience. The study by Nurahmadi & Dalimunthe (2024) showed that nutrition education using a Pop-Up Book can significantly improve elementary school students' nutrition knowledge ($p = 0.002$). That study used a one-group pretest-posttest design with 57 students and showed that the Pop-Up Book medium also affected students' breakfast habits.

The validation results for SiKembar Gizi reinforce the product's feasibility in terms of both substance and design. The material expert's validation obtained 91.2%, while the media expert's obtained 94%, both in the highly valid category. These results indicate that the material presented is aligned with the learning objectives and students' characteristics, while the visual aspects, images, game, and ease of use meet the criteria for learning media.

This finding is in line with the development study of the Nutrigo Board Game, which showed that a nutrition education game medium received a very positive reception from students (Dianah & Mutia, 2025). That study reported an overall satisfaction level of 83% and found a significant increase in knowledge of balanced nutrition after the intervention ($p < 0.001$).

Although SiKembar Gizi shares similarities with these studies in the use of games as a nutrition education medium, it has a more integrative character. The material is not only delivered through the



game, but is first built through the Pop-Up Book and then applied through GIZI GO. Thus, the product connects the processes of understanding concepts, performing movement activities, and applying knowledge within a single learning sequence.

Student responses to SiKembar Gizi showed a very good level of acceptance. The average score increased from 90.8% in the small group to 94% in the large group. The increase of 3.2 percentage points indicates that the medium remained well received when used with a larger group of students.

In the large group, the physical activity aspect obtained the highest score, at 97%, followed by group cooperation at 95%, media attractiveness at 94%, understanding of material at 93%, and ease of use at 91%. This pattern indicates that the strength of SiKembar Gizi lies not only in the appearance of the medium, but also in the active learning experience provided to students.

The high response to attractiveness and understanding of material can be linked to the use of the Pop-Up Book, which presents material in three-dimensional visual form. This representation helps make previously abstract concepts more concrete and easier to observe. This finding is reinforced by the study of Nurahmadi & Dalimunthe (2024), which showed a significant effect of nutrition education using a Pop-Up Book on elementary school students' nutrition knowledge.

In addition, a study comparing video media and a Pop-Up Book in teaching balanced nutrition guidelines showed that a Pop-Up Book can be used as an educational medium to help improve elementary school students' knowledge of balanced nutrition (Putri & Noviani, 2021).

Meanwhile, the high response for group cooperation and physical activity indicates that GIZI GO provides a collaborative learning experience. Students not only moved to complete the game, but also had to use the food cards obtained to classify food groups and compose menus. Thus, physical activity had a learning function because it was directly linked to the cognitive tasks the students had to complete.

The improvement in nutrition literacy is one of the main findings of this study. The mean student score increased from 58.60 in the pretest to 86.40 in the posttest, an increase of 27.80 points. An N-Gain value of 0.706 also indicates that the improvement in students' ability falls into the high category.

This increase indicates that SiKembar Gizi was able to provide a more active learning experience compared with learning oriented solely toward the delivery of information. The Pop-Up Book served to build initial understanding of food groups, the functions of nutrients, and the principle of balanced nutrition. This knowledge was then used in GIZI GO through activities of identifying, classifying, discussing, and composing food combinations.

This mechanism gave students the opportunity to receive information, process information, and apply information in a concrete context. This is important in nutrition learning because understanding healthy food requires not only the ability to remember, but also the ability to recognize and combine various types of food according to the principle of balanced nutrition.

These results are consistent with the study of Nurahmadi & Dalimunthe (2024), which found that the use of a Pop-Up Book had a significant effect on elementary school students' nutrition knowledge ($p = 0.002$). A similar finding was also shown by Dianah & Mutia (2025), who obtained a significant increase in knowledge of balanced nutrition with $p < 0.001$.

Thus, this study's results reinforce the evidence that visual media and games can be an effective approach in nutrition education for schoolchildren. However, SiKembar Gizi provides a further development by integrating visual media, educational games, physical activity, and group cooperation within a single learning design.

The improvement in nutrition literacy scores was not only apparent descriptively, but was also supported by statistical test results. The paired-samples t-test produced a value of 43.969 with $p < 0.001$, while the Wilcoxon Signed-Rank Test also showed $p < 0.001$. The consistency of both analyses indicates a significant difference in nutrition literacy scores between before and after the implementation of SiKembar Gizi.

The use of the Wilcoxon test was important because the Shapiro-Wilk results showed that the posttest data were not normally distributed. Therefore, the Wilcoxon results provided a nonparametric

confirmation of the change in scores that occurred. Thus, the improvement in nutrition literacy was not only shown by descriptive changes in numbers, but was also supported by strong statistical evidence.

The magnitude of the change was also shown by a Cohen's d_z value of 4.741, which falls into the very large category. This result indicates that the difference between pretest and posttest scores had a strong magnitude. This finding is consistent with research on game-based nutrition education. The study by Dianah & Mutia (2025), for example, found a significant effect on knowledge of balanced nutrition with $p < 0.001$.

This similarity in results indicates that game characteristics that provide students with opportunities to interact, choose, classify, and make decisions can help strengthen the nutrition learning process. In SiKembar Gizi, this mechanism is reinforced by physical activity, so that students gain a learning experience through more than one form of engagement.

Another advantage of SiKembar Gizi can be seen in students' physical activity engagement. Observation results showed that 59 students (68.6%) were in the highly active category and 22 students (25.6%) in the active category. Thus, a total of 81 students (94.2%) were in the active and highly active categories, while no students were in the less active category.

This finding indicates that physical activity in GIZI GO was not merely an additional activity, but was designed as part of the learning mechanism. Students ran, jumped, and completed relays to obtain food cards. The cards were then used to complete cognitive tasks in the form of classifying food and composing balanced nutrition menus. This pattern created a direct link between movement and the thinking process.

This game-based approach is also relevant to physical education learning for elementary school students. The study by Harahap et al. (2025) showed that a physical activity game model can be developed as a feasible approach for improving the motor skills of children aged 8-9 years. The large-group trial in that study produced a feasibility level of 89%.

This finding supports the use of the game mechanism in SiKembar Gizi, because movement activities can be packaged in an enjoyable way with a clear purpose. Thus, students do not perceive physical activity as an additional burden in learning, but as part of a game they need to complete.

Viewed as a whole, the main strength of SiKembar Gizi does not lie in the Pop-Up Book or GIZI GO separately, but in the integration of the two within a single learning flow. The Pop-Up Book serves as the stage for introducing and understanding concepts, while GIZI GO serves as the stage for applying that knowledge through physical activity and cooperation.

This flow produces a learning experience that involves observing, understanding, moving, identifying, classifying, discussing, and making decisions. These characteristics make students active participants in learning, rather than merely recipients of information.

The use of the Pop-Up Book medium itself has been shown to have potential in nutrition education. Nurahmadi & Dalimunthe (2024) found an increase in nutrition knowledge and a change in breakfast habits after nutrition education using a Pop-Up Book. Meanwhile, the use of educational games has also shown positive results for students' nutrition knowledge through the Nutrigo Board Game (Dianah & Mutia, 2025).

SiKembar Gizi develops both approaches into a single learning experience. The Pop-Up Book provides a visual experience, while GIZI GO provides a kinesthetic and social experience. This combination is the main distinguishing feature compared with nutrition education media that are oriented solely toward improving knowledge.

From the perspective of physical education, the use of games as a means of activity also supports student engagement. Research on the development of physical activity games for elementary school students shows that games can be used to create engaging activities that also support the development of motor skills (Jannah & Wiyarno, 2026). Thus, the integration of movement activities into nutrition education has a pedagogical basis relevant to the characteristics of school-age children.

These research results imply that nutrition learning in elementary schools can be directed toward a more active, concrete, interactive, and enjoyable approach. Learning media do not only function as a tool for delivering material, but can be designed as part of students' learning experience.

In the implementation of SiKembar Gizi, students first obtain information through the Pop-Up Book, then use it in the GIZI GO game. This process allows the knowledge gained not to stop at the stage of understanding, but to continue with application through concrete activities.



This approach also has the potential to be applied across subjects. Because SiKembar Gizi's material relates to nutrition, health, physical activity, and cooperation, the product can be developed to support learning in Physical Education, Sport, and Health (PJOK), Science and Social Studies (IPAS), and health education. This integration can broaden the function of the medium from merely a nutrition education tool into a more comprehensive health learning medium.

Overall, the research results show that SiKembar Gizi has very good feasibility and produces positive results for students' nutrition literacy and physical activity engagement. Material expert validation of 91.2% and media expert validation of 94%, student responses of 90.8% in the small group and 94% in the large group, an N-Gain increase of 0.706, and 94.2% of students in the active and highly active categories demonstrate positive consistency from the development stage through to implementation.

Thus, the novelty of SiKembar Gizi lies in the integration of nutrition literacy and physical activity within a single learning mechanism. Students not only gain knowledge about balanced nutrition, but also use it through movement activities, classifying food, discussing, and composing menu combinations. This integration of visual, kinesthetic, cognitive, and social experiences makes SiKembar Gizi a potential alternative learning medium for nutrition education among Madrasah Ibtidaiyah students.

CONCLUSION

This study produced SiKembar Gizi, a learning medium that integrates the Pop-Up Book and the GIZI GO game to develop nutrition literacy while encouraging students' physical activity. The product obtained a highly valid category based on validation by the material expert (91.2%) and the media expert (94%), and a highly feasible category based on student responses in the small group (90.8%) and the large group (94%). Implementation with 86 students showed an increase in nutrition literacy from 58.60 to 86.40, with an N-Gain of 0.706 and a significant difference ($p < 0.001$), as well as a very large effect (Cohen's $d_z = 4.741$). In addition, 94.2% of students were in the active and highly active categories during the implementation of GIZI GO. Thus, SiKembar Gizi is feasible and has potential for use as a nutrition learning innovation that integrates visual, cognitive, kinesthetic, and collaborative experiences for Madrasah Ibtidaiyah students.

REFERENCES

- Ahmad, zkiya M., & Nurhidayati, V. A. (2025). Efektivitas Pop-up Book Aplikatif sebagai Media Edukasi tentang Hipertensi pada Siswa SMP Islam Al-Mustarih Kota Bogor. *Jurnal Ilmu Gizi Dan Dietetik*, 4(2), 142–150. <https://doi.org/doi/10.25182/jigd.2025.4.2.142-150>
- Briawan, D. (2016). Perubahan pengetahuan, sikap, dan praktik jajanan anak sekolah dasar peserta program edukasi pangan jajanan. *Jurnal Gizi Dan Pangan*, 11(November), 201–210. <https://doi.org/https://doi.org/10.25182/jgp.2016.11.3.%25p>
- Damayanti, A. Y., Darni, J., & Hafizhatunnisa, H. (2021). *The effectiveness of Islamic comic media in increasing the attitude of healthy breakfast among students*. 9(2), 143–149. <https://doi.org/https://doi.org/10.14710/jgi.9.2.144-150>
- Damayanti, D., Karina, M., Nixon, A. S., & Salsabila, D. (2024). The effect of nutrition education on knowledge , nutrients intake , and physical activity of children with overweight and obesity at elementary school in Jakarta Indonesia. *International Journal of Community Medicine and Public Health*, 11(3), 1058–1065. <https://doi.org/https://dx.doi.org/10.18203/2394-6040.ijcmph20240603>
- Dianah, R., & Mutia, J. (2025). Pengembangan Media Edukasi Nutrigo Board Game. *PREPOTIF : Jurnal Kesehatan Masyarakat*, 9, 7708–7719.

- <https://doi.org/https://doi.org/10.31004/prepotif.v9i3.51518>
- Harahap, M. I., Bangun, S. Y., & Ritonga, D. (2025). Pengembangan model permainan aktivitas jasmani dalam meningkatkan kemampuan motorik anak usia 8–9 tahun di tingkat sekolah dasar. *Jurnal Olahraga Pendidikan Indonesia (JOPI)*, 4, 90–102. <https://doi.org/https://doi.org/10.54284/jopi.v4i2.355>
- Irnani, H., & Sinaga, T. (2017). *Pengaruh pendidikan gizi terhadap pengetahuan , praktik gizi seimbang dan status gizi pada anak sekolah dasar*. 6(1), 58–64. <https://doi.org/https://doi.org/10.14710/jgi.6.1.58-64>
- Jannah, M., & Wiyarno, Y. (2026). Innovative Recreational Game Development : Sport Monopoly Game for Enhancing Physical-Fitness Learning in Elementary Students. *Indonesian Journal of Kinanthropology (IJOK)*, 6(1), 1–10. <https://doi.org/https://doi.org/10.26740/ijok.v6n1.p1-10>
- Ngatman, N. (2017). *Evaluasi Pendidikan Jasmani Olahraga dan Kesehatan*. CV. Sarnu Untung.
- Ngatman, N., & Susworo, A. (2022). *STATISTIKA Untuk Penelitian Bidang Pendidikan Jasmani Olahraga dan Kesehatan/ PJOK (I)*. UNY Press.
- Nurahmadi, R., & Dalimunthe, N. K. (2024). Pengaruh Edukasi Gizi Melalui Media Pop-Up Book Terhadap Pengetahuan Gizi Dan Kebiasaan Makan Pagi Siswa Sekolah Dasar Negeri 3. *Journal of Nutrition College*, 13(April), 210–219. <https://doi.org/https://doi.org/10.14710/jnc.v13i3.40863>
- Omidvar, N., Doustmohammadian, A., Shakibazadeh, E., Clark, C. C., & Kasaii, M. S. (2023). Effects of school-based interventions on Food and Nutrition Literacy (FNLIT) in primary-school-age children: a systematic review. *British Journal of Nutrition*. <https://doi.org/https://doi.org/10.1017/s0007114522002811>
- Purwasih, M., Puspita, W. L., & Hermansyah, A. (2025). *Pengaruh Media Pop-Up Book Terhadap Peningkatan Pengetahuan Dan Konsumsi Buah Dan Sayur Di Sd Negeri 13 Parit Lengkong Desa Mega Timur*. 2(September), 82–86. <https://doi.org/https://doi.org/10.2804/mgk.1811.1116>
- Putri, E. B. P., & Noviani, E. O. (2021). Comparison of Educational Media with Video and Pop-Up Book Towards Knowledge of Balanced Nutrition Guidelines in Elementary School Students. *Child Education Journal (CEJ)*, 3(2), 123–128. <https://doi.org/10.33086/cej.v3i2.2426>
- Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&G* (M. Dr. Ir. Sutopo. S.Pd (ed.)). Alfabeta. www.cvalfabeta.com
- Yulia, C., & Khomsan, A. (2021). Effect of nutrition education and traditional game-based physical activity interventions , on lipid profile improvement in overweight and obese children in West Java Indonesia. *Nutrition Research and Practice*, 15(4), 479–491.

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