



Research article

Exploring students' perception of subjective food literacy: A model of educational practice

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ABSTRACT

Introduction: Latest research showed that lower levels of food literacy led to poorer health outcomes and highlighted the importance of nutrition education to improve food literacy for the population. Although evidence at the global level exists, the scientific literature on food literacy in Romania is scarce; therefore, this article aims to explore the perception of subjective food literacy as an outcome of an educational model in a sample of university students from Romania. **Methods:** The present study used a qualitative inductive approach using focus groups to explore the results from an educational “learning-by-doing” model regarding the perception of subjective food literacy. The sample consisted of 64 second-year students who participated in a class taught by one of the authors between October 2019 and February 2020 and later agreed to participate in the focus groups. All focus groups were audiotaped following participants' permission and transcribed verbatim. Data was analyzed with the QSR Nvivo 12 Pro software package using an inductive thematic analysis.

Results: Several themes and sub-themes emerged from the focus groups discussing prior information of participants regarding nutrition, change in nutrition knowledge (information about plant protein, information about soy and soy products, information about sugar and its effects on health, and additional nutrition information), modified perception of nutrition and food, dietary habits, short-term behavior changes, and aspects that helped them to have more information about nutrition (construction of the health campaign, pre-testing materials, and support offered by the professors). All participants reported acquiring new information about food and nutrition, modified perceptions about nutritional habits, and even reported short-term behavioral change as an outcome of the educational model.

Conclusions: Educational models using a learning-by-doing approach and combining formal and non-formal education can potentially affect students' subjective food literacy. Future research should explore university students' food literacy using evidence-based educational models.

1. Introduction

Health literacy research is becoming a promising and cost-effective approach to preventing non-communicable diseases globally [1]. Health literacy, in essence, pertains to an individual's capacity to obtain, interpret, and use health-related information to make appropriate health decisions [2]. Health literacy is measured in an objective manner by using numeracy and reading tests (such as

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Short Test of Functional Health Literacy in Adults - S-TOFHLA, the Rapid Estimate of Adult Literacy in Medicine – REALM, etc) and in a subjective manner by using self-reported measures that ask participants to self-rate their abilities related to health literacy [3]. Health literacy is context-specific, and many forms of health literacy have emerged over the years, including nutrition and food literacy [4]. Nutrition and food literacy are often used interchangeably; however, they are distinct but complementary concepts [4,5]. Both concepts are components of health literacy, with nutrition literacy serving as a subset of food literacy [5]. Food literacy is a concept that “empowers individuals, households, communities or nations to protect diet quality through change and strengthen dietary resilience over time. It comprises a collection of inter-related knowledge, skills and behaviors required to plan, manage, select, prepare and eat food to meet needs and determine intake” [6]. Food literacy extends beyond offering knowledge; it also encompasses the provision of essential skills and competencies to enhance food behaviors and patterns to achieve a balanced diet and improve physical and psychosocial well-being [7]. A low level of food literacy leads to poorer health outcomes, highlighting the importance of nutrition education to improve food literacy for the population [8–10]. Food illiteracy is responsible for individual and societal costs, contributing to impaired health status. In contrast, food literacy is considered one of the most significant manners of evaluating the effectiveness of public health nutrition policy interventions [7,11].

Initiatives to improve food literacy and promote healthy eating behaviors include interventions such as meal planning and cooking classes for adults and youth [12,13], educational courses for adults [9], gamification techniques [14], and interventions for parents [15,16]. Interventions for adolescents and youth showed that most activities occur in school settings and community centers [17,18]. Apart from interventions for students and youth, policy initiatives exist to enhance health promotion and food literacy by developing health education classes [19,20]. These initiatives have shown promising results in improving students’ food literacy. Moreover, higher education and university years present an opportune and unique time to develop students’ food literacy [21].

Apart from the classical model of health education courses, alternative learning models that combine formal education with non-formal education exist [22]. These models had successful results in improving not only knowledge required by the curriculum but also concepts such as environment literacy [23–25], science literacy [26–28], and health literacy [29–31]. Studies focusing on improving food literacy showed greater nutritional knowledge, better food skills, healthier dietary practices, and long-term healthy dietary behavior, all considered essential for the well-being of the individuals [32]. However, to our best knowledge, no studies on assessing or increasing the food literacy of university students in Romania or any other Eastern European countries that have similar food behaviors, culture and norms, and socio-economic status have been conducted. The present article explores the perception of subjective food literacy as an outcome of an educational model in a sample of university students from Romania.

2. Methodology

2.1. Study design

The present study designed an intervention using a combination of formal and non-formal educational model implemented during one semester (October 2019–February 2020). The present study used a qualitative inductive approach using focus groups to explore the intervention results regarding the perception of subjective food literacy.

2.2. Study participants

The intervention involved a convenience sample of 64 students enrolled at Babes-Bolyai University in Cluj-Napoca, Romania. The sample comprised second-year students from two academic fields, namely Communication and Advertising, who were required to take the “Public Communication” course during their first semester of the academic year as part of their curricula. During the course, they were assigned to design, implement, and evaluate a health campaign on nutrition. Students formed teams (some teams had 3 members, while others had 2 members) and chose different cities and villages from the North-West Region of Romania to implement their health campaign. A number of 28 teams of students (16 teams comprised of 3 students and eight teams consisting of 2 students) that passed the course and displayed great effort and involvement in designing, implementing, and evaluating their health campaigns were asked to participate in the focus groups that took place in one assigned classroom at the university. A number of 20 students (6 teams comprised of 3 students and 2 teams consisting of 2 students) who failed to show up for class or who failed to design, implement, and evaluate their health campaign (hence, failed the course) were excluded from the focus groups since they had no input to provide on the topic.

2.3. Intervention

The intervention model designed for this study incorporated both a formal education component and a non-formal education component.

The formal education component consisted of students’ mandatory “Public Communication” course in their curriculum. The course covered the entire process of public health campaigns, the theoretical concepts specific to planning, implementing, and evaluating public health campaigns, and the practical application of these concepts. The main topic students had to address through their health campaigns was the adverse health effects of an unhealthy diet in the North-West region of Romania. Students had the opportunity to choose different approaches to the problem. The main courses of action focused on the following topics: (a) improving general nutrition knowledge for the target group; (b) improving awareness of healthy eating habits among the target group. The target groups for the students’ campaigns ranged from primary school children to retired citizens. They received evidence-based materials on

nutrition to use for their health campaigns. Nutrition research from World Health Organization (WHO) and Centers for Disease Control and Prevention (CDC) was provided, and they were encouraged to use these resources for their campaigns. Additionally, students had the option to collaborate with nutrition specialists and work with them on their campaigns.

The non-formal educational component was constructed on the experiential learning theory, also called “learning-by-doing approach” [33]. The theory states that practical problem-solving and theoretical teaching usually go hand in hand, and people learn concepts better and faster if offered the chance to practice them in real-life situations [33]. The “learning-by-doing approach” was used in this study to create a learning objective for the non-formal component, namely, to increase the food literacy of the participants by exposing them to a real-life situation in which they had to create a health campaign for the population, being in charge of all the phases of such a task: from finding the required information that suits their topic better, developing materials, pretesting, implementing and evaluating the health campaign [34].

The formal component was assessed using assignments during the semester, an oral examination, and a presentation of the campaign results, all of which were graded before considering the non-formal part. The non-formal component used focus groups and explored the perception of students related to their food literacy as a result of the implementation of the campaign.

2.4. Focus groups and measurement

Semi-structured open-ended questions guided the discussion for the focus groups. The focus group guide was developed by the authors of the manuscript following the literature and focused on evaluating the specific needs of the “Public Communication” course and assessing students’ perception of subjective food literacy. The focus group guide had a starting point of previous research on food literacy [21,22], and it was specifically tailored to meet the course assessment and criteria. The focus group guide was pilot tested with 7 students from the same year, but who were not part of the “Public Communication” course, in order to assess the clarity of the questions asked. No changes were made after the pilot testing, as the target group assessed the questions to be clear and understandable. We only focus on evaluating the non-formal component of this study in the present article, namely exploring students’ perception of their subjective food literacy.

A total of 8 focus groups (FG1- FG8) were conducted with 6–10 participants for each focus group, and the duration of each focus group was approximately one hour. Data saturation was reached after the seventh focus group, meaning new responses emerged from the discussion, and no new themes emerged [35].

2.5. Data collection

The study was reviewed and approved by an ethical commission before its start (IRB approval: No. 18629/October 16, 2018). All students who passed the course and displayed great effort and involvement in designing, implementing, and evaluating their health campaigns were asked to participate in the focus groups that took place in one assigned classroom at the university. All participants were students in the “Public Communication” course taught by the second author of this manuscript, and the first author of the manuscript conducted the focus groups. The participants were informed of the study’s procedures before participating in the focus groups and provided their verbal informed consent to participate in this study, which was recorded on tape.

2.6. Data analysis

All focus groups were audiotaped following participants’ permission and transcribed verbatim. Transcribed focus groups were reviewed by both authors to develop and broaden the understanding of the content as related to project-specific questions and to identify discussion themes. Using an inductive thematic analysis, text segments were assigned codes based on emergent themes or themes extracted from the interview guide by the two researchers using the QSR Nvivo 12 Pro software package. The researchers coded all the interviews using a codebook to establish inter-coder reliability, whereby findings were compared, and disagreements resolved through discussion. Indicative quotes from transcripts have been used to illustrate themes and sub-themes identified from the data. In reporting the findings for this manuscript, the authors followed the Standards for Reporting Qualitative Research (SRQR) [36].

3. Results

There were 38 female students and 26 male students who participated in the focus groups (Table 1). The main themes and sub-themes that emerged from the focus groups are presented in Table 2. The focus group guide is presented in Annex 1, with questions from 2 to 5 being used to write the present manuscript.

Table 1
Sample description.

Focus group	#1	#2	#3	#4	#5	#7	#8
No of participants	10	10	6	8	10	10	10
Gender of the participants	6 females 4 males	5 females 5 males	3 females 3 males	5 females 3 males	6 females 4 males	6 females 4 males	6 females 4 males

Table 2
Themes and sub-themes emerged from the focus groups.

Theme	Sub-themes
Prior information on nutrition and healthy eating	General information
New information about nutrition	New information about plant protein
	New information about soy and soy products
	New information about sugar consumption
	New information about general aspects of nutrition
Modified perception on nutrition	Awareness of what they should eat,
	Awareness of plant-based protein products
	Responsibility on 'practicing what they preach'
	Guilt for not following their own advices
	Behavioral changes regarding nutrition
Useful elements from the campaign that helped them learn more about nutrition	Learning-by-doing approach
	Pre-testing the materials
	Support from course professor and other professionals

3.1. Prior knowledge about nutrition and healthy eating

The first theme identified was students' **prior knowledge about nutrition and healthy eating**. All the participants reported that they knew **general nutrition information**, for example, what to eat and information about the consumption of sugar, fats, or other food products. Still, most of them stated they were not as interested in nutritional information.

"At first, I only knew the basics, that vegetables and fruits are good for you, that it's good to eat fruits and vegetables every day, not only some days. You know, general information that everyone has." [Male student, FG2]

"When we started working on this topic, I knew the generalities: to eat more fruits and vegetables, not to eat a lot of fat ... you know, things that everyone knows and we don't follow through (laughs)." [Female student, FG4]

"I admit, I didn't know anything about it. I just knew I had to drink enough water, that's all." [Male student, FG5]

Very few respondents stated that they were interested in nutritional aspects and already had a lot of information before the campaign they had to do during their course. Most had this information because they started vegetarian or vegan diets and needed to document themselves on plant-based protein and meat substitutes.

"I knew quite a few about nutrition, especially the benefits of eating plant protein and soy because I follow a lot of vloggers and influencers who are vegans and ... well, I follow them for this thing because I started being vegan, and I always saw their stories that they cooked with soy and replaced certain foods with soy, and some are really good." [Female student, FG1]

3.2. New information about nutrition

The second identified theme was related to the **change in nutrition knowledge** as part of implementing the campaign. Several sub-themes emerged from their responses: **information about plant protein, information about soy and soy products, information about sugar and its harmful effects, and additional nutrition information**.

Some respondents mentioned that they **were not aware that protein could be plant-based**. They only knew that you get protein out of meat consumption, so having to design and implement the campaign helped them gather knowledge about different types of protein, assimilation, and nutritional values, and the benefits of other products, such as soy products.

"Regarding healthy eating, I knew some information but didn't know much about plant-based consumption like myths or nutrients. When I heard how much protein soy has, for example, I thought to myself: "this can't be possible" [Female student, FG1]

"I've learned how diverse this category of plant-based proteins was when I was looking for its benefits. Then I found out that broccoli and many others have plant-based proteins. I honestly found out that my diet had more plant-based protein than I expected, and I wasn't aware of that." [Female student, FG3]

"I also found out about meat consumption, and I was like, 'God, do I only have to eat that little meat a week? How can I deal with this?'; Luckily, I discovered veggie food. I eat a lot of lentil burgers now instead of meat." [Male student, FG4]

“This campaign somehow overlapped with my learning about healthy eating. Some myths were replaced in my head: for example, the one saying vegetable protein can’t lead to muscle gain, and that only animal protein can get you there, which isn’t true. I don’t think I would have cared to learn more about these aspects if not for the implementation of the campaign.” [Male student, FG5]

“I learned a lot about soy products, meaning there were certain products I didn’t know about, for example, tofu cheese. I knew about soy milk, but I didn’t know about the rest, and I found out while implementing the campaign that there is a lot of it, and now I want to try them all (laughs)” [Female student, FG8]

Most respondents admitted that they weren’t aware of different aspects of the nutrition field before the campaign.

“It was a learning process. We couldn’t present a workshop without knowing more than what we had put in the presentation, just in case we received additional questions. There was a lot of information I did not know and found out while documenting myself for our workshop.” [Male student, FG7]

Apart from plant-based proteins, **the topic of sugar also emerged as a prominent sub-theme during the focus groups**. Participants stated that they had learned the harmful effects of sugar and perceived that they consume a lot of sugar without being aware of eating or drinking products that contain sugar hidden under different names.

“I knew too much sugar is not good for you, but I didn’t know that it affects memory, and at this age, we need our memory to function so we can learn better. I’ve learned what foods are harmful to you and are rich in sugar and that sugar can be in foods under different names that are hard to pronounce (laughs). I have also learned what foods are not so rich in sugar, and you could try if you want something sweet but a healthier alternative.” [Female student, FG3]

“I was surprised to learn that most sugar-free products have ingredients as harmful as processed sugar. The nutritionist we worked with said not to eat those and replace them with fruits if we want something sweet.” [Female student, FG8]

From students’ responses, **other aspects of nutrition emerged as new learnings**. Participants mentioned recipes, the properties of different foods, and the importance of fruits and vegetables.

“I learned the difference between healthy and unhealthy diets, namely what elements foods contain, and which elements must emphasize in our daily consumption” [Male student, FG2]

“... and recipe ideas, many recipes, which I have not yet tried but have learned about them. Also, I learned a lot about many diseases associated with fatty and unhealthy eating.” [Female student, FG7]

None of the respondents stated that they did not learn anything new. Two participants reported that they were already informed about healthy nutrition, and implementing the campaign reinforced their beliefs and knowledge.

“I’m passionate about healthy eating, and I’m a vegetarian. I gave up meat in the summer, and this project was useful to reinforce my knowledge and beliefs.” [Female student, FG5]

3.3. Modified perception of nutrition

The third theme focused on **students’ perceptions regarding healthy eating** and whether these perceptions changed in any way based on their experience with implementing the campaign.

Their responses varied greatly, with two respondents saying that implementing the campaign did not affect them regarding healthy eating.

“(implementing the campaign) It didn’t influence me so much because I never exaggerated with fast food. I always had a balanced diet, so to speak.” [Female student, FG1]

The rest of the respondents reported different perceptions and small changes in intentions and behavior. The main identified sub-themes were **awareness of what they should eat, responsibility for “practicing what they preach”, guilt for not following their advice, and some short-term behavioral changes resulting from implementing the campaign**.

Responses included that they started **being more aware of the nutritional proprieties of different food products and what they were eating**.

“For example, while implementing this campaign, I started to follow more of these studies on food: for example, lifestyle on food, vegetarian, vegan, and so on, and I was a bit inspired. I have some newsletters that I read when I open the mail, and my goal is to cook on my own once I move into an apartment. I currently live in a dorm, but it motivated me in a way, and this is a benefit of the campaign” [Male student, FG2]

“And I started to pay more attention to the cravings I have for the tastes of sweet, salty, and spicy because at the beginning of the conference we organized, the nutritionist asked everyone what taste we could not give up, and she explained the reasons why we need spicy taste or the need for sweet taste. I am more aware since then when I have cravings to see the reason behind them” [Female student, FG4]

“At least I’m more careful about what I eat, and somehow, I try to remember when I eat bad stuff that I did that campaign, and it’s not good to eat that thing. It’s more on a theoretical level, I mean, it’s still tough for me to apply this stuff, but on a theoretical level, something has changed.” [Female student, FG6]

“That’s what I wanted to say, that I haven’t reached the implementation stage yet, to start eating healthy regularly, buying healthier products, or avoiding fast food, for example, but ... I feel guilty when I buy something unhealthy, and I always think that I went to people and talked about trans fats ... I shouldn’t be doing this (laughs)” [Female student, FG8]

All the focus groups also mentioned the sub-theme of **responsibility and feeling the need to ‘practice what they preach’**. Students felt they needed to follow the same behaviors they were promoting to be credible in front of their audience.

“As we worked on this topic of excessive sugar consumption and low consumption of vegetables, we noticed that before going and implementing the campaign and in the next period after implementing it, we did not eat sweets almost at all. We were always thinking: “Ok, I am going to these kids and telling them not to exaggerate with sweets, to reduce sugar consumption, and I eat tons of chocolate, not cool” [Female student, FG1]

“I mainly think that to convince someone, you must first believe it yourself, and so, I don’t know, I think it changed our perception and ideas; maybe otherwise, we weren’t as convincing, and we couldn’t finish implementing this campaign.” [Male student, FG3]

“I realized that it would be hypocritical to go and sell to others something that I am not willing to change with myself. You feel foolish to tell them, “Hey, don’t eat that much meat”, and after that, I should go and eat a big portion of ribs. So yeah, it counted, I started doing what I was preaching, and it felt good” [Male student, FG6]

“It changed from the moment we made a plan. I was becoming false if I said things I didn’t do, so I started doing them. How to tell these children to do something if I don’t do it. You can’t make a difference or be the difference when you only use words, but you are not doing what you say they should do.” [Female student, FG7]

“We tried so much to change their opinion [participants], but in the end, when I got home, I realized that I have juice and chips on my desk because I’m a fan of them even though I also eat vegetarian, and I said that “Ok, I want to throw them away, and stop”. Since I implemented the campaign, I don’t drink juices anymore, I drink a lot of water, I don’t consume chips anymore, and I feel different.” [Female student, FG7]

“I admit, I’m not a fan of the vegetarian style, and my meals are very varied, but I said that before I talk to children about this topic, I must be informed, and I tried experimenting with different foods. I tried: plant-based meatballs, plant-based snacks, they are good.” [Female student, FG8]

The **sub-theme of guilt for consuming products they have learned are unsuitable for their health** also emerged from the focus groups. Students stated that after implementing the campaign, they felt guilty if they did not follow the advice they gave during their campaign, which did not feel good.

“[...] I had a week after implementing the campaign in which I ate more chocolate than I should have, and I felt guilty and bad” [Female student, FG2]

“A high school student from our target group scolded me, seeing on my Instagram story that I ate something with a lot of sugar ... and then I felt remorseful” [Female student, FG5]

“Now, if you go and talk to people about this stuff, you feel like you should do those things too, or otherwise you feel guilty.” [Female student, FG6]

As a result of implementing the campaigns, students reported **slight changes in short-term behavior** due to working for a semester on this topic. Changes in meat and sugar consumption reduction, increased use of plant-based protein, and overall increased consumption of fruits and vegetables were reported.

“Even now, when I feel like eating something sweet, I think twice about what to replace it with to be healthier. On the other hand, I started to replace milk chocolate with dark chocolate” [Female student, FG4]

“Only since I started implementing the campaign, I take most of it from the organic shelf every time I go shopping for food. My diet includes tofu, soy, hummus, and brown rice. I didn’t eat these before, but now ... I was hesitant about them, but I tried, and they’re delicious, and I have more variety now.” [Female student, FG4]

I heard many people discussing plant-based protein, and I got curious. Now I tried it, and I liked it. It was not as I thought before, having no taste, no consistency. It is good; I am happy I decided to give it a shot.” [Male student, FG5]

“I also noticed that trying to inform others, I informed myself. And I found this concept of veganism very cool, I always appreciated people eating vegan, but I never saw myself in this position. Since the campaign, I alternate meat with vegetarian, I’m not there, but anyway, I started to have a different lifestyle, reducing meat.” [Male student, FG8]

3.4. Useful elements from the campaign that helped them learn more about nutrition

The focus group also asked what **elements of designing, implementing, and evaluating a health campaign help find more nutritional information**. From their answers, several elements surfaced. One of the aspects repeatedly mentioned during the focus groups was that they had to construct the health campaign from scratch, from planning the entire concept to developing materials and implementing and evaluating the results. They consider that the **learning-by-doing approach** helped them better understand what information they needed.

“The fact that we had to develop our materials and structure. I had to go deeper into scientific information to understand what I wanted to achieve through my campaign to help participants understand information. I had to understand it first.” [Male student, FG3]

“The research for the recipes and the actual presentation in front of the students. We prepared a lot, and we learned a lot, and for us was very beneficial.” [Female student, FG4]

“The fact that we had to do everything, I think, helped us a lot. You can’t do a campaign about something if you don’t know about that thing and you’re not sure about the information. So, we had to learn a lot.” [Female student, FG7]

The other sub-theme that was repeated a lot by students was that they had to **pretest the materials**. That aspect helped them realize that it is not enough for them to understand the information, but they need to be capable of knowing how to explain to their target groups since some of them worked with young children or the older population.

“The pretesting was important. We realized during pretesting that we put too much information, and we thought to synthesize according to the advice from the target groups, depending on their level of understanding.” [Male student, FG1]

“Pretesting itself. I thought our materials were perfect for our audience, but it was not like that. Now I know you have to pretest for anything including a target audience to know how to transmit the information.” [Female student, FG5]

Another sub-theme that surfaced from the focus groups was **the support provided by the professor and the teaching assistant**. The evidence-based information materials offered, the seminars where they had the chance to work on their ideas, and having support from nutritionists were all elements mentioned by students as extremely helpful in developing their campaigns. Students expressed their appreciation for the hands-on approach and the experiential learning model. They indicated that they gained substantial knowledge by actively participating and taking responsibility for designing and conducting a health campaign. Additionally, they received practical insights and ‘life advice’ on maintaining a healthy diet.

“The information we learned was practically applied, so you can’t forget. If it’s something you worked on and learned that information to know how to work with it to implement the campaign the way you wanted, you won’t forget it soon. It was much more effective than reading 100 pages and a few questions, and you’re done with the exam.” [Male student, FG6]

“I liked that we had to implement something of our own – we learned so much! And even though when I heard the topics, I wasn’t excited because I thought it has nothing to do with PR, I was amazed to realize they are connected.” [Female student, FG7]

“I liked the hands-on approach; I like going to villages. And as a bonus, I have learned about plant-based protein (laughs)” [Female student, FG8]

4. Discussion

The article aimed to explore university students’ perceptions regarding their subjective food literacy as an outcome of an educational model focused on food and nutrition. The focus groups’ findings reveal that, before the course, respondents believed they reasonably understood general nutritional concepts, with a particular emphasis on fruit and vegetable consumption. These results align with other findings from Romania that show a low interest in nutrition among students [37]. Our results indicate that after implementing the health campaigns, students’ perception of knowledge in nutrition and food was altered only by being exposed to information on nutrition as a part of their research for the campaigns, even if this was neither the objective nor the projected formal outcomes of the course. Even if the students were not the primary target for the information, they still reported finding new information. The students mentioned sugar consumption, plant-based proteins, and general information about nutrition and food that they were unaware of or considered a myth. Other results also show a change in students’ perceptions of healthy eating, especially regarding awareness of nutritional aspects (such as dietary proprieties of foods and their impact on health). Other studies that focused on improving students’ nutritional knowledge by exposing them to educational materials on nutrition showed similar results, especially in terms of perceived susceptibility and severity of diseases associated with dietary choices [38–40] and self-efficacy to adopt healthy eating behaviors [41–43]. Results of the focus groups have also shown that discovering more nutrition information made students more responsible and aware of what they ate, even if short-termed. Previous research in the field demonstrated that higher levels of health, nutrition, and food knowledge are associated with fewer unhealthy eating behaviors [43–45].

Respondents to the focus group stated that after acquiring information about nutrition through the health campaigns they implemented, some felt guilty when consuming foods they knew were unhealthy. Our results are similar to other literature findings that report feelings of guilt when consuming unhealthy foods, such as snacks [46].

Research from other countries showed that non-formal education has been effective in various ages, genders, and nationalities,

even since the 1970s [47]. Studies conducted on different forms of non-formal education showed different settings in which humans can learn about nutrition and food, even if the purpose of the main activity is not nutritional and food education. Some examples of such places are summer camps [48,49], hospitals where people go for treatment or check-ups [50,51], or using gamification techniques [52–54]. Moreover, to our best knowledge, no studies on university students using non-formal education to improve nutrition and food knowledge as a secondary objective exist at the moment of writing the manuscript. Still, research suggests that different methods could improve nutrition and food literacy in a non-formal manner. Academic courses that do not necessarily target nutrition were listed as possible change vectors [21].

Results of elements helpful in helping students acquire new nutrition information showed that students prefer a learning-by-doing approach and support offered by the professors. Research in this domain showed that promising learning-by-doing practices help students retain information better and use it in practical settings, which students prefer as a learning alternative [55–57].

5. Limitations

Our study has several limitations. Firstly, we lacked quantitative data regarding students' pre-course (baseline) knowledge regarding nutrition and eating habits. Therefore, the changes reported in this article rely on subjective responses and perceptions offered by the participants, which may introduce bias into the findings. We tried to counteract this limitation by using an evidence-based approach in the form of the learning-by-doing framework, as the literature suggests [58]. Moreover, there is a potential for recall bias, given the students' exposure to the topic of nutrition during their campaign. The living situation and habits of the participants might affect the facilities they have access to in relation to food and nutrition and, therefore, might influence the responses offered during the focus groups. Another limitation might be represented by social desirability. We tried to control this aspect by having the focus group after they received their grades for the course (grades obtained following the national grading system and national legislation) to decrease the likelihood of socially desirable responses. Nevertheless, all the limitations mentioned above must be considered when interpreting the results.

Future research should further explore and test educational models for university students to acquire food literacy in their mandatory courses. The nutrition and food topics addressed can be tailored to the specific needs of each class and its students'. Moreover, future studies should ensure that baseline information about the participants' knowledge of nutrition and food topics exists for stronger results and impact, and different research designs, such as mixed methods, should be explored. Finally, we consider that such a model can offer a unique opportunity for students to increase their food literacy through a learning-by-doing approach, supported by findings from other studies [59].

6. Conclusions and future implications for studies

The educational model from the present article could help improve the coherence between formal and non-formal education and can have the potential to recognize the benefits of non-formal education. Such an educational model can also help improve students' food literacy and, consequently, health literacy, health outcomes, and overall well-being. Moreover, the characteristics of the educational model can be tailored for other populations and can represent a standard of good practice in improving food and health literacy in a university setting.

7. Ethics statement

The study involving human participants was reviewed and approved by The Scientific Council at Babes-Bolyai University (IRB approval: No. 18629/October 16, 2018). The participants were informed of the study procedures before the focus groups and provided verbal informed consent to participate in this study, which was recorded on tape.

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Data availability statement

All data to support the conclusions has not been deposited into a publicly available repository and will be made available upon request.

CRedit authorship contribution statement

Madalina Adina Coman: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Razvan Mircea Chereches:** Writing – review & editing, Validation, Supervision, Software, Resources, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Annex 1. Focus group guide – translated from Romanian

1. Which components of the mid-terms were useful for you regarding the experience of implementing a campaign for this course?
2. What information about food and eating did you know before implementing the campaign for this course?
3. What new information about food and eating did you learn following the implementation of your campaign for this course?
4. How did your perception of healthy eating change after the campaign implemented on this course?
5. Which elements of the campaign do you think were the most useful for improving knowledge about food and eating?
6. Would you like to have more such projects during your studies?
7. What would you improve on the semester project for Public Communication if it were also carried out on the topic of food and eating?
8. What did you think of the method used in the course? More efficient or less efficient than other methods?

Note: Questions 2, 3, 4, 5 were used for writing the present manuscript.

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