ORIGINAL ARTICLE

DIGITAL MINIGAME AS A FOOD AND NUTRITIONAL EDUCATION TOOL FOR ADOLESCENTS

Ívia Campos Previtali-Sampaio[1]; Luiz Gustavo Sincaruk Vieira[2]; Óliver Savastano Becker[3]; Gustavo Akira Hirakawa[4]; Cláudio Fabiano Motta Toledo[5]; Betzabeth Slater[6]

Highlight: (1) FeiraNutre makes the teaching-learning process engaging, interactive and fun. (2) The minigame can encourage healthy and sustainable food choices. (3) The use of games is promising at schools and flexible for different teaching modalities.

PRE-PROOF

(as accepted)

This is a preliminary, unedited version of a manuscript accepted for publication in Revista Contexto & Saúde. As a service to our readers, we are making this initial version of the manuscript available as accepted. The article will still be reviewed, formatted, and approved by the authors before being published in its final form.

http://dx.doi.org/10.21527/2176-7114.2025.50.14854

How to cite:

Previtali-Sampaio IC, Vieira LGS, Becker ÓS, Hirakawa GA, Toledo CFM, Slater B. Minigame digital como ferramenta de educação alimentar e nutricional para adolescentes. Rev. Contexto & Saúde, 2025;25(50): e14854

[1] Universidade de São Paulo – USP. Faculdade de Saúde Pública. São Paulo/SP, Brazil. https://orcid.org/0000-0001-8258-6911

[2] Universidade de São Paulo – USP. Instituto de Ciências Matemáticas e de Computação. São Carlos/SP, Brazil. https://orcid.org/0000-0002-9706-7951

[3] Universidade de São Paulo – USP. Instituto de Ciências Matemáticas e de Computação. São Carlos/SP, Brazil. https://orcid.org/0009-0007-9904-1302

[4] Universidade de São Paulo – USP. Instituto de Ciências Matemáticas e de Computação. São Carlos/SP, Brazil. https://orcid.org/0009-0005-3402-0725

[5] Universidade de São Paulo – USP. Instituto de Ciências Matemáticas e de Computação. São Carlos/SP, Brazil. https://orcid.org/0000-0003-4776-8052

[6] Universidade de São Paulo – USP. Faculdade de Saúde Pública. São Paulo/SP, Brazil. https://orcid.org/0000-0003-2511-1770

DIGITAL MINIGAME AS A FOOD AND NUTRITIONAL EDUCATION TOOL FOR ADOLESCENTS

ABSTRACT

The objective of this study was to develop a digital minigame to promote adequate, healthy and sustainable eating among adolescents. The educational game was planned and developed in mobile (Android) and desktop (website) versions by an expert team, based on the Brazilian Dietary Guidelines. The Unity platform was used for its creation and the following tools, C#, spriter, gimp and photoshop, for animation, movement, scoring and art. After developing of the game, it will be validated by an expert panel and later will be used in a pilot study with adolescents. It is concluded that "FeiraNutre" minigame is an educational tool capable of transforming the teaching-learning process into an engaging, interactive and fun experience. The playful strategy use can help the player relate the game content to his eating habits, so that they can then present healthier and more sustainable food choices. This possibility has contributed to games being continually introduced in technical schools and with the advantage of being used in face-to-face, remote, hybrid and distance learning.

Keywords: Game; Food and nutritional education; Adolescent.

INTRODUCTION

The global educational scenario was forced to change suddenly, due to the emergency situation of the COVID-19 pandemic, experienced in recent years, which forced schools to close for a long time to comply with health regulations. Consequently, traditional in-person teaching at Brazilian schools was replaced by remote teaching, using digital platforms, and this chaotic situation required adaptations and persistence, both from teachers and students[1].

In order to develop relevant skills and abilities listed in the teaching curriculum, it was necessary for educators to use different forms of teaching mediated by information and communication technology (ICT) to achieve adolescents' active participation during classes and thus promote the successful teaching-learning process[1].

One of the most attractive, promising and assertive educational strategies for adolescents is the digital interactive game[2-4]. In this sense, the educational game, also called a serious game, which is designed not only for entertainment and fun, but also for educational purposes[5], can be a viable, versatile and accessible tool in the virtual learning environment, since 81% (148 million) of the Brazilian population over 10 year-old are internet users and from

the 130 million users who access audiovisual content in the digital environment, 37% play online, according to data released by ICT Households survey 2021[6].

Gamification is an innovative and promising educational approach that uses games or game-like elements, as well as resources to motivate the participation of those involved, such as: narrative, scoring, challenges, and problematization[7]. In the literature it is evident that gamified nutritional interventions can promote healthy eating behaviors among adolescents[3,5,7-13].

However, it is known that the teenage decade (10 to 19 year-old) is a vulnerable period due to the occurrence of intense physical, physiological, psychological, emotional, and social changes and is associated to greater autonomy in food choices[14]. In this phase, there is an increase in both ultra-processed foods (UPFs) intake and excess weight[15-16], resulting in a higher risk of developing non-communicable chronic diseases[17-18]. Indeed, during the period of social distancing due to the pandemic, it was observed that adolescents consumed more UPFs[19].

Given these educational and health scenarios, it is necessary to plan food and nutrition education (FNE) actions that can be used in remote, in-person, and distance learning with adolescents, in order to promote healthy and sustainable eating practices, to impact in adulthood, and to prevent overweight incidence. Considering the need to develop educational strategies mediated by ICTs, the objective of this study was to develop a digital minigame to promote adequate, healthy, and sustainable eating among adolescents.

METHOD

This is a descriptive and narrative study that addresses the digital educational tool development in the food and nutrition area.

A digital minigame was developed, in the serious game category, free of charge and compatible with mobile devices (Android) and desktop (website), named "FeiraNutre."

The team involved in the minigame development was composed of game designers, undergraduate students in mathematics and computer science, and computer science experts, responsible for all programming and art; as well as dietitians and professors, responsible for the technical-scientific and educational content.

The chosen and created virtual sustainable environment was a street market. On this screen, icons were added for selecting the character/player, game start, and an encyclopedia called nutripedia, containing information about the NOVA classification of foods according to the Dietary Guidelines for the Brazilian Population (DGBP), as well as the game instructions.

The objective of the developed minigame is to promote adequate, healthy, and sustainable eating among adolescents through edutainment, a combination of education and entertainment, that is, learning while playing. The tools used in the game's development were Unity, a creating games software and graphical environments in general, object-oriented programming, specifically with the C# language and additional libraries.

- The Dietary Guidelines for the Brazilian Population (DGBP)

The DGBP is a document prepared to disseminate recommendations for adequate and healthy eating, aimed at the Brazilian population. As it serves as a support tool for FNE actions at the national level, it constitutes one of the strategies for implementing the guideline of "Promotion of adequate and healthy eating" that is part of the National Food and Nutrition Policy (PNAN)[20]. In an innovative manner, the DGBP classifies foods into four categories, according to the processing degree carried out by the industry and not by the nutrients present in the food: unprocessed foods are obtained directly from plants or animals, without any alteration, and minimally processed foods are unprocessed foods that have undergone minimal changes without altering their composition; processed culinary ingredients are substances extracted from unprocessed or minimally processed foods, used to season culinary preparations; processed foods are unprocessed or minimally processed foods with salt or sugar and/or oil and fat addition; and UPFs are made with substances extracted from foods, derived from food constituents, or synthesized in the laboratory, and contain various food additives that make them attractive, palatable, durable, and nutritionally unbalanced[20].

However, an adequate, healthy, and sustainable diet is based on a wide variety of unprocessed or minimally processed foods, predominantly of plant origin, moderate in culinary ingredients, limited in processed foods, and avoiding UPFs[20].

- "FeiraNutre" background

Before starting the "FeiraNutre" serious game development, the Brazilian adolescents' eating habits were investigated through the latest food surveys[16,21] and the most consumed foods were identified, with emphasis on UPFs: bakery products (industrialized bread and cakes, cake mixtures), packaged cookies (filled, sweet, salty), instant noodles, ready-to-heat products (pre-prepared pies, pasta, pizza discs, cake and bread), fried and baked snacks, sweetened drinks (soft drinks, flavored milk, soft drinks, industrialized juices, dairy drinks), sausages, ham, hamburgers, hot dogs, salty snacks, candies (chocolate, ice cream/popsicles), pizza and industrialized sauces.

Given the constant presence of UPFs in adolescents' diet, the need to develop an educational instrument using ICT to be used in a nutritional intervention is justified.

- "FeiraNutre" Programming

The platform chosen for the game development was Unity, which facilitates the development of 2D or 3D games, whether a small or large game project. In addition, Unity allows for easy integration of useful tools into the game development process (sound, images and game physics).

During the minigame programming, the game elements (characters, scenery objects and food) were added and the script was written using the C# language employed by Unity. The creation commands with movement and score values were coded at C# language. For the animation, that is, characters and food movements, the Unity spriter tool was chosen, while the creation of the minigame art used a drawing tablet, whose tools were gimp and photoshop (photo editing software).

- "FeiraNutre" Dynamics

The game's narrative is the adventure of a teenager who goes for a walk in his neighborhood's street market with the intention of buying food to eat there and also to take it home. Throughout the street market scenario, foods classified as unprocessed, minimally processed, processed and UPF are thrown and the player needs to collect them (Table 1).

Table 1 – Examples of foods at “FeiraNutre” minigame, according to the NOVA classification presented in DGBP.

Unprocessed and minimally processed food	Processed food	Ultra-processed food
pineapple homemade cake carrot guarana fruit lemon papaya egg cabbage tomato	tuna tomato paste canned corn canned hearts of palm French bread cheese	candy decorated cake chocolate sweetened yogurt artificial tomato sauce pastry soft drink ice cream popsicle

Source: Created by the authors.

This collection is done as soon as the player touches the food figure with his feet and the shopping cart automatically starts to fill up. There are three levels of the shopping cart: empty, partially full and completely full. When the cart is completely full, the player needs to go to the Beetle car and deposit it on its hood, which opens automatically. When the cart is empty, the player can collect more food again. The player does not interact with other players within the game environment.

The minigame time starts at 1 minute, where the challenge is to collect unprocessed and minimally processed foods and avoid processed foods and UPFs. As the player collects more unprocessed and minimally processed foods, the playing time and score increase. On the other hand, if the player collects more processed foods and UPFs, there are no credits. If the collection of unprocessed and minimally processed foods is consecutive, the reward is an increase in the score and playing time multiplier, represented in the upper left corner of the game screen (Figure 1 – f). Therefore, the score can work as a motivation for the player to improve his knowledge and skills.

At the end of each game, when time runs out, the player can get feedback about the food captured and, depending on the percentage of unprocessed and/or minimally processed food, he will receive an incentive message and intrinsic motivation to continue playing (Table 2).

Table 2 – Incentive messages displayed on "FeiraNutre" minigame interface according to the percentage of unprocessed and/or minimally processed food captured during the game.

Percentage	Final message
≥ 70 %	Congratulations! You have collected several healthy foods and got to keep a balanced diet!
< 70%	Your diet is out of balance! Try again and collect at least 70% of unprocessed or minimally processed foods to keep your diet healthy.

Source: Created by the authors.

RESULTS

"FeiraNutre" minigame was created and finalized in mobile (Android) and website versions. On the game's home screen, the minigame logo appears, and on the next screen, three icons were added: character, play, and nutripedia (Figure 1 – a and b). The "character" is the player's avatar, and there are two options: a boy with white skin and brown hair and a girl with black skin and curly black hair, both wearing typical teenage accessories (Figure 1 – c). "Play" is the button to start the game, and "nutripedia" explains the rules and objective of the game, in addition to presenting a list with the definition of food classified as unprocessed, minimally processed, processed food, and UPF, as well as a link to the DGBP document (Figure 1 – d and e).

The virtual scenario is a street market with all its features, such as food stalls for sale at retail, food trucks with ready-to-eat food, a kombi as a typical car used by street vendors to transport food and shrubs (Figure 1 – f). The gameplay is appropriate, motivating and attractive for the teenage audience and all the information contained in the tool is appropriate for its understanding.

Figure 1 – “FeiraNutre” minigame’s screenshots.

(a) home screen

(b) screen with icons

(c) character choice

(d) nutripedia

(e) NOVA food classification information

(f) street market scenario

Source: Created by the authors.

DISCUSSION

“FeiraNutre” minigame’s planning and development for teenagers were successfully completed, and all stages, including the ideation, documentation of the idea (game design

document), development, testing and publication, were completed. All minigame technical information was based on DGBP recommendations, prioritizing unprocessed and minimally processed foods intake, reducing processed foods and avoiding UPFs. Previously, Rangocards® was created, a digital card game based on DGBP and for teenagers[12], but it does not feature much interaction between the character and the scenario items, nor does it feature competitiveness as a motivating agent, and it does not address a sustainable food environment.

"Feiranutre" name attributed to the minigame was created because of the chosen scenario, a street market, and the verb "nutrir (nourish)" conjugated as "nutre (it nourishes)" means that the food sold in this sustainable environment can nourish the individuals who frequent and consume it there. The market refers to a sustainable food environment where, primarily, unprocessed and minimally processed food are sold and represents the connection between rural and urban areas, favoring the agroecology practiced by family farmers. It is a public space suitable for sharing culinary and gastronomic experiences, thus contributing to Food and Nutrition Security[22].

In this context, living near these markets that sell good quality, affordable and well-preserved fruits, vegetables, roots, tubers, grains, cereals, eggs, fresh fish, and handmade pasta makes it more feasible to adopt healthy eating patterns. According to one of the steps for Adequate and Healthy Eating mentioned in the DGBP, it is recommended to shop at street markets because there is a large supply of unprocessed or minimally processed foods, preferably organic and agroecological[20].

According to the National School Health Survey (PeNSE, 2015) data, approximately 25% of Brazilian adolescents are overweight[15], an epidemiological situation directly associated to UPF intake[17]. Considering UPF as an effective predictor of the population's diet quality[17-18,23-24], it is noted that the higher the frequency and UPF intake and the lower unprocessed and minimally processed foods intake, the worse is the diet quality. On the other hand, the opposite is true: the lower the frequency and UPF intake and the higher unprocessed and minimally processed foods intake, the better is the diet quality[25].

Since UPFs accounted for 26.7% of the total calories consumed by adolescents[16], it is necessary to implement FNE actions to reduce this prevalence, although it represents a favorable and privileged situation regarding UPF intake in the global food scenario[26]. Since these interventions can be carried out at schools, a suitable environment where adolescents are

found[9,27], it is pertinent and effective to use active methodology, such as gamification, to promote adequate and healthy eating[13], as provided for the National School Feeding Program – PNAE guidelines[28] and the School Health Program – PSE[29].

Some digital games were created to promote healthy eating among adolescents. The use of the Rango cards® game significantly helped reduce the eating habit while watching television or studying and eating at fast food restaurants. In addition, it favored greater knowledge about the beneficial effects of fruits and vegetables intake, as well as improved self-efficacy in adopting healthy eating practices, such as reducing sodium intake and preparing healthy meals[12].

Amaro et al.[9] developed a board game called "Kàledo" whose objective was to provide nutritional knowledge and promote healthy eating behavior. The researchers tested its effectiveness with Italian adolescents (11 to 14 year-old) for 24 weeks and found that "Kàledo" game provided a significant increase in nutritional knowledge and weekly vegetable intake.

"Creature 101" serious game developed and applied with adolescents revealed a significant reduction in the frequency and quantity of sugary drinks and processed snacks intake when compared to the control group[10]. When evaluating the computer game effects "The Quest to Lava Mountain" on the adolescents' eating behavior (9 to 11 year-old), Sharma et al.[11] observed a significant decrease in sugar intake and a significant increase in the Nutrition Attitude Scale after the intervention. Among students (8 to 12 year-old) who played "Squire's Quest" multimedia game, the researchers observed greater fruits, juices and vegetables intake[8].

In addition to isolated studies, the literature presents some findings on this topic. According to a scope review about interactive FNE games use and eating behavior changes, it was found that 21 of the 22 articles reported positive results from the game[3]. It was found that there are few studies that investigate how the serious games use can influence eating behavior and, among the existing researches, it was found that most games partially achieved their objectives[5].

Gamified nutritional interventions appear to favor the healthy eating behaviors adoption among adolescents in the short term, such as increased fruit and vegetable intake, according to a systematic review conducted by Yoshida-Montezuma et al.[7].

According to another systematic review and meta-analysis, whose objective was to analyze the gamification effect to improve diet, eating behavior, knowledge and body

composition in adolescents, conducted by Suleiman-Martos et al.[13], it was observed that there was an increase fruits, vegetables, whole foods and foods rich in protein intake and a decrease in sugar intake, in addition to the improvement in both knowledge about nutrition and eating behavior, such as: healthy eating practices adoption, healthy meals preparation, decreased frequency of eating while watching television or studying, as well as eating in fast food restaurants.

According to the results obtained through existing digital games use and highlighted in this study, it can be seen that this educational tool is promising in promoting adequate and healthy eating among adolescents; therefore, "FeiraNutre" becomes another learning strategy to be used at schools and that can present positive results, considering the game as an attractive place to involve participants[3]. It can be suggested that long-term interventions for adolescents who use frequent exposure to technological resources, and that have a theoretical component focused on a single change in health behavior, tend to be more successful[2].

When investigating adolescents' preferences, reasons and needs in relation to food and digital games, Holzmann et al.[30] found that more than half of them would like to receive nutritional information through digital games. Since a nutrition serious game can be an appropriate educational method to transmit knowledge about nutrition and promote healthy eating behaviors in adolescents[13], it is believed that "FeiraNutre" will provide an innovative educational experience by encouraging autonomy and protagonism of the young learner in the teaching-learning process, offering greater knowledge about food and nutrition, in addition to motivating him to learn how to have an adequate, healthy and sustainable diet, in a more fun, enjoyable, playful and pleasurable way, compared to the traditional method.

It is worth noting that this educational tool should be used with caution, not excessively, respecting the recommendation of sufficient game time to promote education, which is up to 15 minutes per day, that is, a maximum of 90 minutes per week[11]. This way, gaming addiction is avoided and does not indirectly contribute to a sedentary lifestyle. Before making the mini-game available on the digital platform, it is recommended that its content be evaluated by an experts panel composed by game designers, adolescents from Etec (Public Technical Schools) and nutrition and computer specialists, according to psychometric parameters. After its content validation, the minigame will be patented and then used in a pilot project of educational nutritional intervention with adolescents from a highschool. If there are promising results, the

minigame will be presented to MEC (Ministry of Education) representatives and made available free of charge to schools and youth community.

Considering the strengths of the minigame, it is possible to point out its engaging interaction, the competition it provokes, the reward to be won, the opportunity to identify unprocessed and minimally processed foods as markers of a healthy diet and the UPF of an unhealthy diet. In addition, it is considered an educational tool to promote adequate, healthy and sustainable nutrition during biology or natural science classes and nutritional interventions. In fact, it is considered one of the first digital games developed according to the DGBP guidelines for adolescents.

Among the limitations of the minigame, we can highlight the reduced number of food representing the NOVA classification, the lack of game phases and the fact that the player plays alone in the environment, without direct competition among their peers, and it is not adapted for individuals with visual impairments. Regarding the minigame applicability and usability, the instructors may be unfamiliar with DGBP, making it difficult to discuss the subject after gamification, in addition to having difficulty using ICTs in the classroom; the possible lack of equipments (computers, laptops, tablets, cell phones) at school environment or at home and limited access to the internet.

FINAL CONSIDERATIONS

"FeiraNutre" minigame was successfully developed, featuring dynamics, gameplay, mechanics and art capable of transforming the teaching-learning process into an engaging, interactive and fun experience.

Due to its versatility, it can be effective and timely in hybrid education, that is, including in-person, remote and distance learning, in addition to contributing to eating behavior changes among adolescents, favoring unprocessed and minimally processed foods intake and discouraging processed foods and UPF intake. Future nutritional intervention studies will be necessary to test this educational tool and evaluate its possible impacts on the adolescents' eating behavior.

REFERENCES

1. Santos R, M. De Albuquerque AE, De Santana Moreira Oliveira Da Silva S, Moraes GH. Impactos da pandemia na oferta e no desenvolvimento de cursos técnicos. Cad Estud E Pesqui Em Políticas Educ. 2022;7. https://doi.org/10.24109/9786558010630.ceppe.v7.5579

2. Melo GRA, Vargas FCS, Chagas CMS, Toral N. Nutritional interventions for adolescents using information and communication technologies (ICTs): A systematic review. Nugent RA, organizador. PLOS ONE. 2017;12(9):e0184509. https://doi.org/10.1371/journal.pone.0184509

3. Baranowski T, Ryan C, Hoyos-Cespedes A, Lu AS. Nutrition Education and Dietary Behavior Change Games: A Scoping Review. Games Health J. 2019;8(3):153–76. https://doi.org/10.1089/g4h.2018.0070

4. Holzmann SL, Schäfer H, Groh G, Plecher DA, Klinker G, Schauberger G, et al. Short-Term Effects of the Serious Game "Fit, Food, Fun" on Nutritional Knowledge: A Pilot Study among Children and Adolescents. Nutrients. 2019;11(9):2031. https://doi.org/ 10.3390/nu11092031

5. Adaji I. Serious Games for Healthy Nutrition. A Systematic Literature Review. Int J Serious Games. 2022;9(1):3–16. https://doi.org/10.17083/ijsg.v9i1.466

6. Pesquisa sobre o uso das tecnologias de informação e comunicação nos domicílios brasileiros: TIC Domicílios 2021. Núcleo de Informação e Coordenação do Ponto BR. 1. ed. São Paulo: Comitê Gestor da Internet no Brasil; 2022.

7. Yoshida-Montezuma Y, Ahmed M, Ezezika O. Does gamification improve fruit and vegetable intake in adolescents? a systematic review. Nutr Health. 2020;26(4):347–66. https://doi.org/10.1177/0260106020936143

8. Baranowski T, Baranowski J, Cullen KW, Marsh T, Islam N, Zakeri I, Honess-Morreale L, deMoor C. Squire's Quest! Am J Prev Med. 2003; 24:52–61. https://doi.org/10.1016/S0749-3797(02)00570-6

9. Amaro S, Viggiano A, Di Costanzo A, Madeo I, Viggiano A, Baccari ME, et al. Kalèdo, a new educational board-game, gives nutritional rudiments and encourages healthy eating in children: a pilot cluster randomized trial. Eur J Pediatr. 2006;165(9):630–5. https://doi.org/10.1007/s00431-006-0153-9

10. Majumdar D, Koch PA, Lee Gray H, Contento IR, de Lourdes Islas-Ramos A, Fu D. Nutrition Science and Behavioral Theories Integrated in a Serious Game for Adolescents. Simul Gaming. 2015;46(1):68–97. https://doi.org/10.1177/1046878115577163

11. Sharma SV, Shegog R, Chow J, Finley C, Pomeroy M, Smith C, et al. Effects of the Quest to Lava Mountain Computer Game on Dietary and Physical Activity Behaviors of Elementary School Children: A Pilot Group-Randomized Controlled Trial. J Acad Nutr Diet. 2015;115(8):1260–71. https://doi.org/10.1016/j.jand.2015.02.022

12. Chagas CMDS, Melo GRS, Botelho RBA, Toral N. Effects of the *Rango Cards* game intervention on food consumption, nutritional knowledge and self-efficacy in the adoption of healthy eating practices of high school students: a cluster randomised controlled trial. Public Health Nutr. 2020;23(13):2424–33. https://doi.org/ 10.1017/S136898002000053

13. Suleiman-Martos N, García-Lara RA, Martos-Cabrera MB, Albendín-García L, Romero-Béjar JL, Cañadas-De la Fuente GA, et al. Gamification for the Improvement of Diet, Nutritional Habits, and Body Composition in Children and Adolescents: A Systematic Review and Meta-Analysis. Nutrients. 2021;13(7):2478. https://doi.org/10.3390/nu13072478

14. Mason TB, Do B, Wang S, Dunton GF. Ecological momentary assessment of eating and dietary intake behaviors in children and adolescents: A systematic review of the literature. Appetite. 2020;144:104465. https://doi.org/10.1016/j.appet.2019.104465

15. Conde WL, Mazzeti CMS, Silva JC, Santos IKS, Santos AMR. Estado nutricional de escolares adolescentes no Brasil: a Pesquisa Nacional de Saúde dos Escolares 2015. Rev Bras Epidemiol 2018; 21(1): 1-12. https://doi.org/ 10.1590/1980-549720180008.supl.1

16. Brasil. Instituto Brasileiro de Geografia e Estatística. Pesquisa de Orçamentos Familiares 2017- 2018: análise do consumo alimentar no Brasil. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2020.

17. Louzada MLC, Baraldi LG, Steele EM, Martins APB, Canella DS, Moubarac JC, Levy RB, Cannon G, Afshin A, Imamura F, Mozaffarian D, Monteiro CA. Consumption of ultra-processed foods and obesity in Brazilian adolescents and adults. Prev Med. 2015; 81:9–15. https://doi.org/ 10.1016/j.ypmed.2015.07.018

18. Lane MM, Davis JA, Beattie S, Gómez-Donoso C, Loughman A, O'Neil A, Jacka F, Berk N, Page R, Marx W, Rocks R. Ultraprocessed food and chronic noncommunicable diseases: A systematic review and meta-analysis of 43 observational studies. Obes Rev. 2021;22(3). https://doi.org/ 10.1111/obr.13146

19. Malta DC, Gomes CS, Barros MB de A, Lima MG, Silva AG da, Cardoso LS de M, et al. The COVID-19 pandemic and changes in the lifestyles of Brazilian adolescents. Rev Bras Epidemiol. 2021;24:e210012. https://doi.org/10.1590/1980-549720210012

20. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Guia alimentar para a população brasileira / Ministério da Saúde, Secretaria de Atenção à Saúde, Departamento de Atenção Básica. 2. ed. Brasília: Ministério da Saúde; 2014.

21. Rocha LL, Gratão LHA, Carmo AS do, Costa ABP, Cunha C de F, Oliveira TRPR de, Mendes LL. School Type, Eating Habits, and Screen Time are Associated With Ultra-Processed Food Consumption Among Brazilian Adolescents. J Acad Nutr Diet. 2021; 121(6):1136-42. https://doi.org/10.1016/j.jand.2020.12.010

22. Preiss PV, Navarro RS, Weber JM, Mello LL de. Abastecimento alimentar e COVID -19: uma análise das feiras no Vale do Rio Pardo-RS. Segur Aliment E Nutr. 2021;28:e021007. https://doi.org/10.20396/san.v28i00.8661446

23. Cunha DB, da Costa THM, da Veiga GV, Pereira RA, Sichieri R. Ultra-processed food consumption and adiposity trajectories in a Brazilian cohort of adolescents: ELANA study. Nutr Diabetes. 2018;8(1):28. https://doi.org/ 10.1038/s41387-018-0043-z

24. Chen X, Zhang Z, Yang H, Qiu P, Wang H, Wang F, et al. Consumption of ultra-processed foods and health outcomes: a systematic review of epidemiological studies. Nutr J. 2020;19(1):86. https://doi.org/10.1186/s12937-020-00604-1

25. Rossato SL, Khandpur N, Lo CH, Jezus Castro SM, Drouin-Chartier JP, Sampson L, et al. Intakes of Unprocessed and Minimally Processed and Ultraprocessed Food Are Associated with Diet Quality in Female and Male Health Professionals in the United States: A Prospective Analysis. J Acad Nutr Diet. 2023;S2212267223001594. https://doi.org/10.1016/j.jand.2023.03.011

26. Marino M, Puppo F, Del Bo' C, Vinelli V, Riso P, Porrini M, et al. A Systematic Review of Worldwide Consumption of Ultra-Processed Foods: Findings and Criticisms. Nutrients. 2021;13(8):2778. https://doi.org/10.3390/nu13082778

27. Brasil. Ministério do Desenvolvimento Social e Combate à Fome. Marco de referência de educação alimentar e nutricional para as políticas públicas. Brasília, DF: Ministério do Desenvolvimento Social e Combate à Fome. Secretaria Nacional de Segurança Alimentar e Nutricional; 2012.

28. Brasil. Resolução nº 06, de 08 de maio de 2020. Dispõe sobre o atendimento da alimentação escolar aos alunos da educação básica no âmbito do Programa Nacional de Alimentação Escolar – PNAE. Diário Oficial da União, Edição 89. Seção:1:38; 2020.

29. Brasil. Ministério da Saúde. Gabinete do Ministro. Portaria Interministerial nº 1.055, de 25 de abril de 2017. Redefine as regras e os critérios para adesão ao Programa Saúde na Escola - PSE por estados, Distrito Federal e municípios e dispõe sobre o respectivo incentivo financeiro para custeio de ações. Diário Oficial União, Seção 1:36; 2017.

30. Holzmann SL, Dischl F, Schäfer H, Groh G, Hauner H, Holzapfel C. Digital Gaming for Nutritional Education: A Survey on Preferences, Motives, and Needs of Children and Adolescents. JMIR Form Res. 2019;3(1):e10284. https://doi.org/ 10.2196/10284

DIGITAL MINIGAME AS A FOOD AND NUTRITIONAL EDUCATION TOOL FOR ADOLESCENTS

Submitted: July 16, 2023

Accepted: July 16, 2024

Published: March 17, 2025

Author contributions:

Ívia Campos Previtali-Sampaio: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing.

Luiz Gustavo Sincaruk Vieira: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Validation; Visualization; Writing – original draft; Writing – review & editing.

Óliver Savastano Becker: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Resources; Software; Validation; Visualization; Writing – original draft; Writing – review & editing.

Gustavo Akira Hirakawa: Data curation; Formal analysis; Investigation; Methodology; Resources; Software; Validation; Visualization; Writing – review & editing.

Cláudio Fabiano Motta Toledo: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Resources; Software; Validation; Visualization; Writing – original draft; Writing – review & editing.

Betzabeth Slater: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Validation; Visualization; Writing – original draft; Writing – review & editing.

All authors approved the final version of the text.

Conflict of interest: There is no conflict of interest.

Funded by: PIBIC – Scientific Initiation Program and Initiation in Technological Development and Innovation Program of the University of São Paulo (USP) (2020/2021).

DIGITAL MINIGAME AS A FOOD AND NUTRITIONAL EDUCATION TOOL FOR ADOLESCENTS

Corresponding author:
Ivia Campos Previtali-Sampaio
Universidade de São Paulo – USP
Faculdade de Saúde Pública
Av. Dr. Arnaldo, 715 - Cerqueira César, São Paulo/SP, Brazil. CEP 01246-904
iviaprevitali@usp.br; ivia.previtali@etec.sp.gov.br

Editor: Dr. Giuseppe Potrick Stefani
Editor-in-chief: Dra. Adriane Cristina Bernat Kolankiewicz