IN AN ONLINE NUTRITION EDUCATION PROGRAM DELIVERED TO UNIVERSITY STUDENTS, GROUP INTERACTION WAS KEY TO INCREASING FOOD LITERACY

EM UM PROGRAMA DE EDUCAÇÃO NUTRICIONAL ONLINE ENTREGUE A ESTUDANTES UNIVERSITÁRIOS, A INTERAÇÃO EM GRUPO FOI FUNDAMENTAL PARA AUMENTAR A LITERACIA ALIMENTAR

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Abstract

Our goal was to test an online nutrition education program delivered using social media platforms on the food literacy levels of university students. We experimented with students from universities in northeastern Brazil, organized into three groups: an intervention group (A), which accessed the program content on social media platforms and participated in online activities as a group; a positive control group (B), which only accessed the content of our program on social media platforms; and, finally, a negative control group (C). We applied to all groups a pre- and post-assessment questionnaire on food literacy self-perception. Within groups, the increase in food literacy score was significant only in group A (8.15 ± 13.98), demonstrating the effectiveness of our program. However, comparison among groups showed that accessing the content on social media platforms by itself had no effect on food literacy (group B: 4.88 ± 11.13 and C: 0.16 ± 5.88). Interaction in a small group was key to increasing food literacy. We hope our study can foster a better understanding of how online nutrition education programs are assessed, considering that metrics provided by social media platforms do not inform about educational outcomes.

Keywords: Online Social Networking. Literacy. Sustainable Development. Higher Education. Social Group.

Resumo

Nosso objetivo foi testar um programa de educação nutricional online entregue usando plataformas de mídia social sobre os níveis de literacia alimentar de estudantes universitários. Os participantes foram alunos de universidades do nordeste brasileiro, organizados em três grupos: um grupo de intervenção (A), que acessava o conteúdo do programa em plataformas de mídia social e participava de atividades online em grupo; um grupo de controle positivo (B), que só acessava o conteúdo do nosso programa nas plataformas de mídia social; e, finalmente, um grupo controle negativo (C). Aplicamos um questionário pré e pós-avaliação sobre autopercepção de alfabetização alimentar para todos os grupos. Dentro dos grupos, o aumento no escore de alfabetização alimentar foi significativo apenas no grupo A (8,15 ± 13,98), demonstrando a eficácia do nosso programa. No entanto, a comparação entre os grupos mostrou que o acesso

ao conteúdo nas plataformas de mídia social por si só não teve efeito sobre a literacia alimentar (grupo B: 4,88 ± 11,13 e C: 0,16 ± 5,88). A interação em um pequeno grupo foi fundamental para aumentar a literacia alimentar. Esperamos que nosso estudo possa promover uma melhor compreensão de como os programas de educação nutricional online são avaliados, considerando que as métricas fornecidas pelas plataformas de mídia social não informam sobre os resultados educacionais.

Palavras-chave: Redes sociais online. Literacia. Desenvolvimento Sustentável. Educação Superior. Grupo Social.

Introduction

In recent years, nutrition education campaigns presented to adolescents and young adults have relied increasingly on mobile platforms and social media (CHAU; BURGERMASTER; MAMYKINA, 2018). Despite the growth and popularity of these channels, literature is limited in showing the effect of these campaigns on the food literacy of members of the target audience. Food literacy is a concept that has been used to express certain conditions desirable to pursue a healthy diet (AMOUZANDEH; FINGLAND; VIDGEN, 2019). The most comprehensive definition to date states that food literacy is as a set of interrelated understandings, skills, and behaviors necessary to plan, select, prepare, and eat foods with the objectives of meeting nutritional needs, of protecting and improving dietary quality, while strengthening individual, family, community, and national food resilience over time (VIDGEN; GALLEGOS, 2014). The communication metrics provided by social media platforms, including reach and engagement, do not inform about any actual increase in food literacy. In a nutshell, metrics of social networking sites do not inform about how much people learn, change behaviors, acquire abilities, or improve their health. In order to address this limitation of assessment, one of the key recommendations is to determine the effectiveness of messages delivered through social media using controlled experiments focused on educational or health outcomes (MOORHEAD *et al.*, 2013).

Therefore, the objective of this research was to evaluate the effectiveness of a nine-week nutrition education program on the food literacy of its participants. We ran this online and smartphone-based program using social media platforms, such as

YouTube and Instagram, through which we delivered the content to our participants. We conceived and developed *e-nutrir*, our nutrition education program, to help young university students in their transition to sustainable diets. The focus on university students is justified since this audience experiences life transitions that often result in changes in eating behavior (VELLA-ZARB; ELGAR, 2009). These changes can lead to obesity, as well as the development of chronic non-communicable diseases, impacting also the health of the environment (VELLA-ZARB; ELGAR, 2009). Factors commonly cited to explain changes in eating behavior involve sociocultural variables, such as knowledge, income, time, stress, and convenience (DELIENS *et al.*, 2014; WILSON *et al.*, 2017). Recent research with young university students in northeastern Brazil reveals that these factors were amplified by the social isolation in the current Covid-19 pandemic (SANTANA *et al.*, 2021).

We had two hypotheses while conducting this research (1) individuals exposed to *e-nutrir* content in social networking sites would have higher levels of food literacy when compared with control, considering post- and pre-assessment, and (2) individuals exposed to content delivered in social networking sites plus synchronous interaction in a small group using online channels (Google Meet and Telegram group) would have higher levels of literacy than those exposed just to the content in social media (positive control) and the control group. We based our second hypothesis on the premise that the kind of social interaction created by some social networking sites differs from traditional face-to-face interactions. Loss, Lindacher, and Curbach, (2014) explain that communication in social networking media relies especially on exchanging written comments or emoticons whereas in real life – or even in online models closer to real life – the role of immediate exchange of nonverbal communicative signals increases, bringing more complexity to communication. For example, social networks can simplify feedback options to like buttons and other options of feedback that make no space for any critical assessments of risky health behavior, which may normalize these risks, especially among young people. For this reason, we created a group to test the effect of interaction in an environment closer to the way social interactions occur in real life. We worked with a small group because evidence shows that in this type of environment people create a sense of connectedness that leads to more promising effects than they would in larger groups (BALATSOUKAS *et al.*, 2015).

With this research, we hope to provide a new understanding of how to assess the results of nutrition education programs on social media platforms, exploring possibilities on how to use online tools to foster group interaction in order to increase food literacy.

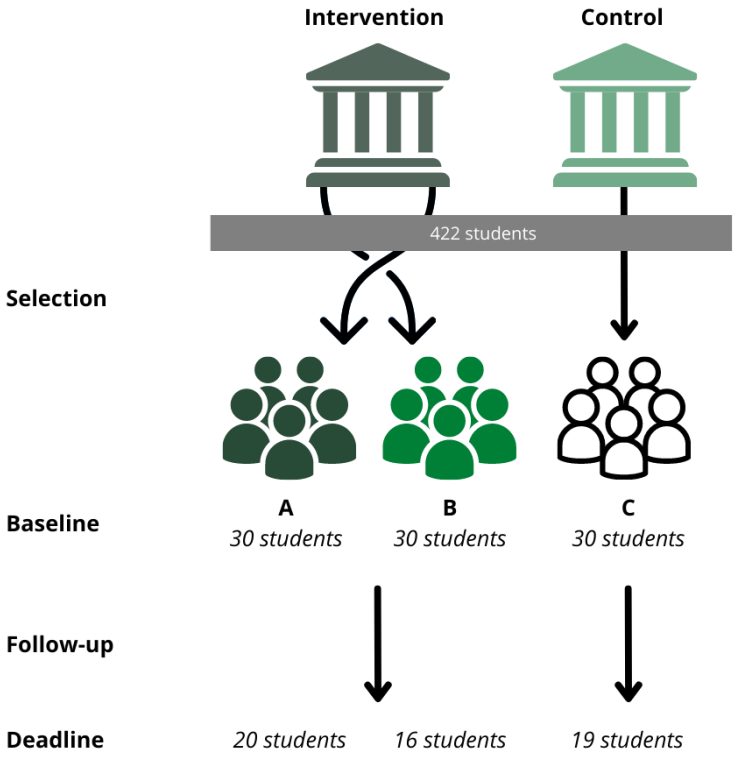
Methods

Setting

We conducted this research in two Brazilian public universities located in the Northeast region. We intentionally chose both universities using convenience criteria. In the Intervention University (IU), located in Natal, state of Rio Grande do Norte, we selected the students who would receive the intervention. We set this university as the IU since most people in our research group work or study at this institution. One colleague facilitated survey procedures in this second institution, the Control University (CU). In this university, located in Aracaju, province of Sergipe, also in the Brazilian Northeast, we selected a control group. We chose a control group in this university to mitigate the risk that the *e-nutrir* content would not be available to control participants through friends enrolled in the experimental group. However, we also used the social media of our laboratory[7] to spread the course content, and, for this reason, we cannot guarantee that members in the control group had not had access to these profiles. We decided that it was worth it to work with a second institution by considering (1) the performance data of our social media profiles, that inform us that the accounts reached by our content are in its majority province-level, and (2) socioeconomic similarities among the provinces where IU and CU are located. Furthermore, as we will present in the "Results" section, we did not find differences in the outcomes of groups B and C, meaning that even if we consider a scenario of contamination between groups, our conclusions are not being affected by this weakness. We summarize the study design in Figure 1.

[7] Further information about LabNutrir is available at www.nutrir.ufrn.br or at @labnutrir (Instagram).

Figura 1: Design of the controlled experiment to test the effect of *e-nutrir*, an online nutrition education program focused on university students, Brazil, 2020.



Fonte: labnutrir.

Study participants and intervention

We published public announcements in the daily newsletters of these universities, and 422 people completed an online questionnaire presenting themselves as candidates, see Fig. 1. In order to select the participants, we used two inclusion criteria: students needed to be (1) over 18 years old and (2) duly registered in the intervention or control university. In addition, we excluded health science students as candidates to avoid biases in our sample due to food and nutrition knowledge acquired by these participants in their scholar programs. After the exclusions, we randomly selected 60 IU students. We split them into two groups of 30 students each, A and B, being: "A" the experimental group and "B" the positive control group. Likewise, we randomly selected 30 students from CU to participate in the negative control group (group C). Participants received no money in any research stage.

We defined the number of students per group based on the following criteria. First, we did not calculate a sample because, in education research, due to the

complexity of this area, the outcomes are latent constructs of a theoretical nature and frequently based on self-perception (MCCONNELL; MONTEIRO; BRYSON, 2019), as is the case with self-reported food literacy. This characteristic of education research makes it difficult to estimate the anticipated difference required by sample calculation methods. Second, considering our theoretical premises, group A depended on the interaction between individuals. In education theory, contact between subjects becomes more likely and more intimate when working in smaller groups (BALATSOUKAS *et al.*, 2015). Third, we respect the average number of participants suggested to nutrition education interventions (FABER-BOOG, 2013).

Group A accessed the program content on social media platforms and participated in online activities as a group. We assigned them to a Telegram group, and each day they received online content. Anytime they could exchange messages with each other within this group. They also had the opportunity to interact on three occasions with all group members, including three members of the research team, in a meeting on the Google Meet platform. We set group B up in a Telegram channel (not a Telegram group). Group B only accessed the content of our program on social media platforms. In comparison with A, the main difference of group B was the absence of socialization between members, either on the Telegram app or in the synchronous virtual meets. Finally, we neither provided content nor opportunities for interaction to group C. To ensure blinding in group assignments, after assigning members, we sent to all participants a general email (Bcc, blinded carbon copy) informing them that they were enrolled in the program. After this first message, we sent emails to each group (also Bcc) with specifics of their treatment. To group C (control group), we said that completing two questionnaires (i.e., the pre- and post-assessment sheets) was their first task in the program. Thus, the flowchart of our experiment can be summarized as follows: (1) all groups completed the pre-assessment questionnaires; (2) groups A and B received *e-nutrir* program treatments as detailed above; (3) all groups completed a post-assessment questionnaire; and finally, (4) group C accessed the complete *e-nutrir* program after we finished the experiment.

At the end of the study, the groups had the following number of participants: group A (n = 20), group B (n = 16), and group C (n = 19). Participants who abandoned the program justified their absence arguing the difficulties to conciliate it with the rising number of remote education tasks. Table 1 presents the characteristics of the

students that participated in the entire study and the respective p values for differences between the treatment and control groups. The groups showed similar pre-intervention age, gender, and income characteristics ($p > 0.05$). We also did not find statistical differences in food motivations in the pre-assessment. This variable indicates the most preeminent factors shaping students' decisions related to food when joining the program (about food choice assessment, see further information under section "Variables", subsection "Demographic variables and food choice motivations").

Tabela 1: Gender, age, per capita income, and dietary motivations for joining the program, as informed by the participants at the beginning of the program *e-nutrir*, Brazil, 2020.

	Groups			
	A Experimental	B Positive control	C Negative control	p-values
Gender, *n* (%)				0.71[a]
Male	6 (30.0)	3 (18.8)	6 (31.6)	
Female	14 (70.0)	12 (75.0)	13 (68.4)	
Other	0 (0.0)	1 (6.2)	0 (0.0)	
Age, *mean ± SD*	25.1 ± 5.3	32.3 ± 11.8	27.2 ± 3.9	0.07[b]
Income (USD), *mean ± SD*	171.4 ± 186.9	145.4 ± 108.6	181.4 ± 171.3	0.79[b]
Food Motivations, *mean ± SD*				
Health	6.2 ± 2.8	8.1 ± 1.1	7.6 ± 2.1	0.19[b]
Humor	5.6 ± 2.9	4.3 ± 3.0	6.5 ± 2.2	0.18[b]
Convenience	5.6 ± 2.7	5.1 ± 2.6	5.6 ± 2.3	0.82[b]
Sensory appeal	5.1 ± 2.5	5.0 ± 2.2	5.9 ± 2.5	0.38[b]
Natural contents	4.7 ± 2.5	6.0 ± 1.7	6.2 ± 1.7	0.12[b]
Price	5.3 ± 1.9	6.1 ± 5.5	5.5 ± 1.8	0.53[b]
Weight control	5.2 ± 2.8	5.2 ± 2.7	4.7 ± 2.8	0.86[b]
Familiarity	4.3 ± 2.8	3.7 ± 1.9	2.6 ± 1.8	0.06[b]
Ethical concerns	3.7 ± 2.5	3.6 ± 2.8	3.2 ± 2.5	0.83[b]

± Standard Deviation; [a]Fisher's Exact Test; [b]Kruskal-Wallis Test.

We obtained informed consent from participants following the ethical guidelines of Resolution No. 466, 2012 of the Brazilian National Council of Health (CNS). We received ethical approval from the Onofre Lopes University Hospital Ethics

Board Committee (4.302.721) at the Federal University of Rio Grande do Norte.

Specific procedures

Supplementary File 1 presents the complete pedagogical proposal of our program divided into nine weeks, comprising eight weeks of content and one week of assessment. The research team members - composed of scholars, nutritionists, and nutrition students with expertise in nutrition education, social sciences, and public health - designed the program. We have had practical experience with extensions nutrition education projects using social media platforms and face-to-face groups. Two other scholars from the intervention university had the opportunity to review our initial proposal. One of them is an education expert, and the other is a specialist in ecology, teaching agroecology courses. Researchers of one of our laboratories, most of them young people, also had the opportunity to provide feedback in the initial proposal. We set the agenda of *e-nutrir* to comprise the food literacy categories and attributes proposed by Perry et al. (2017).

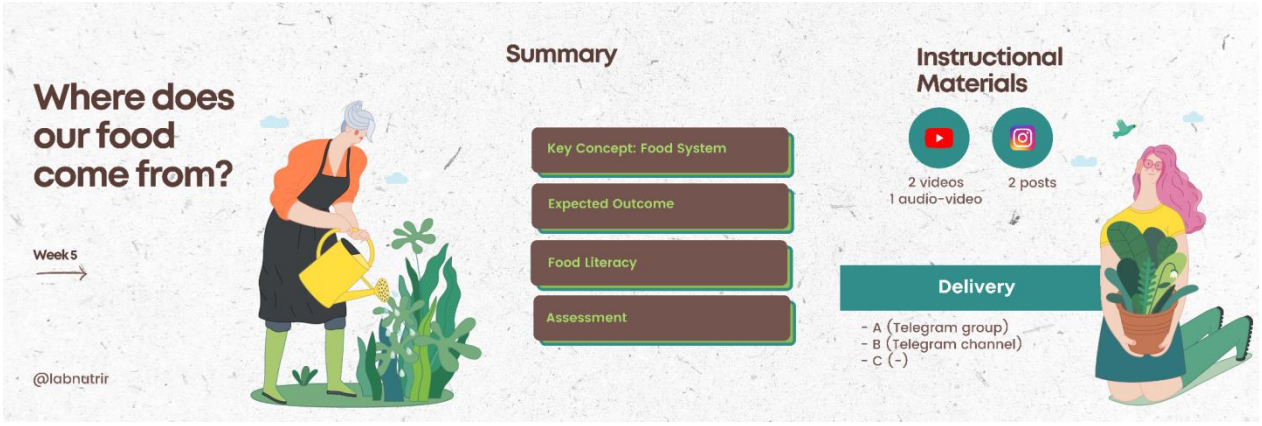
The pedagogical scheme of each week included: the main topic, key concepts, literacy attributes, educational goals, and proposed vehicles (e.g., educational videos, audios, and images), together with a content delivery timeline (see Figure 2). In the ninth week, we concluded the program by performing the following activities: all the participants completed the post-assessment questionnaire, and group A participated in a final synchronous group. Our program offered an estimated workload of 20 hours from October to December of 2020.

During pre-assessment, the participants completed a questionnaire including (1) sociodemographic variables, (2) food literacy attributes, and (3) food motivation factors. In the post-assessment, students completed the food literacy questionnaire again. During the experiment, we also developed guides to use in the synchronous sessions with group A. These guides included topics to stimulate participants to talk about their personal stories with food, food choice motivations, and a qualitative assessment of our program, including its strengths, weaknesses, opportunities, and threats.

We chose the following apps to run our program: Telegram, Google Meet, Google Forms, YouTube, Spotify, and Instagram. We selected these different platforms to explore as many as possible content delivery ways. When we decided

whether (or not) to include an app, we also checked its availability in smartphone format. This decision was because most Brazilians access the internet through their cell phones.

Figura 2: Pedagogical program of one week in *e-nutrir*.



Fonte: Design by Giuliana Lino.

In week 5, under the theme food system, the expected outcome to students was that they could understand and apply the idea of the food system in dietary self-assessment. The food literacy ecology was the dimension that guided our planning, followed by the attributes of (1) socio-cultural influences and eating practices, (2) food and other systems, (3) infrastructure, and population-level determinants. At the end of the week, we challenged students to self-assess their diets, looking for foods with the potential to cause negative impacts on health and the environment, listing barriers to reduce the consumption of these items. Groups A and B received this content, but just A had the opportunity to debate both the content and the assessment with peers in the Telegram group. Instructional materials mentioned in this Figure can be found at: (1) videos and audio-videos: https://bit.ly/3q64RTo, https://bit.ly/3CHe6yp, https://bit.ly/3MR6jmb; (2) posts: https://bit.ly/3KKJFdn, https://bit.ly/3I9r60F

Variables

Demographic variables and food choice motivations.

We collected data on age (years), gender identification (male, female, other), and per capita income (USD income average income per person in the household per month). The sociodemographic variables were used as controls to reduce differences

between groups. We did not include BMI as a variable because this measure might not be the most sensitive to express positive variations in food literacy in short-term programs (PODDAR *et al.*, 2010).

In the pre-assessment, we also collected data to know the most preeminent factors shaping participants' food choices. We presented the nine factors (i.e., health, humor, convenience, sensory appeal, natural contents, price, weight control, familiarity, and ethical concern) pre-established by the Food Choice Questionnaire, translated to Portuguese and validated (HEITOR *et al.*, 2015). Then, we asked the students to order these factors from the less (1) to the most (9) relevant when choosing food.

Food literacy

We measured food literacy using the dimensions of 1) Knowledge of food and nutrition - food and nutritional language; 2) Food skill - techniques; 3) Self-confidence - nutritional literacy, nutritional autonomy, food autonomy, gastronomy autonomy, and food attitudes; 4) Ecology - social and cultural influences in food and determinants of food and nutritional security; and 5) Food decisions - eating behavior (AZEVEDO PERRY *et al.*, 2017). These dimensions congregate 15 attributes. We applied a Likert scale to each food literacy attribute (1 to 5, or poor to excellent). The participants self-assessed their level of literacy for each feature. Therefore, the food literacy variable varied from 0 to 75. Considering the number of attributes of each dimension, they vary in the following way: dimension 1, minimum 4, maximum 20 points; two, 2 to 10; three, 5 to 25; 4, 3 to 15; and 5, 1 to 5. Before its use in this research, this instrument was pre-tested in a similar population (i.e., 64 university students). Finally, we tested the internal consistency of the questionnaire with Cronbach's Alpha Coefficient, and our result was 0.91, demonstrating high consistency.

Our independent variables were the groups A, B, and C: nutrition education intervention (group A), positive control (group B), and negative control (group C).

Data analysis

We calculated descriptive statistics for the demographic data and tested differences between groups using the following tests: for gender, Fisher exact test; for income and age, Kruskal-Wallis test, considering an asymmetric distribution for the numerical variables. We tested the power effect size using the Cohen’s d test between

the groups A (treatment) and C (control).

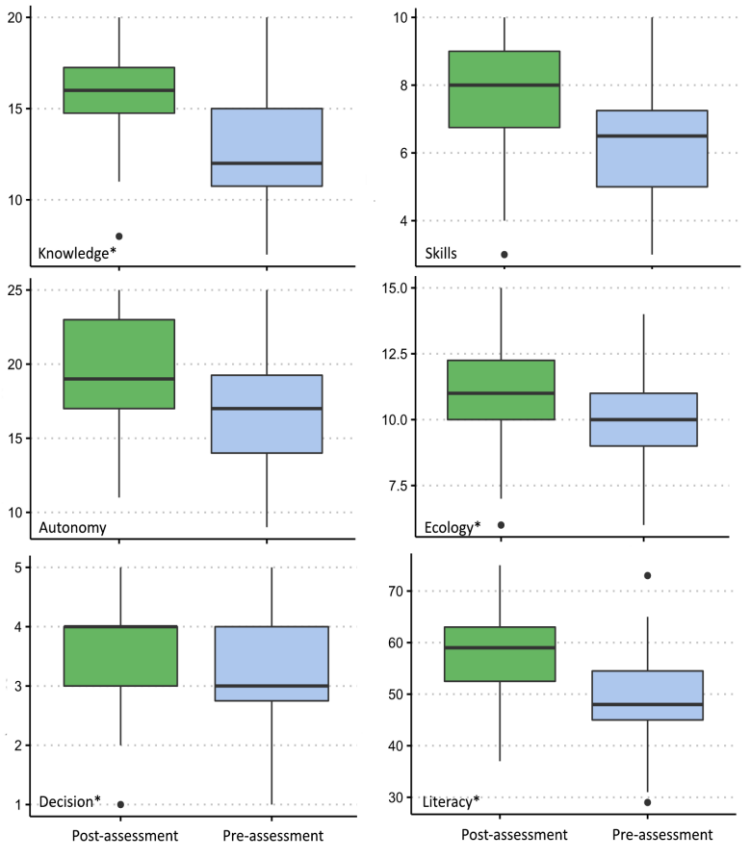
To test the program's effect on food literacy attributes between groups, we used Python's mlxtend library, performing the permutation test with 100,000 interactions each, and a pseudorandom number generator seed value of zero (0). Our alternative hypothesis was that the literacy attributes would be superior, that is, positive, in group A. We rejected the null hypothesis when $p < 0.05$.

Results

In Table 1, we present the characterization of participants. All groups had women comprising a majority. The age ranged from 25 to 32 years old, and the average individual income was from 145 to 181 USD. The average age was above the average of university students in general because our participants were in the program's final years or even studying in a second program. Considering participants' perception, the primary motivation guiding food choice in all groups was health; convenience, sensory appeal, and price also were relevant factors.

Our results show that our program was effective when performed with interaction among members (group A). Figure 3 shows the differences between the medians of the food literacy dimensions of the participants in group A, which participated in the program interacting with the organizers and other members through social networks and online meetings. Comparing pre-and post-assessment, group A presented significant differences in the dimensions of knowledge, ecology, decision, and the global assessment of food literacy ($p < 0.05$ in the permutation test). When we tested the sample size effect between the group A and C, we found the medium effects to literacy (0.74), knowledge (0.76), skills (0.57), ecology (0.78), and decision (0.72), but a small effect to autonomy (0.35).

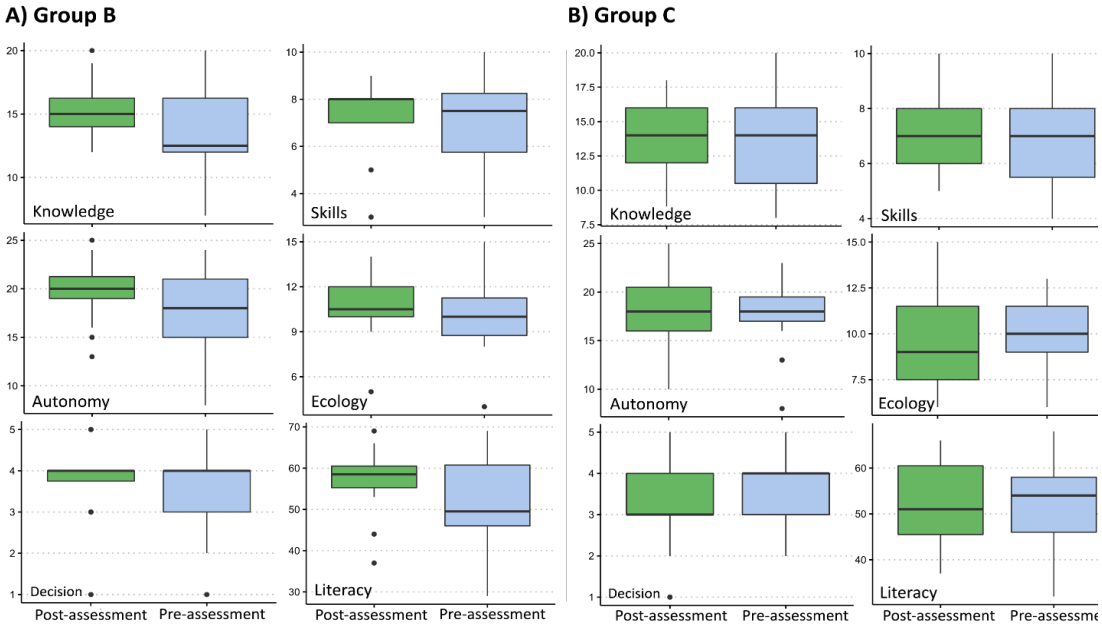
Figura 3: Differences in the median of food literacy dimensions and global food literacy in group A of the *e-nutrir* program, considering post and pre-assessment. *p<0.05.



Fonte: labnutrir.

We cannot state the program's effectiveness when only the content was delivered (group B). Considering post and pre-assessment, we did not observe significant changes in the dimensions of food literacy in the participants of group B (Figure 4). As expected, for group C, the negative control, the effect was absent. Furthermore, comparing the levels of food literacy of groups B and C, we did not find significant differences between them. As the only difference among groups A and B was the interaction among participants and mediators, we infer that this is the factor that explains the effectiveness of the treatment in the experimental group.

Figura 4: Differences in the median of food literacy dimensions and global food literacy in groups B and C of *the e-nutrir* program, considering post and pre-assessment. *p<0.05.



Fonte: labnutrir.

Therefore, in the context of this experiment, we cannot confirm hypothesis number one, that the program's content detached from group interaction could be effective as a nutrition education tool. On the other hand, we could confirm our second hypothesis, which stated that individuals exposed to content delivered in social networking sites plus opportunities to interact socially in a group would have higher food literacy levels.

Discussion

Our objective when conducting this research was to evaluate the effectiveness of a nine-week nutrition education program on the short-term and self-reported food literacy of its participants. The program we tested effectively increased the self-reported food literacy of its participants, as we expected with hypothesis two. However, we observed the effect in cases where individuals had access to the content delivered in social networking sites plus synchronous interaction in a small group using online channels. Besides, in the context of this experiment, we cannot affirm that the exposure to the content available in the social networks was sufficient to provoke any effect on self-reported food literacy. In conclusion, in this online nutrition education program for university students, group interaction was key in increasing food literacy.

The group interaction was a determining factor for the effectiveness of *e-nutrir*, reinforcing group value in nutrition education interventions (MEHTA *et al.*, 2021; MURIMI *et al.*, 2019; PETTIGREW *et al.*, 2016). Literature shows that personal interactions and bonding are potential stimulants when learning about food and nutrition (BAUER; REISCH, 2019). Almeida and Soares (2010), evaluating learning in a care group for diabetes, used the theory of social psychology by Enrique Pichon-Riviére to explain the group effect. For them: "the group situation is sustained by a network of motivations in which people, when interacting, recognize both themselves and others through dialogue and continuing exchange" (p. 1125). Thus, when interacting with group members, the subject connects to the new reality in which he is part (e.g., information socialized by others), stimulating more profound thoughts and elaborations about itself. As our data show, with a well-planned educational program, the positive results generated by the group effect can be extended to virtual environments.

Assessments of the effect of online groups in the context of nutrition education interventions are still scarce. Some tangential evidence shows how face-to-face groups can positively influence this kind of intervention. For instance, in the context of nutrition education programs to university students, evidence shows that groups with friends and colleagues have great potential to influence changes in eating behavior (DELIENS *et al.*, 2014). We also know that participant-moderator interaction can also positively impact intervention results. In a systematic review, Murimi *et al.*, (2019) identified that those programs that allowed regular interaction between researchers and participants (e.g., email, telephone, direct-question messaging) were more likely to achieve the stated goals. Based on our experience with *e-nutrir*, participant-participant and participant-researcher interactions allowed us to create spaces for exchanging experiences, feedback, and doubts. Future studies can help determine the ideal group size and types and levels of participant-participant and participant-moderator interaction most desirable.

Participants in the treatment group had significant differences in pre- and post-assessment literacy levels related to the attributes of knowledge, skills, ecology, and decisions. We want to highlight some aspects of the ecological dimension since we planned a program focused on sustainable diets, including the environmental and social contexts of sustainable food systems. Educational approaches that facilitate the

understanding of the impacts that diet can have on the environment can increase the perception of participants on ecological issues that would exceed their individual experiences (GAYLIE, 2009; SUMNER, 2013). In consequence, ecological perception can foster sustainable and ethical food choices, expressed as behaviors such as reduced meat intake and local market purchases (MEHTA *et al.*, 2021). To illustrate this comprehensive effect of the ecological dimension on others dimensions of food literacy in the context of our program, consider the following example. During group synchronous sessions, participants reported their intent to reduce meat consumption (decision). Some even shared pictures of meals that they prepared (skills) with the recipes we shared in our program. In addition, they stated that the ecological knowledge (knowledge) they acquired in the program led them to change some eating behaviors. However, we must analyze with caution the positive aspects illustrated here in this situation, as well as its drivers and consequences. There is a well-established barrier between increased food literacy and dietary change in the context of nutrition education programs (VAITKEVICIUTE; BALL; HARRIS, 2015). Dietary decisions depend on the intersection of individual intrinsic (i.e., knowledge, motivation, skills) and extrinsic or ecological factors (i.e., socio-cultural determinants, the influence of other systems) (AZEVEDO PERRY *et al.*, 2017). Considering the nine weeks of *e-nutrir*, we do not believe that a radical change in extrinsic factors occurred, at least not enough to justify the self-reported variation in the decision attribute. Furthermore, considering the data we have, there is no evidence that the increase in these dimensions of food literacy will be sustained in the long term.

Our research demonstrates that social media is a promising channel for delivering nutrition education program content focused on young audiences. However, we verified no significant variation between the increase in global literacy of the positive control group (group B) compared to the negative control. Neither did we find any significant pre- and post-assessment variation in literacy scores within the B groups, meaning that it was impossible to determine the effectiveness of the content alone. We think that the lack of a sense of being part of a group with a shared goal is one probable explanation for this absence of effect in the positive control group. Even with all participants in the same virtual place, they could not connect. The feeling of being part of a group is one of the core characteristics of successful nutrition

education programs (SIERO, 2000). For instance, in a study exploring the role of social media in collaborative learning among university students, Ansari & Khan (2020) found that interactivity with teachers and peers had a significant impact on engagement and academic engagement performance of students. With the advance of virtual opportunities to teach and learn, nutrition education program developers and practitioners can find it handy to use some platforms or social media as a space to engage small groups towards a common goal. Our findings alert the necessity of evaluating the effectiveness of nutrition education programs when delivered through social media and with no opportunities for more complex social interactions. Also, researchers designing this kind of assessment need to bear in mind that communication metrics provided by social media platforms do not necessarily inform about educational and health outcomes (LOSS; LINDACHER; CURBACH, 2014; MOORHEAD *et al.*, 2013).

Our study has three main limitations. First, we did not use a validated instrument to measure food literacy due to (1) the absence of a validated tool and (2) an urgent demand to develop and run the program, generated by the social isolation imposed from Covid-19. We thus chose to develop a tool based on the most comprehensive theoretical study on the subject available.[13] To mitigate this weakness, we ran a pilot study using the tool we developed and tested the internal consistency of the questionnaire with Cronbach's Alpha Coefficient, having high consistency. Second, we worked with a self-reported food literacy scale. Third, we did not calculate a sample. In the section methods (subtopic "Study Participants and Intervention"), we justified these last two weaknesses due to the complexities of experiments in education research that we could not address appropriately so far. For this reason, our conclusions must be read and generalized with caution.

Despite limitations, our study has the following implications for research and practice: (1) provides a controlled experimental design to assess educational outcomes in online nutrition education programs; (2) presents the effectiveness result of the program assessed; (3) brings theoretical and practical insights on group-based nutrition education programs; (4) describes the program itself for those interested in replicating it. We hope our study can foster a better understanding of how online nutrition education programs are delivered and assessed.

Conclusion

The e-nutrir program is an effective online nutritional education program which increases university student food literacy, focusing specifically on knowledge, skills, ecology, and food decisions. The program's effectiveness depended heavily on socialization, a characterizing component of the experimental group, where we created a collective virtual environment in which participants could share experiences, questions, and even recipes with their peers and facilitators. This result was not surprising since food is a social matter and learning about food with others presents more opportunities to create a meaningful learning environments. In the midst of the social distancing brought by Covid-19, the e-nutrir program is a helpful tool towards fostering online nutrition education.

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