

The effect of interactive learning on nutritional knowledge among teachers, parents and students at primary schools in Central Java

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Abstract. Background: Failure of linear growth or stunting is one of childhood's most common nutritional deficiencies. Parenting patterns and food provision greatly influence children's ability to consume balanced nutrition. Interactive learning transforms the educational process into a dynamic, engaging, and effective experience, providing students with applicable and long-lasting skills and knowledge. Objectives: This study identified the impact of interactive learning on nutritional knowledge among students, parents, and teachers in primary schools in Central Java. Methods: The research used a pre-post study design, involving an interactive learning process, where balanced nutrition material and relevant games were delivered to the respondents. The duration of the intervention was five hours. The research involved 252 participants from 51 primary schools. The instrument measures several important components of the government's balanced nutrition guideline. It assesses the knowledge of children, parents, and teachers regarding the components of a plate, protein sources, children's nutritional needs, children's ideal body weight, the significance of breakfast, the role of vitamins and vegetables, the benefits of tempeh or tofu, and proper handwashing techniques. Measurements were taken before and after the intervention. Results: The pre-post test showed that there was a significant difference in nutritional knowledge in the teacher and parent groups but not in the student group (p-value: 0.751). Conclusions: Continuous efforts are needed to educate students regarding nutrition. Apart from interactive games, the lecture method can also be used to emphasize several important points during learning.

1 Introduction

The most prevalent undernutrition in childhood is linear growth failure or stunting [1]. In 2022, the prevalence of stunting in Indonesia was 14.1% [2]. Stunting has long-term effects

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including poor cognition and educational performance, low adult wages, lost productivity, and an increased risk of nutrition-related chronic diseases in adult life [1]. Healthy eating in childhood and adolescence is essential for proper growth and development and for preventing various health conditions including stunting [3]. The Indonesian Government launched the “*Isi Piringku*” campaign to tackle stunting [4]. Generally, the campaign describes the food consumed on one plate consisting of 50 percent fruit and vegetables and the remaining 50 percent carbohydrates and protein. A survey showed that parents and teachers do not fully understand the importance of healthy eating patterns and providing balanced nutrition for primary school-age children [5].

Education about balanced nutrition should be carried out at every age group level, including children. Children aged 6-9 years have entered school and play a lot outside, so the influence of friends, offers of snacks, high levels of activity, and exposure to sources of infectious disease are high. Some children aged 6–9 years have begun to enter the period of rapid pre-puberty growth, so the need for nutrients increases significantly. Consequently, it is imperative to ensure the provision of balanced, nutritious food for children in this age group [6].

The establishment of balanced nutritional habits in children is significantly shaped by their parents' parenting and feeding practices. Research shows that there is a significant relationship between eating patterns and the nutritional status of children in primary school. Children with a good diet have good nutritional status [7–10]. Children's dietary habits are significantly shaped by their parents' understanding, perspectives, and actions concerning balanced nutrition. Studies indicate a significant correlation between a mother's knowledge, attitudes, and behaviors and the nutritional status of her children [11–15]. Parents and schools have an important role in increasing children's knowledge and attitudes toward nutritious and balanced food. One survey showed that parents and teachers do not fully understand the importance of healthy eating patterns and providing balanced nutrition for primary school-age children [5].

Research on balanced nutrition conducted among primary school children showed that some respondents lacked knowledge (50%) and the majority of respondents had a negative attitude towards balanced nutrition (55.9%), and it was concluded that there was a relationship between knowledge and balanced nutrition behavior ($p < 0.05$) [16]. This is also supported by research that states there was a relationship between nutritional knowledge and eating behavior, which reflects a child's nutritional status [17]. Based on the 2023 Indonesian Health Survey, as many as 64.2% of those aged 10–14 years possess correct knowledge about stunting, and for the adult age group, on average, only 68.78% possess correct knowledge about stunting [18]. Another study in a primary school showed that 80% of children's diets were not good and 60% of children were malnourished. Another study also revealed that there was a relationship between eating patterns and the nutritional status of students in grades IV and V of primary school [19]. Therefore, nutrition education is needed to increase the nutritional knowledge and attitudes of schoolchildren [20–21].

More studies are required to explore the outcomes of health promotion courses employing an interactive approach and to compare the results across students, parents, and teachers in Indonesia. Considering the significance of nutritional knowledge among students, parents, and educators, research is required to determine intervention strategies to enhance their knowledge. Therefore, this study examines the effects of interactive learning on the nutritional knowledge among teachers, parents, and students in primary schools in Central Java, Indonesia.

2 Materials and methods

This pre-post intervention study was conducted in 51 primary schools in Wonosobo,

The variable measured in this study focused on nutritional knowledge. The instrument consisted of 10 questions adopted from the “Isi Piringku” campaign and the balanced nutrition guidelines developed by the Indonesian Government. Each question in the instrument had a corrected total-item correlation score (>0.56) higher than the R-table, and the Cronbach alpha score was 0.64, which indicates the questionnaire has valid items and acceptable reliability.

The measurement was conducted both before and after the intervention. The intervention was interactive learning for parents/teachers' group and students' group. All learning is interactive, as learners engage with content to process information, complete tasks, and resolve problems, aiming to enhance cognitive development [22]. The intervention was conducted as a single session, lasting approximately five hours. For teachers and parents' group, lesson was delivered by using presentation; and for students' group, various games were used such as snakes and ladders [Figure 1], crosswords, and puzzles. The lesson was delivered by dietician and public health experts. The facilitators in the intervention were public health practitioners with background in health and social education. Data were collected using a questionnaire. A paired t-test was performed to measure the effect of the intervention. Data were analyzed by using SPSS ver. 27.0.



Figure 1. Snakes and ladders: Balanced nutrition education

3 Results and discussion

The respondents were divided into three groups: students (37.7%), parents (28.6%), and teachers (33.7%). Consistent with the location of the primary school, the participants came from three cities in Central Java, namely Surakarta, Klaten, and Wonosobo. The majority of participants in this study were female (75.4%). The average age for students was 10.5 years, while the average ages for parents and teachers were 37.2 and 34.6 years, respectively [Table 1].

The findings indicated that the student group achieved the lowest score on both the pre- and post-test, with scores of 5.95 and 5.91, respectively. Furthermore, there was no observed improvement in students' scores after the completion of training sessions. Both the teacher and parent groups showed an improvement in their knowledge score before and after attending the training session. In addition, the teacher group achieved the highest score compared to other groups (8.56 vs 8.39 vs 5.91).

T-test analysis showed a significant difference in knowledge scores before and after intervention in the parent and teacher groups ($p < 0.001$) and all groups ($p: 0.001$). However, there was no significant difference in knowledge score in the student group [Table 2]. In the parent and teacher groups, only 35% answered the vitamin function question correctly. Table 3 presents the correct answers to each question in both the pre-test and post-test. The results indicated that certain questions received low scores, specifically regarding the function of vitamins and the advantages of tempeh and tofu. The correctness of responses regarding various topics, including food portion components, instant noodles as a protein source, children's nutritional requirements, optimal body weight for children, and the role of vitamins, diminished within the student group. This may be due to the complexity of certain questions, which were difficult for students to comprehend within a limited timeframe, necessitating multiple sessions to grasp various intricate nutrition-related concepts.

This study found that students demonstrated a lower level of knowledge about nutrition compared to other groups. The 2023 Indonesia Global School Health Policies and Practices Survey revealed that only 61.7% schools provide nutrition and dietary behavior education to their students [23]. Lack of health education in primary school might be caused by several reasons such as lack of resources, training and management [24–26]. Insufficient nutritional knowledge results in suboptimal dietary selections, adversely affecting the health of individuals and populations, increasing the risk of various health issues, including obesity and malnutrition [27]. The students' knowledge did not improve after completing the intervention but tended to decrease, probably because of limited encouragement for creativity, critical thinking, motivation to learn, and effective communication or interaction with peers and instructors. Also, according to Kumar *et al.* (2016), the instructor must transition from being a traditional lecturer to acting as a facilitator to support interactive learning. This approach should be evaluated by all instructors involved in interactive learning. These factors are essential to improve students' participation and performance [28].

This study found significant improvement in parents and teachers' knowledge after participating in interactive learning sessions. Another study showed that interactive education intervention enhanced primary care personnel's knowledge, behaviors, and confidence in employing health literacy strategies with patients and families [29]. Interactive sessions consist of a series of activities organized for groups of participants who collaborate to investigate and resolve collectively presented problems [30]. Providing health education to students, teachers, and parents is a significant step to improve their knowledge. Learning method should be chosen carefully to ensure effective knowledge transfer. Interactive learning is one of method that can be used to enhance the educational experience, rendering it more enjoyable and engaging for students [31].

Table 1. Respondent characteristics

| | Total | | Student | | Parent | | Teacher | |
|-----------------|-----------------|-------|-----------------|------|------------------|------|-------------------|------|
| | n | % | n | % | n | % | n | % |
| Total | 252 | 100.0 | 95 | 37.7 | 72 | 28.6 | 85 | 33.7 |
| Sex | | | | | | | | |
| Male | 62 | 24.6 | 40 | 64.5 | 5 | 8.1 | 17 | 27.4 |
| Female | 190 | 75.4 | 55 | 28.9 | 67 | 35.3 | 68 | 35.8 |
| City | | | | | | | | |
| Surakarta | 93 | 36.9 | 34 | 36.6 | 27 | 29.0 | 32 | 34.4 |
| Klaten | 81 | 32.1 | 30 | 37.0 | 20 | 24.7 | 31 | 38.3 |
| Wonosobo | 78 | 31.0 | 31 | 39.7 | 25 | 32.1 | 22 | 28.2 |
| Age (in years)* | 26.2 (9.0–55.0) | | 10.5 (9.0–13.0) | | 37.2 (32.0–48.0) | | 34.6 (18.0 –55.0) | |

*Mean (Min – Max)

Table 2. Pre- and post-test results

| | Mean±SD (Min-Max) | p-value |
|---------------|------------------------|---------|
| Student group | | |
| Pre-test | 5.95±1.78 (2.00–10.00) | 0.751 |
| Post-test | 5.91±1.73 (3.00–9.00) | |
| Parent group | | |
| Pre-test | 7.74±1.67 (3.00–10.00) | <0.001 |
| Post-test | 8.39±1.18 (5.00–10.00) | |
| Teacher group | | |
| Pre-test | 8.19±1.19 (4.00–10.00) | <0.001 |
| Post-test | 8.56±1.10 (4.00–10.00) | |
| All group | | |
| Pre-test | 7.21±1.86 (2.00–10.00) | 0.001 |
| Post-test | 7.51±1.86 (3.00–10.00) | |

Table 3. The proportion of correct answers during the post-test

| | Student (n:95) | | Parent (n:72) | | Teacher (n:85) | |
|--|-------------------|--------------|------------------|-------------|-------------------|--------------|
| | Pre test | Post test | Post Test | Pre Test | Pre test | Post test |
| Isi piringku component | 62.1 | 58.9 | 80.6 | 94.4 | 91.8 | 94.1 |
| Rice portion | 28.4 | 29.5 | 62.5 | 84.7 | 72.9 | 94.1 |
| Instant noodle as source of protein | 83.2 | 82.1 | 97.2 | 100.0 | 97.6 | 100.0 |
| Nutritional needs for child | 62.1 | 56.8 | 73.6 | 86.1 | 81.2 | 90.6 |
| Hand washing with soap and running water | 97.9 | 97.9 | 98.6 | 100.0 | 100.0 | 100.0 |
| Ideal weigh for child | 52.6 | 46.3 | 88.9 | 95.8 | 91.8 | 92.9 |
| Breakfast function | 91.6 | 96.8 | 95.8 | 97.2 | 97.6 | 98.8 |
| Vitamin function | 8.4 | 7.4 | 31.9 | 40.3 | 37.6 | 40.4 |
| Vegetable’s function | 43.2 | 50.5 | 75.0 | 79.2 | 83.5 | 82.4 |
| Health benefits of tempeh and tofu | 65.2 | 65.2 | 69.4 | 61.1 | 64.7 | 63.5 |

4 Conclusion

Nutritional education for early adolescents remains essential to improve their knowledge and awareness of nutritional needs particularly in topics related to the food portion and sources. This study showed that lessons delivered solely through gamification were not sufficient to improve students’ knowledge. Therefore, a lecture should be delivered to emphasize several important topics during learning. After that, an interactive game session could be held to

reinforce key concepts and facilitate children's comprehension and retention.

A limitation of the research is that not all participants were able to participate consistently due to time constraints or other priorities, which in turn reduced their motivation to engage actively. Additionally, the short duration of the research limited the visibility of participants' understanding. Furthermore, this research may not be generalizable to a wider population because it only involved participants from certain regions.

A strength of this research is its direct measurement of balanced nutrition understanding among students, parents, and teachers. Additionally, participants who have been given training will later be tasked to create a nutrition education program at their respective schools, involving various stakeholders and available resources.

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