

Card Game-based Learning on Nutrition Value and Labeling

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ABSTRACT

In a consumer society, educating children for a healthy lifestyle is challenging for the teacher. Daily, children are exposed to large amounts of information (including misinformation) and the field of healthy eating is no exception. The teacher must, therefore, develop good teaching strategies that include informative/innovative teaching tools. The aim of the study was to determine whether the learning results of pupils after the introduction of a didactic game with nutrition cards were better than the learning results of pupils who acquired knowledge through a traditional (teacher-lead) presentation. This pedagogical experiment was conducted with 56 Slovenian Grade 6 pupils aged 11–12 (28 students in the experimental group [EG] and 28 in the control group [CG]). The results showed that the EG students (students learning with nutritional cards) achieved a better result in the knowledge test compared to CG students. Most pupils taught with nutrition cards expressed a positive opinion about this type of learning. They also stated that they would pay more attention to nutrition labeling in future purchases. The results suggest that using nutritional cards in teaching can have a positive effect on the learning process and the learning outcome.

KEY WORDS: didactic game; food labeling; nutrition cards; traffic light; visualization

INTRODUCTION

According to the World Health Organization (WHO) (2020), there are over 40 million obese children in the world. An uncritical following of certain trends or ideas such as an idealized lean body is detrimental to a healthy lifestyle. This can lead children to restricting calorie intake, consuming dietary supplements, and following modern diets leading to nutritional deficiencies (Calton, 2010). In today's fast-paced consumer world, one of the problems is that families do not always have the time to prepare high-quality meals; due to the lack of time, they purchase food recklessly, eat restaurant food, and therefore often buy ready-made or frozen meals (Jurak et al., 2016).

Improving an individual's diet is a complex process. Initially, the diet of children is most strongly influenced by the family, but later an expert can also play an important role and equip them with appropriate knowledge (Moreaus et al., 2015). Improved nutrition knowledge may help young people make healthier food choices (Lakshman et al., 2010). Along with parents, the educational system can help young people develop proper and balanced eating (Günsel et al., 2009). According to Franks et al. (2007), schools are an ideal place to promote healthy lifestyle to both young people and their parents. To follow guidelines on healthy diet, Worsley (2002) suggested increasing the knowledge of the nutritional content of consumed foods.

To increase nutritional knowledge on the nutritional content of consumer foods, several teaching strategies could be used. One of them is including a game in the teaching process. Oblinger

(2004) stated that games have an educational value because they follow the natural principle of learning. In comparison to spontaneous games, didactic games are games which are not totally free (in terms of participation) and have roles, clearly stated educational goals, and final evaluation (Brousseau, 1997; Stoffová, 2016). A didactic game as a teaching method, therefore, allows students to be relaxed and strongly motivated to play while learning (Whitton and Moseley, 2012). Mental activity and movement during play activate both cerebral hemispheres, which allow the individual to remember more and store the knowledge longer (Ginnis, 2004). Through games, various skills (e.g., problem solving, deductive reasoning, memorization, cooperation, collaboration, negotiation, group decision-making, and respect for peers) can be developed (McFarlane et al., 2002).

The teaching resources (such as posters and cards) used in different didactic games can include visualization. Visualization allows us to present data in a more distinct form such as numbers, words, and tables (Marr, 2017). The teacher can use various visualization elements such as pictures, photographs, thought patterns, and sketches, which enables students to develop a better idea of the subject (Vogrinc and Devetak, 2007). Visualization can help students to achieve the correct understanding of new concepts (Chuang and Liu, 2012) and is effective for the interpretation of abstract concepts. In addition to eliminating misconceptions, visualization elements increase interest and contribute to a better monitoring of lessons and greater motivation to learn new learning content (Wu et al., 2001). The didactic material must, therefore, be designed properly to enable the

achievement of learning goals and to increase motivation (Bilousova and Zhyteneva, 2014).

In nutrition education, the commonly used visualization element is the food pyramid (Montagnese et al., 2015), followed by the food plate and nutrition cards (Kostanjevec et al., 2007). Nutrition cards can represent a learning tool for learning about food and nutrition (Kordaki and Gousiou, 2015). Cards are appropriate for every age and education group; a card game encourages interactions between players (active learning), improves communication skills (Bochennek et al., 2007), encourages interpersonal intelligence (Berger and Pollman, 1996), and may help students to make healthier food choices, and strive to a healthier eating (Lakshman et al., 2010).

In everyday life, we use many agreed visual cues, for example, almost universally, we all know that we stop when the traffic light is red or when there is a stop sign (Rot Gabrovec, 2009). The UK Food Standards Agency (FSA, 2007) has introduced traffic light labeling on food products. Traffic light labels are a front-of-pack graphics providing information of the number of calories and selected nutrients in a food product (Wartella et al., 2010). An Australian study (Sacks et al., 2011) revealed that traffic light labeling is an effective method in obesity prevention.

Research Problem

The research questions of the study were as follows:

- Which group (experimental group [EG] or control group [CG]) will be more successful in solving knowledge assessment tasks?
- What are the students' opinions on learning through playing with nutritional cards?

METHODOLOGY

Research Design

This study describes a micro didactic experiment in which 56 Slovenian Grade 6 (students aged 11–12) voluntarily agreed to be involved. The pedagogical experiment was carried out in two groups (with 28 people in each). The pupils were

randomly selected from three different classes in Grade 6. In the EG, the pupils were learning with nutritional cards; in the CG, the lesson was presented in a traditional way. In both groups, the interventions lasted for 2 h. The main reason to choose Grade 6 was the fact that their Home Economics curriculum includes nutrition and that the students would have no previous experience learning with nutritional cards. To collect the data on knowledge differences between EG and CG, 5 test tasks were analyzed. To collect the data on pupils' opinion on learning with nutritional cards, a questionnaire was used. The instruments included closed and open-ended questions (Figure 1). The research only included students with parental consent.

The obtained data were carried out with the SPSS computer program version 22. The data were analyzed with a descriptive and inferential analysis. The difference in knowledge between groups was determined with the Mann–Whitney U-Test. The statistical differences were evaluated at the significance level $P < 0.05$.

Strategy application on the EG

The implementation of the activity with the nutritional cards was carried out in a lesson on milk and dairy products (the primary school teacher's content plan was followed). Even though the diet cards contained foods from all food-pyramid groups, only milk and dairy products cards were, therefore, used. On the nutrition cards, children can find information on nutritional and energy value of the food item per 100 g, portion size, and *traffic light* food labels (Figure 2). Cards provide real information on the composition of individual foods, allowing students to learn about the composition of foods, compare foods with the dominant nutrient, plan or analyze the nutritional, and energy value of food/meals. They also allow various activities related to the content of wise food purchasing (nutrition labeling and food traffic light).

During the lesson, the pupils had to complete several tasks. First, they had to find the information on the energy and nutrition value of the selected food. Then, they had to perform the following activities:

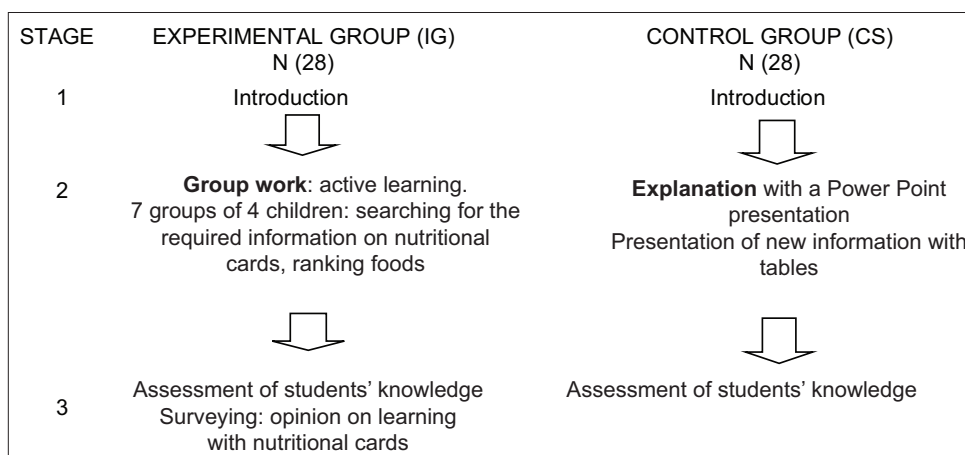


Figure 1: The design of a micro didactic experiment

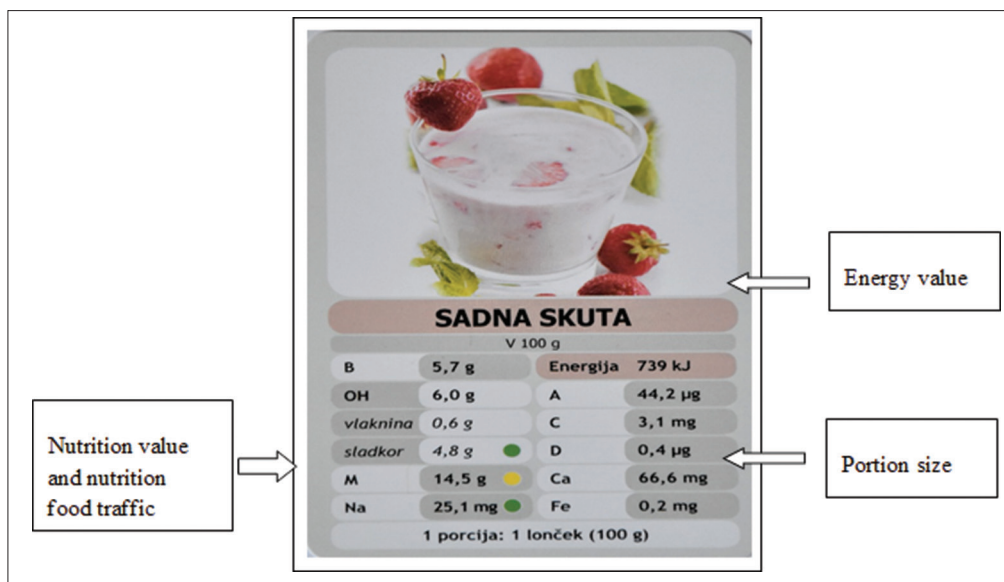


Figure 2: Example of nutrition card used by pupils during lessons

- Ranking foods according to the content of the selected nutrient (proteins, fat, sugar, sodium, and calcium content of the selected foods). Figure 3 shows how one group of children ranked the foods according to fat content.
- Showing a card with the food containing the most of an observed nutrient (e.g., sodium).
- Grouping cards into two groups: A group with food traffic light and a group without it, while answering the question why one of the foods was labeled with the food traffic light and another was not.

In all activities, it was not important to memorize the data on nutrients but to try to memorize foods ranging from those with high to those with low amounts of any selected nutrient.

Strategy application on the CG

In the CG, the lesson was presented using a PowerPoint presentation containing the data on the nutritional values of selected foods in tables – the data that the students in EG searched using nutritional cards. The logic of the traffic light was explained through examples. At the end of the lesson, the pupils completed a worksheet with tasks testing new knowledge.

FINDINGS AND DISCUSSION

The learning performance of both groups was compared based on the average of points achieved in the knowledge test. The results showed that the EG pupils achieved statistically significantly better results in knowledge test than the CG pupils (Table 1).

When answering questions on sugar, sodium, and fat, the EG obtained the correct results in 63%, 10%, and 39.3%, respectively, compared to 11.8%, 0%, and 12%, respectively, for the CG. When asked about proteins and calcium, the EG was right in 16.7% and 39.3%, respectively, compared to 22.2% and 50% for the CG. It is interesting that the EG pupils



Figure 3: Example of foods ranked by fat from the highest to the lowest fat content.

Table 1: The difference in the knowledge test between groups

Group	N	M	SD	U	ρ
EG	28	3.04	1.105	124.000	0.000
CG	28	1.43	1.069		

EG: Experimental group, CG: Control group

achieved better results in nutrients marked with nutrition traffic lights. The reason could be that the students focused more on the traffic light since they did not know it before the lesson. This could also be the reason why the EG pupils were perhaps not as focused on protein and calcium content in milk and milk products, resulting in the slightly lower performance in solving these two tasks in comparison to the CG pupils.

We wanted also to obtain pupils' opinion on learning with nutritional cards. The results showed that 93.0% of the pupils found the cards interesting. About 96.0% of the pupils also agreed that they had learned much more with cards than they would learn if the teacher had just explained the new topic to them. About 93.0% of the pupils stated that they liked activities where they could work with peers; only 17.0% of the pupils stated that they did not like this form of learning. About 79.0%

Table 2: Pupils focus on information when buying food products before and after the lesson

Information on	Before the lesson		In the future	
	f	%	f	%
Proteins	0	0.0	0	0.0
Fat	6	22.0	8	28.0
Sugar	2	7.0	8	28.0
Salt	0	0.0	8	28.0
Sodium	0	0.0	0	0.0
Traffic light	0	0.0	2	8.0
Energy value	0	0.0	2	8.0
All information	0	0.0	12	44.0
Nothing	9	33.0	0	0.0
Price, origin, appearance	8	30.0	3	12.0

agreed that, in the future, it would make sense to use nutrition cards in home economics lessons more often.

In nutrition education, it is important that students also apply what they have learned in their daily lives. Bloju (2015) states that a skillful use of the game enables an environment that will encourage students' interests, their research, and a spontaneous use of acquired knowledge. To get information on students' intention to use knowledge in everyday life, two questions were posed:

Q1: To what information did you pay attention to when buying food in the past?

Q2: To what information would you pay attention to when buying food in the future?

The results showed that 33.0% of the pupils did not pay attention to the any food labels before the lesson. Those who paid attention to the food labels on food products before the lesson stated that they had paid attention to the origin, price, and appearance, or to the amount of fat. No one mentioned food traffic light. The pupils were asked if they would pay more attention to the traffic light in the future. Most of them answered yes (79.0%).

They were also asked on what they would generally pay attention to during their purchasing process in the future. About 44.0% of pupils answered that they would pay attention to all the information on the food labels, 28.0% would pay attention to fat, sugar, and sodium, 8.0% on the nutrition traffic light, and 8.0% on energy value (Table 2). The results show that pupils' attention to product labeling has increased together with their intention to apply what has been learned in everyday life. This result aligns with the findings by Amaro et al. (2006) claiming that a didactic game could not only increase nutrition knowledge but also modify dietary behavior.

CONCLUSIONS

The aim of the research was to find out whether the game with nutritional cards could be helpful in achieving better learning results. The results showed that learning with nutritional cards

allowed the EG pupils to achieve better learning results when compared to the pupils experiencing traditional teaching (CG). The results also revealed that pupils learning with nutritional cards liked the possibility of cooperating with classmates and they thought that they learned more than they would if they had merely listened to an explanation. The results suggest an important motivational aspect of the game in terms of encouraging the pupils to change their behavior. The results in general suggest that nutritional cards can improve the quality of the learning process and learning outcome. However, for more definite conclusions, more research should be done; the presented study is limited by its small research sample and the lack of research on the long-term effect of the teaching intervention with nutrition cards. It would make sense to conduct the research on a larger sample and also investigate the impact of card games on long-term memorization and application of the new knowledge in everyday life: How many pupils realize their intention to change behavior expressed at the end of the learning activity with cards.

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REFERENCES

- Amaro, S., Viggiano, A., Di Costanzo, A., Madeo, I., Viggiano, A., Ena Baccari, M., Marchitelli, E., Raia, M., Viggiano, E., Deepak, S., Monda, M., & De Luca, B. (2006). Kalèdo, a new educational board game, gives nutritional rudiments and encourages healthy eating in children: A pilot cluster randomized trial. *European Journal of Pediatrics*, 165(9), 630-635.
- Berger, E., & Pollman, M. (1996). Multiple intelligences: Enabling diverse learning. *Early Childhood Education Journal*, 23(4), 249-253.
- Bilousova, L.I., & Zhyteneva, N.V. (2014). Didactic aspects using technology of vizualization in educational process of secondary school. *Information Technologies and Learning Tools*, 40(2), 1-13.
- Bloju, C.L. (2015). The importance of the didactic game in acquiring and consolidating the notions of communication building in primary education. *Procedia Social and Behavioral Sciences*, 180, 241-247.
- Bochennek, K., Wittekindt, B., Zimmermann, S.Y., & Klingebiel, T. (2007). More than mere games: A review of card and board games for medical education. *Medical Teacher*, 29(9/10), 941-948.
- Brousseau, G. (1997). In: Balacheff, N., Cooper, M., Sutherland, R., & Warfield, V., (Eds.), *Theory of Didactical Situations in Mathematics*. Netherlands: Kluwer Academic Publishers.
- Calton, J.B. (2010). Prevalence of micronutrient deficiency in popular diet plans. *Journal of the International Society of Sports Nutrition*, 7(24), 1-9.
- Chuang, H.H., & Liu, H.C. (2012). Effects of different multimedia presentations on viewers' information-processing activities measured by eye-tracking technology. *Journal of Science Education and Technology*, 21(2), 276-286.
- Food Standards Agency (FSA). (2007). *Front-of-pack Traffic Light Signpost Labelling. Technical Guidance*. Available from: https://www.foodwatch.org/fileadmin/Themen/Ampelkennzeichnung/guidance_ampel_issue_1_januar_2007.pdf.
- Franks, A.L., Kelder S.H., Dino, A.G., Horn, A.K., Gortmaker, S.L., Wiecha, J.L., & Simoes, E.J. (2007). School-based programs: Lessons learned from CATCH, planet health, and not-on-tobacco. *Preventing Chronic Disease*, 4(2), 1-9.
- Ginnis, P. (2004). *Teacher-I Am My Master. How to Lead Each Student to Success*. United States: Rokus Publishing House.

- Günsel, B., Hatice, B., Meziyet, A., & Zuhail, B. (2009). Use of Piaget's theory in preschool nutrition education. *Nutrition Magazine*, 22(6), 905-917.
- Jurak, G., Starc, G., Kovač, M., Kostanjevec, S., Radi, P., Erjavšek, M., Lovšin Kozina, F., Krpač, F., & Jurak, G. (2016). *Handbook for Prevention Teams for Carrying Out Activities in the Field of Exercise and Nutrition in the Pilot Testing of the Project Enjoy Health*. Portorož, Slovenia: University in Ljubljana.
- Kordaki, M., & Gousiou, A. (2015). *Card Game-based Learning in Food Safety and Nutrition Education*. Available from: <https://www.svako.lt/uploads/pstp-2016-116-7.pdf>.
- Kostanjevec, S., Koch, V., & Polak, A. (2007). Understanding the food pyramid model. In: Devetak, I., (Ed.), *Elements of Visualization in Science Lessons*. Slovenia: University of Ljubljana, Faculty of Education. pp. 177-195.
- Lakshman, R.R., Sharp, J.S., Ong, K.K., & Forouhi, G.N. (2010). A novel school-based intervention to improve nutrition knowledge in children: Cluster randomised controlled trial. *BMC Public Health*, 10, 123.
- Marr, B. (2017). *The Biggest Data Visualization Mistakes Everyone Can Easily Avoid*. Available from: <https://www.blog.qlik.com/the-5-biggest-data-visualization-mistakes-everyone-can-easily-avoid>.
- McFarlane, A., Sparrowhawk, A., & Heald, Y. (2002). *Report on the Educational Use of Games. TEEM (Teachers Evaluating Educational Multimedia)*. Available from: http://www.questgarden.com/84/74/3/091102061307/files/teem_gamesined_full.pdf.
- Montagnese, C., Santarpia L., Buonifacio, M., Nardelli, A., Caldara, A.R., Silvestri, E., Contado, F., & Pasanisi, F. (2015). European food-based dietary guidelines: A comparison and update. *Nutrition*, 31(7-8), 908-915. Available from: https://www.researchgate.net/publication/272197943_European_Food-based_Dietary_Guidelines_A_Comparison_and_Update.
- Moreaus, L., Lissner, L., Olsson, L., & Sjoberg, A. (2015). Age and time effects on children's lifestyle and overweight in Sweden. *BMC Public Health*, 15(355), 1-10.
- Oblinger, D. (2004). The next generation of educational engagement. *Journal of Interactive Media in Education*, 2004(8), 1-18.
- Rot Gabrovec, V. (2009). With Alice in Wonderland of the Non-Verbal. In: Vintar, J., (Ed.), *Relationships Between Pictorial and Verbal Messages*. Slovenia: Institute of the Republic of Slovenia for Education. pp. 24-45.
- Sacks, G., Veerman, J.L., Moodie, M., & Swinburn, B. (2011). Traffic-light nutrition labelling and junk-food tax: A modelled comparison of cost-effectiveness for obesity prevention. *International Journal of Obesity*, 35(7), 1001-1009.
- Stoffová, V. (2016). *The Importance of Didactic Computer Games in the Acquisition of New Knowledge*. United States: The European Proceedings Social and Behavioural Sciences EPSBS, ICEEPSY 2016: 7th International Conference on Education and Educational Psychology. pp. 676-688.
- Vogrinc, J., & Devetak, I. (2007). Determining the effectiveness of the use of visualization elements in science lessons with the help of pedagogical research. In: Devetak, I., (Ed.), *Elements of Visualization in Science Lessons*. Slovenia: University of Ljubljana, Faculty of Education. pp. 197-215.
- Wartella, E.A., Lichtenstein, A.H., & Boon, C.S. (2010). *Examination of Front-of-package Nutrition Rating Systems and Symbols: Phase I Report*. Kathmandu, Nepal: Institute of Medicine. Available from: https://www.ncbi.nlm.nih.gov/books/NBK209847/pdf/Bookshelf_NBK209847.pdf.
- Whitton, N., & Moseley, A. (2012). *Using Games to Enchase Learning and Teaching. A Beginner's Guide*. United Kingdom: Routledge.
- World Health Organization (WHO). (2020). *Obesity and Overweight*. Available from: <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight><15.3.2020.
- Worsley, A. (2002). Nutrition knowledge and food consumption: Can nutrition knowledge change food behaviour? *Asia Pacific Journal of Clinical Nutrition*, 11, 579-585.
- Wu, H.K., Krajcik, J.S., & Soloway, E. (2001). Promoting understanding of chemical representations: Students' use of a visualisation tool in the classroom. *Journal of Research in Science Teaching*, 38(7), 821-842.