

Development a Board Game : The Fruit-Veggie Wonderlands Game, Nutrition Education Tools For Elementary School Students

Sujarinee Sangwanna¹,

Weerasak Seelarat², and Teerapap Panklai³

Valaya Alongkorn Rajabhat University under the Royal Patronage^{1,2}

Rajamangala University of Technology Thanyaburi³

Corresponding Author, E-mail: sujarinee@vru.ac.th

Abstracts

Promoting nutrition literacy through appropriate games for school-aged children is a key principle that helps revitalize learning at this age. The purpose of this research is to develop board games to be learning media on nutrition related to the value of fruits and vegetables. Game outcomes created by three experts were assessed, and game satisfaction was assessed using a satisfaction questionnaire among elementary school-aged children in grades 4-6 (n = 30).

The results of the study found that the game has an average expert rating of 16 out of 20. Satisfaction after playing the game among 18 male and 12 female students was 13.5 points (90%), with the highest scores being game enjoyment (100%), game aesthetics (97%), overall game preference (93%), game duration (87%), and game ease (73%), respectively. School-aged children are highly satisfied with the game. This fruit and vegetable wonderland board game can be used as an educational material suitable for children and may help increase the nutritional knowledge of fruits and vegetables in school-age children effectively.

Keywords: Boardgame; Nutritional knowledge; School-age children

Introduction

Socio-economic changes in each country around the world affect lifestyles, overconsumption of food, and decrease of physical activity leading to obesity. Non-communicable diseases (NCDs) in both children and adults have increased rapidly, in 1997 the World Health Organization (WHO) has announced that “Obesity is a non-communicable disease that is prevalent in many countries around the world”. More than 50 percent of adults are overweight and obese. Overweight in children is an urgent public health problem worldwide that needs to be improved, including in Thailand. The current trend of overweight in children is increasing, and the epidemic is rapidly spreading around the world. Overweight in children is more found in western countries but now is more found in other developing countries (World Health Organization, 2012 : online). The statistics of the United States in 2003-2004 showed that the number of children who were overweight increased from 10.5% to 17.4%.

Causes of obesity in children are mostly a result of the relationship between genetics and the environment. Especially the changing of socio-economic, which affects the consumption and physical activity. Currently, many genes have been discovered related to obesity, in addition, environments also cause obesity (obesogenic environment) such as parental overnutrition, changing of the nutritional status of infants after birth, not breastfeeding

* Received: February 8 , 2022; Revised: February 25, 2022; Accepted: March 4, 2022

and milk powder feeding after birth, parents' education, family socioeconomic status, a parenting approach that encourages children to have unrestrained, living near a convenience store, a more comfortable lifestyle, and lack of physical activity. Thai children spend time to one in a fifth of their free time watching television, resulting in low physical activity which is an imbalance between the energy intake and the energy expenditure in the body.

Games have been indicated as being a great tool to promote active learning (Baid & Lambert, 2010 : 548-552; Kirikkaya, ER, & Vurkaya, 2010 : 1-13). Game-based learning could be the best way to stimulate students' learning (Dickey, 2010 : 65 ; Huang, 2010 : 87). Therefore, if studies in school are able to apply games to teaching, students can not only have better learning goals but also learn happily via these games. From the Rango card study that was designed to help promote healthy food (Chagas, et al., 2018: 1-10), the characteristics of the game were a food type or meal card game. This research study among adolescents from private schools at the central government of Brazil. It was expected to help develop food knowledge and recognize their own ability to manage health behaviors that will help promote proper food intake in the future. This game was designed as a food and nutrition learning tool based on Brazilian dietary advice. Alvina, et al., (2017: 81–86), this study aimed to analyze the influence of educational games about “Nutrient Hero” on healthy food. After the game "Nutrients Hero" was produced, the evaluation of the application performed by the pre-and post-test was given to 100 people. The results show post-test scores were higher than pre-test. In conclusion, playing the game "Nutrient Hero" can increase users' knowledge about vitamins and minerals. The study of a Kaledo game development in a school in Naples provincial or Salerno Province (Campania, Italy) by Viggiano, et al., (2014 : 217-228). This study was divided into two groups, the experimental group played games and received advice each week for more than 20 weeks, while the control group did not receive anything. The results found that after 6 months, the experimental group can improve the food questionnaire (14.4, 10.9), nutritional knowledge (6.5, 4.6), dietary behavior (32.4, 27.6), and BMI (0.44, 0.58) was significant difference better than a control group, respectively ($p < 0.001$). Thus, it indicated that Kaledo can improve nutrition knowledge and it also helps to modify dietary habits and promote long-term weight loss. The study on the effect of games on nutritional learning (Yien, J.M, et al., (2011 : 1-10). A 4-week trial in grade 3 of elementary schools in southern Taiwan. The experimental group received nutrition education taught using computer games, while the control group was taught nutrition content with the multimedia program (PowerPoint19). The results showed that the learning achievement of the students in the experimental group (17.39) was significantly different ($p < 0.001$) better than the control group (14.64). It showed that computer game instruction contributed to increasing academic achievement and improvement in the food and beverage consumption behavior of the students. The study of Cullen, et al. (2005 : 148–151) used the multimedia game Squire's Quest! to examine changes in fruit and vegetable juice consumption. The participants who were students in grade 4 of 26 elementary schools were divided into experimental groups and control groups by randomized. Food consumption was assessed 4 days before and after experiments. The results showed the experimental group had a significant increase in serving fruit and vegetable juices at lunchtime when compared with a control group. Several studies have suggested learning about food and nutrition through digital games. It can help increase motivation to learn and teach in adolescents' groups. In addition, it can be applied to use as a food and nutrition guideline for changing dietary behavior.

From all of these problems, it is the source of cooperation with Tha Khong Municipality and schools in this area to solve problems about nutritional education and organize activities to improve nutritional status in school-aged children. Therefore, this study aims to create the board game “the fruit-veggie wonderlands game” as the teaching materials on nutrition.

Research Methodology

The development of a board game “The fruit-veggie wonderlands”

The fruit-veggie wonderlands game was developed as a guideline for promoting proper nutrition learning for school-aged children using games as a base for learning. The study was conducted according to Anderson and Krathwohl’s revision of Bloom’s educational objectives that indicated the knowledge can occur through games (Anderson, W. and Krathwohl, D., 2001:45). We designed a board game: fruit-veggie wonderlands for learning nutrition knowledge about energy, mineral, and vitamin in fruits and vegetables.

The fruit-veggie wonderlands game consists of:

- 1) The board has 22 fruit and vegetable compartments (fruits and vegetables are high in vitamins and minerals). Ten magic card slots with questions about the vitamins and minerals of each fruit and vegetable, and 4 special slots (Start point, Tractor maintenance point, Rest point, and Tractor point magic).
- 2) The magic card, on the front is a picture of fruits and vegetables, with the words "magic card" and on the back, with questions related to the benefits of fruits and vegetables in terms of vitamins and minerals with 4 choices and a small hidden answer.
- 3) The territory card has a name on it that belongs to a vegetable or fruit. There is a brief description of the benefits of that vegetable or fruit as well as the territory's trading price
- 4) Mak walking game is a different miniature doll to use as checkers for each player's game.

How to play the fruit-veggie wonderlands game? This board game can be 3–7 players. All players start at the beginning and get equal money each. Then take turns rolling 2 dice to walk through the different channels. According to the number of dice and when walking around the board, you will receive a salary increase every round. During the walk, the player may walk along with the various land plots. If there is no owner, it can be bought and possessed. In the event of a fall, someone else has to pay a fee. In the end, whoever has the most money wins.

Data collection and Statistical Analyses

Thirty obesity students (18 Males and 12 Females) in grades 4-6 in a government school, Pathumthani, Thailand. All elementary school students that were included in this study, teachers, and the student’s parents (or legal guardian) gave informed consent for participation before commencing the study. The evaluation of the fruit-veggie wonderlands game by experts and satisfaction scores on the fruit-veggie wonderlands game by school-age children were measured using the questionnaire after game development. Students played the games for a month, with the school providing children with nutrition learning through games once a week. Data were shown as numbers and percentages.

Results

The participant's data

Data was collected from a sample group of 30 students in grades 4-6, aged 9–11 years, using an interview and teacher. It was found that 60% of the students were male and 40% were female, respectively. Most of the students were in the age range of 9 years (46.7%), 10 years (30.0%), and 11 years (23.3%), respectively, and 46.7% of the students were in grade 4, 30.0% grade 5, and grade 6, 23.3%. The data was shown in **Table 1**.

Table 1 Demographics data (n=30)

Characteristics		n (%)
Sex	Male	18 (60)
	Female	12 (40)
Age (years)	9	14 (46.7)
	10	9 (30.0)
	11	7 (23.3)
Level	Grade 4	14 (46.7)
	Grade 5	9 (30.0)
	Grade 6	7 (23.3)

Evaluation of the fruit-veggie wonderlands game by experts

The evaluation of the fruit-veggie wonderlands game by 3 experts, which consists of fruit and vegetable wonderland board game, magic cards, the territory cards, banknotes, and cartoon characters for playing games. It was found that the average score of the fruit and vegetable wonderland game was 16 out of 20 scores (80%). When evaluating the fruit-veggie wonderlands game in 5 aspects, it was found that the language received the most points was 3.7 points (92.5%), illustrations were appropriate at 3.3 points (82.5%). Moreover, the content was correct, suitability for the participants, and an overview of the game indicated that the game has the same score of 3 points (75%). The results were shown in **Table 2**.

Table 2 Assessment of the fruit-veggie wonderlands game by experts (n=3)

	Expert Person 1	Expert Person 2	Expert Person 3	Average
The content is accurate	3	4	2	3
Suitability for the candidates	3	3	3	3
Illustrations are appropriate	4	3	3	3.3
Easy to understand language	4	3	4	3.7
Overview of the game set	3	3	3	3
Total	17	16	15	16

A total of 20 points, each topic has 4 points.

Satisfaction scores on the fruit-veggie wonderlands game by school-age children

The satisfaction scores of the fruit-veggie wonderlands game by school-age children (n = 30), it was found that the summary of satisfaction scores was 13.5 out of 15 points (90%). From the satisfaction assessment of 5 aspects, it was found that the aspect that received the highest score was the enjoyment of the game (100%), the beauty of the game (97%), overall liking of the game (93%), game duration (87%), and a game easy (73%), respectively as shown in **Table 3**.

Table 3 Satisfaction scores of the fruit-veggie wonderlands game by school-age children (n = 30)

	Satisfaction scores (3 points)	%
The beauty of the game	2.9	97
The game's ease of play	2.2	73
Game duration	2.6	87
The fun of the game	3.0	100
Overall liking for the game	2.8	93
Total	13.5	90

Discussion

The fruit-veggie wonderlands game was a board game for nutrition learning. This game has a language that is easy to understand and the content used is accurate. In addition, the images used for the illustration are suitable for school-age children. The results indicated that the children had fun playing the fruit-veggie wonderland game, liked the beauty of the game, and had an overall preference for the game of the fruit-veggie wonderlands game set. Children's obesity prevention programs require tools that can improve health and education while also being enjoyable (Zheng, W., et al, 2014 : 263-269). Games could be an appropriate choice that can help students increase their knowledge by enhancing enjoyment and improving long-term learning. (Bonati, M. and Campi, R., 2005 : 6). This is consistent with previous research by Srichan, C, (2018 : 13-16) developed nutritional materials for children is imperative to help engage children, and must use a media that is easy to understand. When providing nutrition counseling with media, children's understanding was 87.25% higher and children's attention was more attractive than when teaching without media. Chen, et al., (2012 : 236-240) developed an educational card game for six fourth-grade elementary school students. They indicated that traditional games such as board games and card games can increase social interactions among people through playing games face-to-face. Torkar, G., Pintarič, M., Koch, V., (2010 : 74-80) study on the efficacy of playing fruit and vegetable card games. In 109 children, after playing the game, school-age children had higher scores on cognition of nutrients in fruits and vegetables, such as vitamin A, vitamin C, and vitamin E, compared to their pre-game results ($p < 0.05$). Yien, J.M, et al., (2011 : 1-10) conducted a study on computer games for sixth-grade nutrition education. Most students had good attitudes towards learning about nutrition games. Moreover, the learning outcomes in the experimental group were better than those in the control group. They also found that there was no difference in knowledge by gender. Jones, B.A., Madden, G.J., & Wengreen, H.J., (2014 : 53) assess the FIT game to increase fruit and vegetable consumption in a sample school of elementary school students in Utah. It was found that after playing the FIT game, the students' fruit and vegetable consumption increased by 39% and 33% ($p < 0.01$, $p < 0.05$). Suchart Sanpitch, (2015 : 1413-1426) developed a Thai boxing card game to promote exercise. After playing the game, it was found that the mean score of the experimental group ($n=30$) using the Muay Thai card game for exercise had a statistically significant mean score of Muay Thai exercise scores that were 70% higher than the specified threshold ($p < 0.05$). The effectiveness of games in teaching healthy eating habits was studied in 3110 Italian children using Kaledo games (Viggiano, A., et al., 2014 : 217-228). Nutrition literacy scores were higher than those of the control group ($p < 0.001$). It was concluded that Kaledo games may be used as an effective tool to promote nutrition teaching and improve children's dietary habits. There is also evidence that gaming media can also help with better food intake. Folkvord, F., Anastasiadou, D.T., & Anschutz, D. et al. (2017 : 106-111) examined whether playing memory games with fruit affects fruit intake in children. A randomized design among 127 children was assessed by weighing the fruits before and after the children entered the game. The results concluded that playing memory games with fruits increased overall fruit consumption ($p < 0.016$). Rungthip Sornsingh et al., (2017 : 76) conducted a comparative study of the problem-solving abilities of early childhood children before and after learning using educational games, to study the level of problem-solving ability of early childhood children who are educated using educational games. The sample consisted of 16 pre-primary children aged 3–4 years. According to the study's findings, after learning through educational games. Early childhood children have higher problem-

solving abilities than before learning. statistically significant at the 0.05 level. Children actively build knowledge through experiences when they play games.

Promoting nutrition knowledge through appropriate games for school-aged children is a key principle that helps restore learning at this age. The "fruit-veggie wonderland" game is a board game that is appropriate for children and may effectively increase the nutritional knowledge of fruits and vegetables in school-age children.

Our suggestion is that further nutrition knowledge testing should be continued after playing this board game, as well as positive changes in the body weight and dietary habits of the students.

References

- Anderson, W. and Krathwohl, D. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Blooms' Education Objectives*. New York, NY: Longman.
- Alvina, A. et al. (2017). The Influence of Game "Nutrients Hero" For Healthy Diet. *Procedia Computer Science*. 116, 81–86.
- Baid, H., & Lambert, N. (2010). Enjoyable learning: The role of humour, games, and fun activities in nursing and midwifery education. *Nurse Education Today*, 30 (6), 548-552.
- Bonati M and Campi R. (2005). What can we do to improve child health in southern Italy?. *PLoS Med.* 2, e250. doi:10.1371/journal.pmed.0020250
- Chagas, C. M. D. S., et al. (2018). Rango Cards, a digital game designed to promote a healthy diet: a randomized study protocol. *BMC Public Health*. 18 (1), 1-10.
- Chen, P. G., Liu, E. Z. F., Lin, C. H., Chang, W. L., Hsin, T. H. and Shih, R. C. (2012). Developing an Education Card Game for Science Learning in Primary Education. *IEEE Fourth International Conference on Digital Game and Intelligent Toy Enhanced Learning*, (236-240), DOI: 10.1109/DIGITEL.2012.63.
- Cullen, K.W, et al. (2005). Squire's Quest: intervention changes occurred at lunch and snack meals. *Appetite*. 45, 148–151.
- Dickey, M. D. (2010). Murder on Grimm Isle: The impact of game narrative design in an educational game-based learning environment. *British Journal of Educational Technology*. doi:10.1111/j.1467-8535.2009.01032.x
- Folkvord, F., Anastasiadou, D.T., & Anschutz, D. et al. (2017). Memorizing fruit: The effect of a fruit memory-game on children's fruit intake. *Preventive Medicine*, 5, 106-111.
- Huang, W. H. (2010). Evaluating learners' motivational and cognitive processing in an online game-based learning environment. *Computers in Human Behavior*. doi: 10.1016/j.chb.2010.07.021
- Jones, B.A., Madden, G.J., Wengreen, H.J. (2014). The FIT Game: preliminary evaluation of a gamification approach to increasing fruit and vegetable consumption in school. *Preventive Medicine*. <http://dx.doi.org/10.1016/j.ypmed.2014.04.015>.
- Kirikkaya, E. B., İŞERİ, Ş., & Vurkaya, G. (2010). A board game about space and solar system for primary school students. *The Turkish Online Journal of Educational Technology*, 9 (2), 1-13.

- Rungthip Sornsingh, Pornchai Thongchuea, and Ponglak Jitkarun. (2017). *A comparative study of problem solving ability of preschool children before and after organizing learning experiences using educational games*. Curriculum and teaching disciplines Master of Education Program, Faculty of Education, Phibunsongkhram Rajabhat University, Faculty of Education, Phibunsongkhram Rajabhat University.
- Srichan, C. (2018). Development of nutrition education tools for pediatric patients. *TUH Journal*. 3 (1), 13-16. In thai.
- Suchart Sanpich. (2015). Developing a collaborative learning model using online games to develop scientific process skills. *Veridian E-Journal, Thai version, Humanities, Social Sciences and Arts*, 8 (2), 1413-1426. In thai.
- Torkar, G., Pintarič, M., Koch, V. (2010). Fruit and vegetable playing cards: utility of the game for nutrition education. *Nutrition & Food Science*, 40 (1), 74-80.
- World Health Organization. Overweight and Obesity. (2012). <https://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight>
- Yien, J. M. et al. (2011). A game-based learning approach to improving students' learning achievements in a nutrition course. *The Turkish Online Journal of Educational Technology*. 10 (2),1-10.32.
- Viggiano, A. et al. (2014). Kaledo, a board game for nutrition education of children and adolescents at school: cluster randomized controlled trial of healthy lifestyle promotion. *European Journal of Pediatrics*. 15 (2), 217-228.
- Zheng W, Suzuki K, Sato M, Yokomichi H, Shinohara R, Yamagata Z. (2014). Adolescent growth in overweight and non-overweight children in Japan: a multilevel analysis. *Paediatr Perinat Epidemiol*. 28, 263–269. doi:10.1111/ppe.12116